Appendix J

Natura Impact Statement

Straitéis Iompair na Gaillimhe
Galway Transport Strategy

Comhairle Cathrach na Gaillimhe
Galway City Council

Comhairle Chontae na Gaillimhe
Galway County Council

Údarás Náisiúnta Iompair
National Transport Authority

Aonad Iompair na Gaillimhe
Galway Transport Unit

SYSTRA

ARUP

GALWAY TRANSPORT STRATEGY

NATURA IMPACT STATEMENT

Rev.	Status	Author	Reviewed By	Approved By	Issue Date
R00	Final	AS/KMOC	PS	PS	Sept 2016

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Appendices

1 Introduction

1.1 Legal Requirement for Appropriate Assessment

This Natura Impact Statement (NIS) has been prepared by Scott Cawley Ltd. on behalf of Galway City Council. It provides information on, and assesses the potential for, the Galway Transport Strategy (hereafter referred to as the GTS) to impact on Natura 2000 sites (hereafter referred to as European Sites)[1] and furthermore assess whether the GTS would impact on the integrity of any European Site.

The responsibility for carrying out the Appropriate Assessment (AA) lies with the competent authority (in this instance Galway City Council) and the information provided in this NIS facilitates the AA by Galway City Council.

It is necessary that the process by which Galway City Council and Galway County Council to prepare and integrate the GTS as a key element of supporting land use plans is carried out in accordance with the requirements of Article 6 of the of the Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora (as amended) (hereafter referred to as the Habitats Directive). The Habitats Directive is primarily transposed into Irish Law by S.I. No. 477 of 2011, European Communities (Birds and Natural Habitats) Regulations 2011 (hereafter referred to as the Birds and Habitats Regulations) and by Part XAB of the Planning and Development (Amendment) Act 2010, as amended (hereafter referred to as the Planning Acts).

Articles 6(3) and 6(4) of the Habitats Directive set out the requirement for an assessment of proposed plans and projects likely to affect European Sites.

Article 6(3) establishes the requirement to screen all plans and projects and to carry out a further assessment if required (Appropriate Assessment (AA)):

> “Any plan or project not directly connected with or necessary to the management of the [Natura 2000] site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subjected to an appropriate assessment of its implications for the site in view of the site’s conservation objectives. In light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.”

Article 6(4) allows proposed plans and projects to be approved under certain circumstances:

> “If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, Member States shall take all compensatory measures necessary to ensure that the overall

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[1] Natura 2000 sites are defined under the Habitats Directive (Article 3) as a European ecological network of special areas of conservation composed of sites which host the natural habitat types listed in Annex I and habitats of the protected species listed in Annex II. The aim of the network is to aid the long-term survival of Europe's most valuable and threatened species and habitats. In Ireland these sites are designated as European Sites – defined under the Planning Acts and/or Birds and Habitats Regulations as (a) a candidate site of Community importance, (b) a site of Community importance, (c) a candidate special are of conservation, (d) a special area of conservation, (e) a candidate special protection area, or (f) a special protection area. They are commonly referred to in Ireland as Special Areas of Conservation (SACs) and Special Protection Areas (SPAs)

> coherence of the Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted. Where the site concerned hosts a priority natural habitat type and/or a priority species the only considerations which may be raised are those relating to human health or public safety, to the beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest."

This Natura Impact Statement will inform the Appropriate Assessment process for the Galway Transport Strategy.

2 Assessment Methodology

2.1 Formal Guidance

The preparation of the NIS has taken account of guidance contained in the following documents:

- *Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities.* (Department of Environment, Heritage and Local Government, 2010 revision)
- *Appropriate Assessment under Article 6 of the Habitats Directive: Guidance for Planning Authorities.* Circular NPWS 1/10 and PSSP 2/10
- *Appropriate Assessment of Land Use Plans*. Circular Letter SEA 1/08 & NPWS 1/08
- *Assessment of Plans and Projects Significantly Affecting Natura 2000 sites: Methodological Guidance on the Provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC* (European Commission Environment Directorate-General, 2001); hereafter referred to as the EC Article 6 Guidance Document. The guidance within this document provides a non-mandatory methodology for carrying out assessments required under Article 6(3) and (4) of the Habitats Directive
- *Managing Natura 2000 Sites: The Provisions of Article 6 of the Habitat's Directive 92/43/EEC* (EC Environment Directorate-General, 2000); hereafter referred to as MN2000. Note that a revised version of this Guidance is due to for publication in 2016 and will be taken into account when appropriate
- *Guidance Document on Article 6(4) of the 'Habitats Directive' 92/43/EEC. Clarification of the Concepts of Alternative Solutions, Imperative Reasons of Overriding Public Interest, Compensatory Measures, Overall Coherence.* Opinion of the European Commission (European Commission, January 2007)
- *Guidelines for Good Practice Appropriate Assessment of Plans Under Article 6(3) Habitats Directive* (International Workshop on Assessment of Plans under the Habitats Directive, 2011)
- *Communication from the Commission on the precautionary principle.* European Commission (2000)

2.2 Sources of Information Used

Information relied upon included the following information sources, which included mapping, ecological and water quality data:

- Ordnance Survey of Ireland mapping and aerial photography available from www.osi.ie

- Online data available on European sites as held by the National Parks and Wildlife Service (NPWS) from www.npws.ie – including site synopsis, conservation objectives and other relevant supporting documentation (accessed May 2016)
- GIS based ecological datasets held by the NPWS (e.g. habitat datasets)
- Ecological survey results and GIS ecological datasets gathered as part of the route selection study for the N6 Galway City Transport Project—as presented in the *N6 Galway City Transport Project: Route Selection Report* (Arup, 2015)
- Information on land use zoning from the online mapping of the Department of the Environment, Community and Local Government http://www.myplan.ie/en/index.html;
- Information on water quality in the area available from www.epa.ie
- Information on the Western River Basin District from **Error! Hyperlink reference not valid.**www.wfdireland.ie
- Information on soils, geology and hydrogeology in the area available from www.gsi.ie
- Information on the status of EU protected habitats and species in Ireland (National Parks & Wildlife Service, 2013b and 2013c)
- A wide range of spatial land use strategies, development plans at a regional, county and local level, and relevant projects informed the in-combination assessment—refer to Appendix E for full list
- *Biodiversity Action Plan for County Galway 2008-2013* (Galway County Council, 2008)
- *Galway City Draft Biodiversity Action Plan 2014-2024* (Galway City Council, 2015)
- *Galway City Habitat Inventory. Galway City Council* (Natura Environmental Consultants, 2005) – including digital mapping dataset
- Coastal Habitat Study for Bearna (Galway County Council, 2007b)
- Galway Harbour Extension Environmental Impact Statement (Galway Harbour Company,2014)
- The Barna Woods Project, Biodiversity Report (Browne et al., 2009)

2.3 Appropriate Assessment: Purpose and Process

Galway City Council and Galway County Council, in partnership with the National Transport Authority, have prepared the GTS. The GTS consists of a number of project elements, generated by a series of guiding principles, strategic objectives and strategic aims under an overall vision “to create a connected city region driven by smarter mobility”, to form a coherent and integrated transport strategy for Galway City and its environs. The GTS encompasses all modes of transport, and includes an implementation strategy over the short, medium and long term.

All plans, such as the GTS, must be prepared and examined to ensure that there will not be any adverse effects on the integrity of European Sites. The Irish Government and local planning authorities have a legal obligation to protect these sites.

The process of assessing the GTS was an iterative process. The overall purpose of the assessment process was to ensure that the GTS, when implemented, does not result in adverse effects on the “integrity[2]” of the European Sites within the Natura 2000 network.

The first step was to look at the overall GTS in principle and to answer the questions: is it likely that the implementation of this Strategy could result in likely significant effects (LSEs) on the European Sites within the Natura 2000 network? This step is known as “Screening”. In order

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[2] Adverse effects on site integrity are considered with respect to the conservation objectives of the European Site supporting the Qualifying Interests (QIs)/Special Conservation Interests (SCIs) conservation condition.

to ensure that the GTS complied fully with the requirements of Article 6 (3) of the Habitats Directive and all relevant Irish transposing legislation, RPS Group Ltd., on behalf of Galway City and County Councils prepared a screening for appropriate assessment report of the GTS (RPS, 2016). The outcome of this Screening Stage was that it was determined by Galway City Council that due to the nature and location of the transport infrastructure elements proposed to be implemented under the GTS, that significant effects could not be ruled out and that the GTS would need further assessment during its preparation. The AA process then moved to full Appropriate Assessment.

The full AA process involves analysing the relationship between the proposed elements of the GTS and the Conservation Objectives of the European Sites. Where there was the potential for adverse impacts to occur, recommendations were made to change elements of the GTS to avoid or mitigate measures to address the potential impact(s). These recommendations were integrated into the GTS so that the implementation of the Strategy would not result in any adverse effects on the integrity of any European Sites.

As part of the iterative assessment process Scott Cawley Ltd. were provided with draft chapters/appendices during the process of preparing the final version of the GTS and these drafts were reviewed and feedback provided.

2.4 How the AA process is applied within the Planning Hierarchy

The AA process takes place at several stages within the land use planning hierarchy. In the case of the GTS, it must take cognisance of the Regional Planning Guidelines for the West Region 2010-2022 and its “Habitats Directive” (Appropriate) Assessment.

The integration of the GTS into the County, City and Bearna land use plans will then provide a framework for the AA and implementation of individual project elements (and any associated individual planning applications) that will be implemented under these plans. These project-level AAs will have to take this NIS into account.

The Appropriate Assessment requirements of Part XAB of the Planning and Development (Amendment) Act 2010 apply to all levels of the planning hierarchy[3]. At each stage the scale and nature of the assessment will match the scale and level of the hierarchy. As projects pass from the County and City Plan-level to the local plan level and then to individual planning applications, the following aspects become expressed at a sharper and more detailed level:

- Geographic specificity (i.e. from generally described locations for plan elements, to those with a more defined and fixed location)
- Duration and timing of impacts (usually not known at the strategic plan level)
- Raw materials required, wastes and energy generated (can be predicted in a generic sense at plan level but precise constituents and quantities are usually only known at the project level)

In order to address this hierarchy of level of detail, the current AA of the GTS has ensured that where the certain aspects are not predictable at the Strategy level, but may pose a risk to the European Site when project details are known, that this is highlighted in the AA process and appropriate safeguards or capture mechanisms are proposed.

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[3] Some proposals may fall under the European Communities (Birds and Natural Habitats) Regulations 2011

2.5 Assessment Methodology

The various elements of the GTS – the Overall Vision, Guiding Principles, Strategic Objectives and Key Performance Indicators, and Strategic Aims – were analysed and assessed to determine which had the potential to adversely affect the integrity of any European Sites. This assessment was undertaken in consideration of all potential impact pathways connecting the GTS elements to European Sites in view of the conservation objectives supporting the conservation condition of the Sites' Qualifying Interests (QIs)/Special Conservation Interests (SCIs).

The conservation objectives relating to each QI/SCI are expressed generally for SAC QIs as "to maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected", and for SPA SCIs as "To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA".

Following from this, favourable conservation status (or condition, at a site level) of a habitat is achieved when:

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

The favourable conservation status (or condition, at a site level) of a species is achieved when:

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

Where site-specific conservation objectives have been prepared for a given European Site, these include a series of specific attributes and targets against which effects on conservation condition, or integrity, can be measured—i.e. an impact which affects the achievement of favourable conservation condition, as measured by the attributes and targets, is an impact on site integrity. In the case of many SACs/SPAs, site-specific conservation objectives are not available, or have not been published. Where that is the case, sample site specific attributes and targets for a given QI/SCI have been compiled, based on those from other European Sites, as a guide in assessing how conservation condition could potentially be affected by the GTS elements.

In the case of some QIs/SCIs in certain European Sites, the conservation objective is to restore rather than maintain conservation condition[4] and this distinction is taken into account in the assessment; as is any legacy damage to European Sites that has occurred since their designation.

Having ascertained during the screening test that the GTS is either likely to have a significant effect on a European Site(s), or that any such likelihood is uncertain or cannot be ruled out, Appropriate Assessment (AA) considers whether or not that significant effect would adversely affect the integrity of any European Site(s), either alone or in-combination with other plans or

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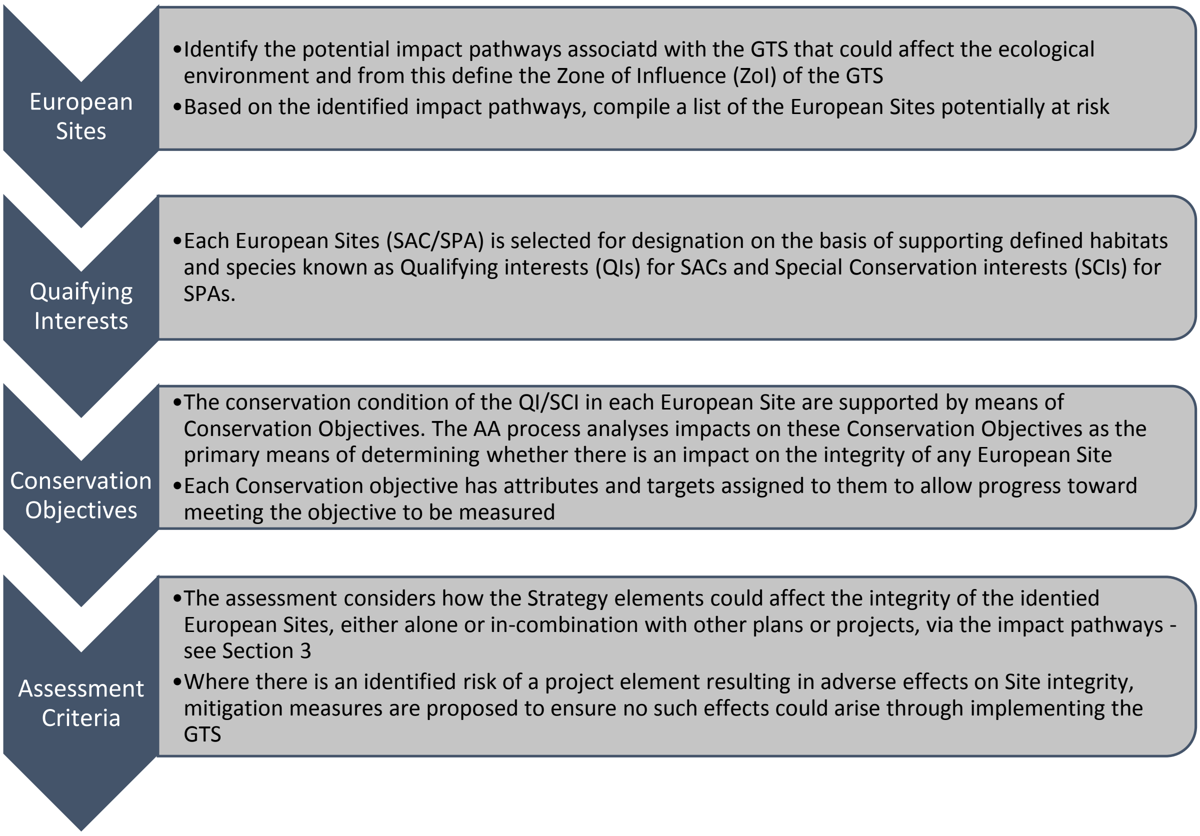
[4] This information in relation to the European Sites within the ZoI of the GTS is included in Appendix C, Table C-2.

projects, in consideration of mitigation measures – *i.e.* where a source-pathway-receptor relationship exists, would it, despite the implementation of mitigation measures, result in significant adverse effects on the habitats and/or species for which the site has been designated, either alone or in-combination with other plans or projects, with respect to the Site's conservation objectives supporting their conservation status?

Where the assessment found that GTS elements had the potential to adversely affect the integrity of a European Site, via impacts to the conservation objectives supporting the conservation condition of the Sites' QIs/SCIs, mitigation measures have been included within the GTS to ensure that the GTS poses no risk of adversely affecting any European Sites.

This process is summarised below in Figure 1.



- Identify the potential impact pathways associatd with the GTS that could affect the ecological environment and from this define the Zone of Influence (ZoI) of the GTS
- Based on the identified impact pathways, compile a list of the European Sites potentially at risk

- Each European Sites (SAC/SPA) is selected for designation on the basis of supporting defined habitats and species known as Qualifying interests (QIs) for SACs and Special Conservation interests (SCIs) for SPAs.

- The conservation condition of the QI/SCI in each European Site are supported by means of Conservation Objectives. The AA process analyses impacts on these Conservation Objectives as the primary means of determining whether there is an impact on the integrity of any European Site
- Each Conservation objective has attributes and targets assigned to them to allow progress toward meeting the objective to be measured

- The assessment considers how the Strategy elements could affect the integrity of the identied European Sites, either alone or in-combination with other plans or projects, via the impact pathways - see Section 3
- Where there is an identified risk of a project element resulting in adverse effects on Site integrity, mitigation measures are proposed to ensure no such effects could arise through implementing the GTS

Figure 1: Preparation of Assessment Criteria

Projects which are found to have adverse effects on the integrity of any European Site(s) can only proceed under the provisions of Article 6(4) of the Habitats Directive and this scenario is provided for in both the relevant land use Plans. This process is outlined in more detail in Chapter 10 of the GTS, *Implementation and Outcomes*.

2.6 Overview of the GTS

The GTS consists of a number of project elements, generated by a series of guiding principles, strategic objectives and strategic aims under an overall vision "to create a connected city region driven by smarter mobility". The various projects that are proposed to be implemented through the strategy, over an anticipated 20 year period, can be grouped under the following general headings:

- The pedestrian network

- Bearna Greenway
- Galway to Dublin Cycleway (Galway City to Oranmore)[5]
- Galway to Oughterard Greenway[6]
- Non-greenway elements of the cycle network
- Public transport network
- N6 Galway City Ring Road (GCRR)

The various projects proposed under the GTS are described at different levels of geographic specificity: the greenways are referenced at a non-specific scale, linking Galway City with Bearna, Oranmore and Moycullen; many of the proposed public transport, non-greenway cycle network and pedestrian network projects are generally linked to road corridors, with some proposing bridge crossings of the River Corrib referenced at specific locations (e.g. the proposed cycle and pedestrian bridge at the former crossing of the Old Clifden Railway), and, the proposed N6 GCRR referenced by means of a defined corridor extending around the city from Bearna to the Ardaun area.

As many of the proposed project elements will cross, may interact with (given the general location descriptions given) or will/may be in close proximity to European Sites, there is the potential for the GTS to adversely affect the integrity of several European Sites, either directly or indirectly, or in-combination with other plans or projects.

2.7 Overview of the Receiving Environment

The full extent of the GTS includes Galway City and its environs as far as An Spidéal to the west, Maigh Cuilinn to the north, and Oranmore to the east. In terms of land use, this area includes both the expanse of urban and suburban development of Galway City and these commuter settlements, and the surrounding landscape of agricultural lands, quarries and semi-natural habitats. A wide range of habitats and species listed under the EC Birds and Habitats Directives are present within this area.

Galway Bay forms the southern boundary of the GTS study area. Galway Bay is designated as far west as Rusheen Bay as an SAC for a range of marine, coastal and terrestrial habitats These include reefs, intertidal mudflats, coastal lagoons, saltmarsh habitats, shingle and gravel banks, wetland habitats such as turloughs and fen, and also Juniper and calcareous grassland habitats. The marine and intertidal habitats support a range of benthic communities, Otter, Harbour seal and the range of bird species for which Inner Galway Bay SPA is designated.

The study area may be perceived to be conveniently divided into western and eastern sections by the River Corrib, each of which is characterised by the underlying geology. The western part of the study area is predominantly underlain by granite and this is reflected in the range of peatland habitats present in this area. The eastern part of the study area is a karst landscape underlain by limestone and resulting in habitats such as limestone pavement, calcareous grasslands and scrub, calcareous springs and turloughs. A zone east of the N59, along the western shores of Lough Corrib, includes a number of Annex I lake habitats, supporting a range of wetland habitats in addition to areas of exposed limestone and calcareous grasslands. Within this zone are Ross Lake and Woods SAC and Gortnandarragh Limestone Pavement SAC.

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[5] The GTS includes that portion of the Galway to Dublin Cycleway between Galway City and Oranmore.

[6] The GTS only references that section of the Galway to Oughterard Greenway between Galway City and Moycullen, as use of this section is a realistic option for use as a cycle route to/from Galway City by commuters. However given that the project is the full extent of the greenway to Oughterard, the intension is for the greenway to utilise the disused Clifden to Galway rail line along much of its length (Section 4.5.1 of Galway City Council (2016) and Section 4.12.13 of Galway County Council (2015)), and that the rail line passes through Ross Lake and Woods SAC, the full extent of the project is considered in the NIS and therefore, so are potential impacts on Ross Lake and Woods SAC.

The River Corrib and Lough Corrib are designated as part of Lough Corrib SAC and Lough Corrib SPA. The River Corrib and Lough Corrib support a range of both breeding and wintering bird species. These waterbodies support a range of aquatic flora and fauna species such as Slender naiad *Najas flexilis* and Stoneworts *Chara* spp., Otter *Lutra lutra*, Atlantic salmon *Salmo salar* and lamprey, and further north from Galway City White-clawed crayfish *Austropotamobius pallipes* and Freshwater pearl mussel *Margaritifera margaritifera*.

Within the GTS study area, Lough Corrib SAC also includes the Coolagh Lakes and an area between the River Corrib and Ballindooley. The Coolagh Lakes themselves are hard water lakes which support a diverse wetland complex of fen, reed swamp and wet grassland. Between the River Corrib and Ballindooley are semi-natural woodlands, a range of limestone pavement habitat types and calcareous grassland.

The main watercourses in the western part of the study area are the Knocknacarragh Stream, Bearna Stream, the Trusky Stream and Sruthán na Líbeirtí. In the eastern part of the study area there are fewer watercourses as a result of the permeable karst geology. Other than the River Corrib, watercourses in the eastern area include the Terryland River and the Merlin Stream.

Aside from the European Sites, the area surrounding Galway City also supports many other fauna species protected at the national and/or European level including bat species, Badger *Meles meles*, Red squirrel *Sciurus vulgaris*, Pine marten *Martes martes*, Barn owl *Tyto alba*, Peregrine falcon *Falco peregrinus* and the Marsh fritillary butterfly *Euphydryas aurinia*.

3 Appropriate Assessment

3.1 Assessment Results

3.1.1 Identification of Potential Impact Pathways and defining the Zone of Influence (ZoI)

The first stage of the assessment was to examine and analyse all elements of the GTS in order to determine which had the potential to adversely affect the integrity of European Sites, and how.

Analysis of the GTS identified the following impact pathways by which elements of the GTS could potentially adversely affect the integrity of European Site(s):

- *Habitat Loss*
  Direct loss of habitat (terrestrial or freshwater) in European Site; habitat fragmentation is directly associated with this impact pathway
- *Habitat degradation – hydrogeology*
  Tunnelling and/or deep excavations affecting groundwater quality and/or quantity and thereby the existing hydrogeological regime
- *Habitat degradation – tunnelling/excavation*
  Tunnelling and/or deep excavations affecting the structural integrity of surface-level habitats
- *Habitat degradation – water quality impacts during construction*
  Construction works affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats
- *Habitat degradation – water quality impacts during operation*
  Project operation affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats
- *Habitat degradation – shading*
  Shading effects of bridge structures on habitats (e.g. reduction in sunlight and direct precipitation)
- *Habitat degradation – air quality*
  A reduction in air quality affecting fauna species and/or habitats (e.g. vegetation composition and structure)
- *Habitat degradation – non-native invasive species*
  Introducing or spreading non-native invasive species affecting habitats (e.g. vegetation composition and structure)
- *Disturbance/displacement*
  Disturbance to fauna resulting in displacement from important habitat areas (e.g. breeding/resting places or foraging areas – including consideration of ex-situ sites[7] and their role in supporting the SCI bird species of affected SPAs)
- *Barrier effect*
  Construction works or new structures creating a barrier to faunal species movement

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[7] The need to consider use of habitat areas outside of an SPA by SCI bird species is set out in Section 3.1 and 5.2 of the *Inner Galway Bay Special Protection Area (Site Code 4031), Conservation Objectives Supporting Document, Version 1* (National Parks & Wildlife Service, 2013a); and in the absence of a site specific conservation objectives document for many other SPAs potentially affected by GTS, this is applied for all. These areas are termed 'ex-situ' sites and are defined as areas of habitat situated within the immediate hinterland of the SPA, or in areas ecologically connected to it, which support SCI bird species.

- *Mortality risk*
  Mortality/road traffic collision risk to fauna species

The potential Zone of Influence (ZoI) with respect to European Sites was defined as all European Sites within the GTS study area, those downstream of the GTS projects, those selected for groundwater-dependent habitats and within the same groundwater bodies as the GTS, or within a distance of the GTS where disturbance effects could potentially occur during construction or operation (300m). In poorly productive bedrock, the ZoI was considered to be more local (i.e. in the western part of the study area where granite is the underlying rock, a precautionary distance of 1km was used), compared with karst areas where a more precautionary approach was taken to include the whole groundwater body and those with potential hydrological connections to European Sites (e.g. surface water features such as rivers, streams and drainage features). The potential ZoI of the GTS is shown on Figure 1.

The results of the assessment carried out to identify which of the GTS elements have the potential to adversely affect the integrity of any European Sites are provided in Appendix A. This follows on to a more detailed assessment in Appendix B, Table B-1, which examines which European Sites the various projects proposed under the GTS could affect and by which impact pathways. A summary matrix of this assessment is also provided in Appendix B, Table B-2.

3.1.2 Identifying European Sites within the ZoI of the GTS

In order to determine which European Sites were within the ZoI of the GTS the nature and scale of the various projects proposed under the GTS, the potential impact pathways identified (and their ZoI) and their relationship to European Sites were considered.

In the absence of mitigation measures and considering the absence of detailed design for the majority of strategy elements, the GTS was assessed as having the potential to adversely affect the integrity of the following European Sites[8]:

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

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[8] The GTS only references that section of the Galway to Oughterard Greenway between Galway City and Moycullen, as use of this section is a realistic option for use as a cycle route to/from Galway City. However, given that the project is the full extent of the greenway to Oughterard, the intension is for the greenway to utilise the disused Clifden to Galway rail line along much of its length (Section 4.5.1 of Galway City Council (2015) and Section 4.12.13 of Galway County Council (2015)), and that the rail line passes through Ross Lake and Woods SAC, the full extent of the project is considered in the NIS and therefore, so are potential impacts on Ross Lake and Woods SAC.

Although the Gortnandarragh Limestone Pavement SAC lies within the mapped ZoI boundary, it was scoped out at the AA Screening stage and is therefore not discussed further in this report. It was scoped out on the basis that given its general location (as discussed above) is associated with the disused Clifden to Galway rail line, and this is 1.5km from the SAC, the Galway to Oughterard Greenway poses no risk of direct impacts to the SAC. As the SAC is designated for Limestone pavement, a habitat which would not be affected by groundwater or surface water impact pathways, the greenway poses no risk of indirect impacts.

Although Ardrahan Grassland SAC lies within the mapped ZoI boundary it was scoped out at the AA Screening stage and is therefore not discussed further in this report. It was scoped out on the basis that there is no risk of direct impacts to the SAC, no potential for indirect impacts via hydrological or hydrogeological impact pathways.

Although Monivea Bog SAC lies at the margins of the mapped ZoI boundary it is more than 18km from the nearest of the GTS projects and was scoped out at the AA Screening stage and is therefore not discussed further in this report. It was scoped out on the basis that there is no risk of direct impacts to the SAC, and the proposed GTS projects pose no risk to raised bog habitat in the SAC via hydrological or hydrogeological impact pathways.

- Ross Lake and Woods SAC
- Cregganna Marsh SPA
- Rahasane Turlough SAC
- Rahasane Turlough SPA
- Castletaylor Complex SAC
- Kiltiernan Turlough SAC
- Lough Fingall Complex SAC

Appendix C lists the QIs and SCIs of these European Sites (Table C-1), and their conservation objectives with reference to the attributes and targets supporting the QI/SCIs conservation condition (Table C-2). Table C-2 presents a more detailed examination and analysis of how the GTS could affect the QI/SCIs conservation objectives via the identified impact pathways.

Identifying these potential impact pathways and assessing how they could affect European Sites has informed the mitigation measures required to ensure that the GTS does not adversely affect the integrity of any European Site(s).

In assessing the links between the various impact pathways and the conservation objectives of the QIs and SCIs of the European Sites within the ZoI of the GTS (in Table C-2 in Appendix C of this NIS), all QIs/SCIs are included in that analysis. This is a precautionary approach as the details, and in many cases the precise locations, scope and extent of works, will not be known until the project design stage. In the absence of this information, the potential for any given project to impact upon specific QIs/SCIs with a given European Site, and not others, cannot be definitively ruled out at this stage. The results of this analysis therefore, present the full picture of how projects linked to European Sites via a given impact pathway could potentially affect the specific attributes, measures and targets defining the conservation objectives which support the conservation condition of the Site’s QIs or SCIs. It also provides a framework or reference point through which any future AA Screening or AA of projects implemented through the GTS should consider how a given project could potentially affect any of the European Sites within the GTS’ ZoI, once the potential impact pathways have been determined.

3.1.3 Interaction between the GTS Elements and European Sites

This section provides a summary of how the various GTS project elements could result in adverse effects on the integrity of those European Sites via the potential impact pathways.

N6 Galway City Ring Road (N6 GCRR)

The potential impact pathways associated with the proposed N6 GCRR and the European Site(s) which are potentially at risk of adverse effects on Site integrity are summarised below:

Habitat Loss

The N6 GCRR will likely result in the direct loss of habitat (terrestrial and/or freshwater) in Lough Corrib SAC; habitat fragmentation is directly associated with this impact pathway. None of the habitats within both the SAC boundary and the current road corridor that will be lost are qualifying interest (QI) habitats of Lough Corrib SAC, nor are they supporting habitats to any QI habitat or to species such that their loss would affect the species’ conservation objectives. However, as the final landtake associated with the proposed N6 GCRR has not yet been determined, there remains a risk that some level of habitat loss may occur outside of the current

corridor for the proposed N6 GCRR and could therefore result in additional habitat loss/fragmentation within Lough Corrib SAC.

Mitigation measures: refer to Box 1c in Section 3.2 below

Habitat degradation – hydrogeology

Tunnelling and/or deep excavations likely to be associated with the N6 GCRR may affect the existing hydrogeological regime which in turn may affect groundwater dependant habitats (and in some cases supported species) within the following European Sites: Lough Corrib SAC, Lough Corrib SPA, Inner Galway Bay SPA, Cregganna Marsh SPA, Rahasane Turlough SAC, Rahasane Turlough SPA, Castletaylor Complex SAC, Kiltiernan Turlough SAC and/or Lough Fingall Complex SAC.

Mitigation measures: refer to Box 2b in Section 3.2 below

Habitat degradation – tunnelling/excavation

Tunnelling and/or deep excavations at Lackagh Quarry has the potential to affect the integrity of surface level habitats in Lough Corrib SAC.

Mitigation measures: refer to Box 3 in Section 3.2 below

Habitat degradation – water quality impacts during construction and/or operation

As the N6 GCRR will cross the River Corrib and numerous watercourses which drain to Galway Bay, construction works, and operation of the proposed road development, has the potential to affect surface, ground and/or coastal water quality and as a consequence affect wetland/coastal/estuarine habitats in Lough Corrib SAC, Galway Bay Complex SAC and/or Inner Galway Bay SPA.

Mitigation measures: refer to Box 4 and Box 5b in Section 3.2 below

Habitat degradation – shading

The proposed River Corrib Bridge will have shading effects (i.e. reduced sunlight and levels of direct precipitation) on habitats beneath the structure within Lough Corrib SAC.

Mitigation measures: refer to Box 6 in Section 3.2 below

Habitat degradation – air quality

Introducing a new road has the potential to cause a reduction in air quality, potentially affecting fauna species and/or habitats[9].

Mitigation measures: refer to Box 7 in Section 3.2 below

Habitat degradation – non-native invasive species

Introducing or spreading non-native invasive species during construction and/or operation (e.g. maintenance works) of the proposed road development has the potential to affect habitats, and may as a consequence affect supported species, in Lough Corrib SAC, Galway Bay Complex SAC, Lough Corrib SPA and/or Inner Galway Bay SPA.

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[9] As one of the key principles of the GTS is to “To promote and encourage sustainable transport, and in particular to make it convenient and attractive to walk, cycle or use public transport”, the may be an overall positive impact compared with the “Do-nothing” scenario in urban and suburban areas of Galway City and the associated European Sites (Lough Corrib SAC, Galway Bay Complex SAC and Inner Galway Bay SPA

Mitigation measures: refer to Box 8 in Section 3.2 below

Disturbance/displacement

Construction works and/or operation associated with the proposed road development has the potential to result in levels of disturbance that could potentially displace QI/SCI species from important habitat areas (e.g. breeding/resting places or foraging areas) within Lough Corrib SAC (e.g. along the River Corrib), Galway Bay Complex SAC (e.g. in the vicinity of Bearna Woods), and Lough Corrib SPA or Inner Galway Bay SPA (in the case of SPAs, important ex-situ habitat areas remote from the designated site but important in supporting SCI populations).

Mitigation measures: refer to Box 9 in Section 3.2 below

Barrier effect

Construction works associated with the proposed road development along the River Corrib have the potential to create a barrier to fauna species movement (e.g. within foraging areas or along commuting routes) in Lough Corrib SAC.

Mitigation measures: refer to Box 10 in Section 3.2 below

Mortality risk

The N6 GCRR will include for the construction of a new bridge structure across the River Corrib, a new road in the vicinity of the Coolagh lakes, and a new bridge over the Bearna Stream. All of these areas are used by Otter (a QI species of Lough Corrib SAC and Galway Bay Complex SAC) and there is a permanent risk of mortality/road traffic collision impacts if Otter gain access to the road carriageway. Constructing a new bridge over the River Corrib poses a (temporary) risk of construction materials/debris falling into the river and injuring/killing QI aquatic. A new bridge across the River Corrib poses a permanent collision risk with the bridge structure to SCI bird species of Lough Corrib SPA and/or Inner Galway Bay SPA commuting along the river corridor.

Mitigation measures: refer to Box 11 in Section 3.2 below

Bearna Greenway

The potential impact pathways associated with the proposed Bearna Greenway and the European Site(s) which are potentially at risk of adverse effects on Site integrity are summarised below:

Habitat Loss

As a route has not yet been selected for the Bearna Greenway, applying the precautionary principle, it has the potential to result in the direct loss of habitat (terrestrial and/or estuarine/marine) in Galway Bay Complex SAC and Inner Galway Bay SPA as the Greenway may follow the coastline between the city and Bearna Village; habitat fragmentation is directly associated with this impact pathway. Loss of habitat from these European Sites, and indeed in any potential ex-situ sites supporting SCI bird species of the SPA (e.g. high-tide roost sites or terrestrial feeding sites), has the potential to affect the conservation objectives supporting the Site's QI/SCI species.

Mitigation measures: refer to Box 1a in Section 3.2 below

Habitat degradation – hydrogeology

Although unlikely, there is the possibility that excavations associated with the Bearna Greenway may affect the existing hydrogeological regime which in turn may affect groundwater dependant habitats (and in some cases supported species) within European Sites. Given the likely nature of works associated with building a cycleway (which would be minimally invasive in terms of excavation requirements and therefore pose little risk of interacting with groundwater), and the underlying geology in this area (poorly productive granite bedrock), the Zone of Influence (ZoI) of any groundwater interaction would not be expected to extend beyond Galway Bay Complex SAC, Inner Galway Bay SPA, and wetland sites locally which may support SCI species of both Inner Galway Bay SPA and/or Lough Corrib SPA.

Mitigation measures: refer to Box 2a in Section 3.2 below

Habitat degradation – water quality impacts during construction

As the Bearna Greenway may be located adjacent to the coastline and/or must cross watercourses which drain to Galway Bay, construction works have the potential to affect surface, ground and/or coastal water quality. As a consequence, the Bearna Greenway could affect wetland/coastal/estuarine habitats, and potentially QI/SCI species, in Lough Corrib SAC, Galway Bay Complex SAC and/or coastal ex-situ sites which may support SCI species of Lough Corrib SPA.

Mitigation measures: refer to Box 4 in Section 3.2 below

Habitat degradation – shading

Any new bridge structures installed as part of the Bearna Greenway that are located within Galway Bay Complex SAC and/or Inner Galway Bay SPA, have the potential to result in shading effects (i.e. reduced sunlight and levels of direct precipitation) on habitats beneath the structure. Such impacts could potentially affect QI habitats and/or habitats which may support QI/SCI species of these European Sites.

Mitigation measures: refer to Box 6 in Section 3.2 below

Habitat degradation – non-native invasive species

Introducing or spreading non-native invasive species during construction and/or operation (e.g. maintenance works) of the Bearna Greenway has the potential to affect habitats, and may as a consequence affect supported species, in Lough Corrib SAC, Galway Bay Complex SAC and/or coastal ex-situ sites which may support SCI species of Lough Corrib SPA.

Mitigation measures: refer to Box 8 in Section 3.2 below

Disturbance/displacement

Construction works and/or operation associated with the Bearna Greenway has the potential to result in levels of disturbance that could potentially displace QI/SCI species from important habitat areas (e.g. breeding/resting places, such as high tide roosts for wintering birds, or foraging areas) within Galway Bay Complex, Inner Galway Bay SPA and potentially Lough Corrib SPA (coastal ex-situ sites which may support SCI species of this SPA).

Mitigation measures: refer to Box 9 in Section 3.2 below

Barrier effect

As the Bearna Greenway must cross the Bearna Stream (part of Galway Bay Complex SAC) and may affect other habitat areas within Galway Bay Complex SAC, construction works and/or any proposed new structures have the potential to create a barrier to fauna species movement (e.g. within foraging areas or along commuting routes).

Mitigation measures: refer to Box 10 in Section 3.2 below

Galway to Dublin Cycleway (Galway City to Oranmore)

The potential impact pathways associated with the proposed Galway City to Oranmore section of the Galway to Dublin Cycleway and the European Site(s) which are potentially at risk of adverse effects on Site integrity are summarised below:

Habitat Loss

As a route has not yet been selected for this section of the Galway to Dublin Cycleway, applying the precautionary principle, it has the potential to result in the direct loss of habitat (terrestrial and/or estuarine/marine) in Galway Bay Complex SAC and Inner Galway Bay SPA as it may follow the coastline between the city and Oranmore Village; habitat fragmentation is directly associated with this impact pathway. Loss of habitat from these European Sites, and indeed in any potential ex-situ sites supporting SCI bird species of the SPA (e.g. high-tide roost sites or terrestrial feeding sites), has the potential to affect the conservation objectives supporting the Site's QI/SCI species.

Mitigation measures: refer to Box 1a in Section 3.2 below

Habitat degradation – hydrogeology

Although unlikely, there is the possibility that excavations associated with this section of the Galway to Dublin Cycleway may affect the existing hydrogeological regime which in turn may affect groundwater dependant habitats (and in some cases supported species) within European Sites. Given the likely nature of works associated with building a cycleway (which would be minimally invasive in terms of excavation requirements and therefore pose little risk of interacting with groundwater), the ZoI of any groundwater interaction would not be expected to extend beyond Galway Bay Complex SAC or Inner Galway Bay SPA, and wetland sites locally which may support SCI species of both Inner Galway Bay SPA and/or Lough Corrib SPA. However, given the underlying karst geology, hydrogeological impacts affecting a wider area to include Cregganna Marsh SPA, Rahasane Turlough SAC, Rahasane Turlough SPA, Castletaylor Complex SAC, Kiltiernan Turlough SAC or Lough Fingall Complex SAC cannot be ruled out.

Mitigation measures: refer to Box 2a in Section 3.2 below

Habitat degradation – water quality impacts during construction

As this section of the Galway to Dublin Cycleway may be located adjacent to the coastline and/or must cross watercourses which drain to Galway Bay, construction works have the potential to affect surface, ground and/or coastal water quality. As a consequence, this section of the Galway to Dublin Cycleway could affect wetland/coastal/estuarine habitats, and potentially QI/SCI species, in Lough Corrib SAC, Galway Bay Complex SAC and/or coastal ex-situ sites which may support SCI species of Lough Corrib SPA.

Mitigation measures: refer to Box 4 in Section 3.2 below

Habitat degradation – shading

Any new bridge structures installed as part of this section of the Galway to Dublin Cycleway that are located within Galway Bay Complex SAC and/or Inner Galway Bay SPA, have the potential to result in shading effects (i.e. reduced sunlight and levels of direct precipitation) on habitats beneath the structure. Such impacts could potentially affect QI habitats and/or habitats which may support QI/SCI species of these European Sites.

Mitigation measures: refer to Box 6 in Section 3.2 below

Habitat degradation – non-native invasive species

Introducing or spreading non-native invasive species during construction and/or operation (e.g. maintenance works) of this section of the Galway to Dublin Cycleway has the potential to affect habitats, and may as a consequence affect supported species, in Lough Corrib SAC, Galway Bay Complex SAC and/or coastal ex-situ sites which may support SCI species of Lough Corrib SPA.

Mitigation measures: refer to Box 8 in Section 3.2 below

Disturbance/displacement

Construction works and/or operation associated with this section of the Galway to Dublin Cycleway has the potential to result in levels of disturbance that could potentially displace QI/SCI species from important habitat areas (e.g. breeding/resting places, such as high tide roosts for wintering birds, or foraging areas) within Galway Bay Complex, Inner Galway Bay SPA and potentially Lough Corrib SPA (coastal ex-situ sites which may support SCI species of this SPA).

Mitigation measures: refer to Box 9 in Section 3.2 below

Barrier effect

As this section of the Galway to Dublin Cycleway may cross streams or coastal habitats within Galway Bay Complex SAC, construction works and/or any proposed new structures have the potential to create a barrier to fauna species movement (e.g. within foraging areas or along commuting routes).

Mitigation measures: refer to Box 10 in Section 3.2 below

Galway to Oughterard Greenway

The potential impact pathways associated with the proposed Galway to Oughterard Greenway and the European Site(s) which are potentially at risk of adverse effects on Site integrity are summarised below:

Habitat Loss

As a route has not yet been selected for the Galway to Oughterard Greenway, applying the precautionary principle, it has the potential to result in the direct loss of habitat (terrestrial and/or aquatic) in Lough Corrib SAC and Lough Corrib SPA and Ross Lake and Woods; habitat fragmentation is directly associated with this impact pathway. Loss of habitat from these European Sites, and indeed in any potential ex-situ sites supporting SCI bird species of

the SPA (e.g. roost sites or feeding sites), has the potential to affect the conservation objectives supporting the Site's QI/SCI species.

Mitigation measures: refer to Box 1a in Section 3.2 below

Habitat degradation – hydrogeology

Although unlikely, there is the possibility that excavations associated with the Galway to Oughterard Greenway may affect the existing hydrogeological regime which in turn may affect groundwater dependant habitats (and in some cases supported species) within European Sites. Given the likely nature of works associated with building a cycleway (which would be minimally invasive in terms of excavation requirements and therefore pose little risk of interacting with groundwater), and the locations of groundwater bodies in that area, the ZoI of any groundwater interaction would not extend beyond Lough Corrib SAC, Lough Corrib SPA or Ross Lake and Woods SAC, and/or wetland sites locally which may support SCI species of Lough Corrib SPA.

Mitigation measures: refer to Box 2a in Section 3.2 below

Habitat degradation – water quality impacts during construction

As the Galway to Oughterard Greenway may be located within or adjacent to Lough Corrib SAC, Lough Corrib SPA and/or Ross Lake and Woods SAC and/or must cross watercourses which drain to these European Sites and to Galway Bay, construction works have the potential to affect surface and/or groundwater quality. As a consequence, the Galway to Oughterard Greenway could affect wetland habitats, and potentially QI/SCI species, in Lough Corrib SAC, Lough Corrib SPA, Ross Lake and Woods SAC, Galway Bay Complex SAC, and/or ex-situ sites which may support SCI species of Lough Corrib SPA.

Mitigation measures: refer to Box 4 in Section 3.2 below

Habitat degradation – shading

Any new bridge structures installed as part of the Galway to Oughterard Greenway that are located within Lough Corrib SAC, Lough Corrib SPA and/or Ross Lake and Woods SAC, have the potential to result in shading effects (i.e. reduced sunlight and levels of direct precipitation) on habitats beneath the structure. Such impacts could potentially affect QI habitats and/or habitats which may support QI/SCI species of these European Sites.

Mitigation measures: refer to Box 6 in Section 3.2 below

Habitat degradation – non-native invasive species

Introducing or spreading non-native invasive species during construction and/or operation (e.g. maintenance works) of the Galway to Oughterard Greenway has the potential to affect habitats, and may as a consequence affect supported species, in Lough Corrib SAC, Lough Corrib SPA, Ross Lake and Woods SAC, Galway Bay Complex downstream, and/or ex-situ sites which may support SCI species of Lough Corrib SPA.

Mitigation measures: refer to Box 8 in Section 3.2 below

Disturbance/displacement

Construction works and/or operation associated with the Galway to Oughterard Greenway has the potential to result in levels of disturbance that could potentially displace QI/SCI species

from important habitat areas (e.g. breeding/resting places, such as roost sites for wintering birds, or foraging areas) within Lough Corrib SAC, Lough Corrib SPA, Ross Lake and Woods SAC and/or ex-situ sites which may support SCI species of Lough Corrib SPA.

Mitigation measures: refer to Box 9 in Section 3.2 below

Barrier effect

As this section of the Galway to Oughterard Greenway may cross streams or linear habitats within Lough Corrib SAC and/or Ross Lake and Woods SAC, construction works and/or any proposed new structures have the potential to create a barrier to fauna species movement (e.g. within foraging areas or along commuting routes).

Mitigation measures: refer to Box 10 in Section 3.2 below

Public Transport Network

The potential impact pathways associated with the proposed Public Transport Network and the European Site(s) which are potentially at risk of adverse effects on Site integrity are summarised below:

Habitat Loss

Due to their locations within, or in close proximity to, European Sites some of the public transport infrastructure elements have the potential to result in direct loss of habitat in Galway Bay Complex SAC, Inner Galway Bay SPA or Lough Corrib SAC; habitat fragmentation is directly associated with this impact pathway. Loss of habitat from these European Sites, and indeed in any potential ex-situ sites supporting SCI bird species of the SPA (e.g. roost sites or feeding sites), has the potential to affect the conservation objectives supporting the Site's QI/SCI species.

These public transport elements are as follows (numerical references when given are as per Appendix D of the GTS):

- Park & Ride Facilities – the indicative location of the Western Distributor Road/R336 Bearna Road could affect habitats within Galway Bay Complex SAC, Inner Galway Bay or ex-situ sites linked with the latter and Lough Corrib SPA
- Rail – additional transport infrastructure at Ceannt Station and surrounding lands lie within or adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA
- Providing additional coach parking at Ceannt Station/Galway Harbour may include lands within or adjacent to Galway bay Complex SAC and/or Inner Galway Bay SPA
- Salmon Weir Bridge (and associated with this measure is the provision of a new pedestrian bridge to the south of the Salmon Weir Bridge which must cross Lough Corrib SAC)
- D2.1.3 UHG Grounds/University Road – terminates at the Salmon Weir Bridge which is within Lough Corrib SAC
- D2.1.7 Coast Road – the existing road and associated hard standing lies within, or is adjacent to, Galway bay Complex SAC and lies adjacent to Inner Galway Bay SPA
- D2.1.8 Salthill Road Upper – the southern end of this corridor lies within Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA
- D2.2.1 St. Vincent's Avenue/St. Francis Street/Eglington Street – this corridor includes the Salmon Weir Bridge which is within Lough Corrib SAC

- D2.2.3 Forster Street/College Road – the northern end of this corridor lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA
- D2.2.4 Old Dublin Road – the western end of this corridor lies within and in close proximity to Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA

Mitigation measures: refer to Box 1b in Section 3.2 below

Habitat degradation – hydrogeology

Although unlikely, there is the possibility that excavations associated with the installation of the public transport network may affect the existing hydrogeological regime which in turn may affect groundwater dependant habitats (and in some cases supported species) within European Sites. Given the likely nature of works associated with the infrastructure described in Appendix D of the GTS - which would be minimally invasive in terms of excavation requirements and with any such works being undertaken in the urban environment, poses little risk of interacting with groundwater – only elements adjacent to Lough Corrib SAC, Galway Bay Complex SAC or Inner Galway Bay SPA are likely to be at any risk of effects. However, even in those locations the risk is minimal.

Mitigation measures: refer to Box 2a in Section 3.2 below

Habitat degradation – water quality impacts during construction/operation

All of the public transport elements will be connected to the existing drainage network which ultimately discharges to Galway Bay via the River Corrib or other watercourses within the city and environs. Construction works therefore, have the potential to affect surface and/or groundwater quality which in turn could affect aquatic/wetland habitats, and potentially QI/SCI species, in Lough Corrib SAC, Galway Bay Complex SAC, Inner Galway Bay SPA and/or ex-situ sites which may support SCI species of Inner Galway Bay SPA or Lough Corrib SPA. Some elements are (or could potentially be) located within or in close proximity to European Sites and therefore may pose a greater risk in this regard (numerical references when given are as per Appendix D of the GTS):

- Park & Ride Facilities – the indicative locations given in Appendix E of the GTS are potentially hydrologically linked to Lough Corrib SAC, Galway Bay Complex SAC, Inner Galway Bay or ex-situ sites linked with Inner Galway Bay SPA or Lough Corrib SPA
- Additional transport infrastructure (rail or coach parking) at Ceannt Station/Galway Harbour or Galway Cathedral lies within or adjacent to Lough Corrib SAC, Galway Bay Complex SAC and Inner Galway Bay SPA
- D2.1.3 UHG Grounds/University Road – terminates at the Salmon Weir Bridge which is within Lough Corrib SAC
- D2.1.7 Coast Road – the existing road and associated hard standing lies within, or is adjacent to, Galway bay Complex SAC and lies adjacent to Inner Galway Bay SPA
- D2.1.8 Salthill Road Upper – the southern end of this corridor lies within Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA
- D2.2.1 St. Vincent’s Avenue/St. Francis Street/Eglington Street – this corridor includes the Salmon Weir Bridge which is within Lough Corrib SAC
- D2.2.3 Forster Street/College Road – the northern end of this corridor lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA

- D2.2.4 Old Dublin Road – the western end of this corridor lies within and in close proximity to Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA
- D2.2.7 Headford Road/Dun na Coiribe/Castlelawn heights/Tirellan Heights – crosses the Terryland River which drains to the River Corrib

Many of the GTS road infrastructure proposals will involve upgrades to the existing road network, in addition to new road infrastructure. Facilitating increased use of transport modes such as bus, bicycle and walking over individual car use in Galway City and its environs would be expected to reduce traffic levels and have a positive impact on water quality discharges from the city drainage network.

The GTS includes a number of new road infrastructure developments in Galway City, aside from the N6 GCRR: new road links from Newcastle Road to Bóthar Einde, from Dun na Coiribe to Castlelawn Heights, between Bóthar na dTreabh and the Tuam Road via Liosbán Industrial Estate, between Ballybrit Business Park and Parkmore Business Park, between Parkmore Link Road and the N17 and two links at Merlin Park (one from the Dublin Road and over the R446 at Doughiska. Road drainage, in the absence of any treatment measures, could contain pollutants such as hydrocarbons and heavy metals, which could impact on water quality in receiving watercourses and in Galway Bay. A reduction in water quality in receiving watercourses/waterbodies could affect sensitive QI habitats and QI/SCI species of European Sites downstream – Lough Corrib SAC, Galway Bay Complex SAC, Inner Galway Bay SPA and/or ex-situ sites which may support SCI species of Inner Galway Bay SPA or Lough Corrib SPA.

Mitigation measures: refer to Box 4, Box 5a and Box 5b in Section 3.2 below

Habitat degradation – shading

Upgrading the public transport network will/may require the provision of (or may be dependent on the delivery of) additional transport infrastructure in areas within or adjacent to European Sites which have the potential to affect habitat areas within Lough Corrib SAC as a result of direct shading:

- Salmon Weir Bridge (and associated with this measure is the provision of a new pedestrian bridge to the south of the Salmon Weir Bridge which must cross Lough Corrib SAC)

New bridge structures have the potential to result in shading effects (i.e. reduced sunlight and levels of direct precipitation) on habitats beneath the structure. Such impacts could potentially affect QI habitats and/or habitats which may support QI/SCI species of Lough Corrib SAC.

Mitigation measures: refer to Box 6 in Section 3.2 below

Habitat degradation – non-native invasive species

Introducing or spreading non-native invasive species during construction and/or operation (e.g. maintenance works) of any public transport network elements has the potential to affect habitats, and may as a consequence affect supported species, in Lough Corrib SAC, Lough Corrib SPA, Galway Bay Complex SAC, Inner Galway Bay SPA and/or ex-situ sites which may support SCI species of Inner Galway Bay SPA or Lough Corrib SPA.

Mitigation measures: refer to Box 8 in Section 3.2 below

Disturbance/displacement

Construction works and/or operation associated with elements of the public transport network has the potential to result in levels of disturbance that could potentially displace QI/SCI species from important habitat areas (e.g. breeding/resting places, such as roost sites for wintering birds, or foraging areas) within Lough Corrib SAC, Lough Corrib SPA, Galway Bay Complex SAC, Inner Galway Bay SPA and/or ex-situ sites which may support SCI species of Inner Galway Bay SPA or Lough Corrib SPA. Those in closest proximity to European Sites, and posing the greatest risk of effects, are:

- Park & Ride Facilities – the indicative locations given in Appendix E of the GTS are potentially located within or in close proximity to Lough Corrib SAC, Galway Bay Complex SAC, Inner Galway Bay or ex-situ sites linked with Inner Galway Bay SPA or Lough Corrib SPA
- Additional transport infrastructure (rail or coach parking) at Ceannt Station/Galway Harbour or Galway Cathedral lies within or adjacent to Lough Corrib SAC, Galway Bay Complex SAC and Inner Galway Bay SPA
- D2.1.3 UHG Grounds/University Road – terminates at the Salmon Weir Bridge which is within Lough Corrib SAC
- D2.1.7 Coast Road – the existing road and associated hard standing lies within, or is adjacent to, Galway bay Complex SAC and lies adjacent to Inner Galway Bay SPA
- D2.1.8 Salthill Road Upper – the southern end of this corridor lies within Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA
- D2.2.1 St. Vincent’s Avenue/St. Francis Street/Eglington Street – this corridor includes the Salmon Weir Bridge which is within Lough Corrib SAC
- D2.2.3 Forster Street/College Road – the northern end of this corridor lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA
- D2.2.4 Old Dublin Road – the western end of this corridor lies within and in close proximity to Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA
- D2.2.7 Headford Road/Dun na Coiribe/Castlelawn heights/Tirellan Heights – crosses the Terryland River which drains to the River Corrib

Mitigation measures: refer to Box 9 in Section 3.2 below

Barrier effect

The Cross-City Link is an integral part of the Public Transport Network and includes for a new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge. Construction works and/or the new structure has the potential to create a barrier to fauna species movement (e.g. within foraging areas or along commuting routes).

Mitigation measures: refer to Box 10 in Section 3.2 below

Mortality Risk

The Cross-City Link is an integral part of the Public Transport Network and includes for a new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge. Construction works have the potential to result in the mortality of QI/SCI species as a result of construction debris/materials accidentally falling onto aquatic/estuarine habitats.

Mitigation measures: refer to Box 11 in Section 3.2 below

Cycle Network (Non-Greenway Elements of the GTS)

The potential impact pathways associated with the proposed Non-Greenway Cycle Network and the European Site(s) which are potentially at risk of adverse effects on Site integrity are summarised below:

Habitat Loss

Due to their locations within, or in close proximity to, European Sites some of the non-greenway cycle network infrastructure elements have the potential to result in direct loss of habitat in Lough Corrib SAC, Galway Bay Complex SAC or Inner Galway Bay SPA; habitat fragmentation is directly associated with this impact pathway. Loss of habitat from these European Sites, and indeed in any potential ex-situ sites supporting SCI bird species of the SPA (e.g. roost sites or feeding sites), has the potential to affect the conservation objectives supporting the Site's QI/SCI species.

These non-Greenway cycle network elements are as follows (numerical references when given are as per Appendix F of the GTS):

- F4.1 Knocknacarra South – includes a feeder cycle corridor along the coast road/R336 which lies within, or is adjacent to, Galway Bay Complex SAC and lies adjacent to Inner Galway Bay SPA (the Bearna Greenway also forms part of the proposals in this area and is described separately under that heading)
- F4.2 Salthill – includes Threadneedle Road, Salthill Road Upper and Whitestrand Road, sections of which either lie within or adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA
- F4.6 Newcastle & Dangan – includes the N6/Quincentenary Bridge, NUIG and Chestnut Lane sections of which lie either within or adjacent to Lough Corrib SAC (the Galway to Oughterard Greenway also forms part of the proposals in this area and is described separately under that heading)
- F4.7 City Centre – includes new bridges over the River Corrib at the site of the Old Clifden Railway bridge, the Salmon Weir Bridge and Wolfe Tone Bridge, and proposed works along College Road. The first two locations cross Lough Corrib SAC, the area south of Wolfe Tone Bridge crosses Galway Bay Complex SAC, and the proposed works along College Road lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA
- F4.8 Terryland and Ballinfoyle – includes the N6/Quincentenary Bridge, which crosses Lough Corrib SAC, and Dyke Road, sections of which lie adjacent to Lough Corrib SAC
- F4.10 Renmore & Dublin Road – includes College Road, the Dublin Road and Doughiska Road. The northern end of College Road lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA, the western end of the Dublin Road lies within and in close proximity to Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA, and the southern end of Doughiska Road lies adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA (the proposed Galway City to Oranmore section of the Galway to Dublin Cycleway also forms part of the proposals in this area and is described separately under that heading)
- Supporting measures to expand the bike share scheme, provide for and upgrade bicycle parking facilities, and improve cycling permeability across the city are not location

specific and could potentially affect European Sites within Galway City – Lough Corrib SAC, Galway Bay Complex SAC and Inner Galway Bay SPA

- A greenway connecting Eyre Square and Renmore (in the vicinity of Galway Port or the existing rail crossing over Lough Atalia) would cross Galway Bay Complex SAC and Inner Galway Bay SPA

Mitigation measures: refer to Box 1b in Section 3.2 below

Habitat degradation – hydrogeology

Although unlikely, there is the possibility that excavations associated with the installation of non-greenway cycle network elements may affect the existing hydrogeological regime which in turn may affect groundwater dependant habitats (and in some cases supported species) within European Sites. The likely nature of works associated with the majority of infrastructure described in Appendix F of the GTS and would be minimally invasive in terms of excavation requirements and with any such works being undertaken in the urban environment, poses little risk of interacting with groundwater – only elements adjacent to Lough Corrib SAC, Galway Bay Complex SAC or Inner Galway Bay SPA are likely to be at any real risk of effects (see list above under habitat loss). Installation of new bridge structures may be more likely to interact with groundwater. However, as these bridges are all associated with a modified urban landscape in the city centre, the risk is likely to remain low.

Mitigation measures: refer to Box 2a in Section 3.2 below

Habitat degradation – water quality impacts during construction

Many of the non-greenway cycle network elements may be connected to the existing drainage network which ultimately discharges to Galway Bay via the River Corrib or other watercourses within the city and environs. Construction works therefore, have the potential to affect surface and/or groundwater quality which in turn could affect aquatic/wetland habitats, and potentially QI/SCI species, in Lough Corrib SAC, Galway Bay Complex SAC, Inner Galway Bay SPA and/or ex-situ sites which may support SCI species of Inner Galway Bay SPA or Lough Corrib SPA. Some elements are (or could potentially be) located within or in close proximity to European Sites and therefore may pose a greater risk in this regard (numerical references when given are as per Appendix F of the GTS):

- F4.1 Knocknacarra South – includes a feeder cycle corridor along the coast road/R336 which lies within, or is adjacent to, Galway bay Complex SAC and lies adjacent to Inner Galway Bay SPA (the Bearna Greenway also forms part of the proposals in this area and is described separately under that heading)
- F4.2 Salthill – includes Threadneedle Road, Salthill Road Upper and Whitestrand Road, sections of which either lie within or adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA
- F4.3 Shantalla – includes facilities along the canals which are hydrologically linked to Lough Corrib SAC, Galway Bay Complex SAC and Inner Galway Bay SPA via the River Corrib
- F4.6 Newcastle & Dangan – includes the N6/Quincentenary Bridge, NUIG and Chestnut Lane sections of which lie either within or adjacent to Lough Corrib SAC (the Galway to Oughterard Greenway also forms part of the proposals in this area and is described separately under that heading)

- F4.7 City Centre – includes new bridges over the River Corrib at the site of the Old Clifden Railway bridge, the Salmon Weir Bridge and Wolfe Tone Bridge, and proposed works along College Road. The first two locations cross Lough Corrib SAC, the area south of Wolfe Tone Bridge crosses Galway Bay Complex SAC, and the proposed works along College Road lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA
- F4.8 Terryland and Ballinfoyle – includes the N6/Quincentenary Bridge, which crosses Lough Corrib SAC, and Dyke Road, sections of which lie adjacent to the River Corrib (Lough Corrib SAC)
- F4.10 Renmore & Dublin Road – includes College Road, the Dublin Road and Doughiska Road. The northern end of College Road lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA at Lough Atalia, the western end of the Dublin Road lies within and in close proximity to Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA at Lough Atalia, and the southern end of Doughiska Road lies adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA at Oranmore Bay (the proposed Galway City to Oranmore section of the Galway to Dublin Cycleway also forms part of the proposals in this area and is described separately under that heading)
- Supporting measures to expand the bike share scheme, provide for and upgrade bicycle parking facilities, and improve cycling permeability across the city are not location specific and could potentially affect European Sites within Galway City – Lough Corrib SAC, Galway Bay Complex SAC and Inner Galway Bay SPA
- A greenway connecting Eyre Square and Renmore (in the vicinity of Galway Port or the existing rail crossing over Lough Atalia) would cross Galway Bay Complex SAC and Inner Galway Bay SPA at Lough Atalia

Many of the non-greenway cycle elements are likely to be dependent on either upgrades to the existing road infrastructure, or proposed new road infrastructure – this is assessed above under *Habitat degradation – water quality impacts during construction/operation* in the Public Transport Network section.

Mitigation measures: refer to Box 4 in Section 3.2 below

Habitat degradation – shading

Upgrading the non-greenway cycle network will/may require the provision of (or may be dependent on the delivery of) additional transport infrastructure in areas within or adjacent to European Sites which have the potential to affect habitat areas within those Sites as a result of direct shading:

- The secondary cycle network includes for a proposed new bridge over the River Corrib along the line of the Old Clifden Railway at NUI Galway/Waterside which crosses Lough Corrib SAC
- Facilitating city cycling relies upon the Cross-City Link which includes for a new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge
- Connecting a greenway between Eyre Square and Renmore may impact on Galway Bay Complex SAC and Inner Galway Bay SPA at Lough Atalia

- A proposed new cycle/pedestrian bridge over the River Corrib, to the south of Wolfe Tone Bridge, must cross Galway Bay Complex SAC

New bridge structures have the potential to result in shading effects (i.e. reduced sunlight and levels of direct precipitation) on habitats beneath the structure. Such impacts could potentially affect QI habitats and/or habitats which may support QI/SCI species of Lough Corrib SAC, Galway Bay Complex SAC or Inner Galway Bay SPA.

Mitigation measures: refer to Box 6 in Section 3.2 below

Habitat degradation – non-native invasive species

Introducing or spreading non-native invasive species during construction and/or operation (e.g. maintenance works) of any non-greenway cycle network elements has the potential to affect habitats, and may as a consequence affect supported species, in Lough Corrib SAC, Lough Corrib SPA, Galway Bay Complex SAC, Inner Galway Bay SPA and/or ex-situ sites which may support SCI species of Inner Galway Bay SPA or Lough Corrib SPA.

Mitigation measures: refer to Box 8 in Section 3.2 below

Disturbance/displacement

Construction works and/or operation associated with elements of the non-greenway cycle network has the potential to result in levels of disturbance that could potentially displace QI/SCI species from important habitat areas (e.g. breeding/resting places, such as roost sites for wintering birds, or foraging areas) within Lough Corrib SAC, Lough Corrib SPA, Galway Bay Complex SAC, Inner Galway Bay SPA and/or ex-situ sites which may support SCI species of Inner Galway Bay SPA or Lough Corrib SPA. Those in closest proximity to European Sites, and posing the greatest risk of effects, are:

- F4.1 Knocknacarra South – includes a feeder cycle corridor along the coast road/R336 which lies within, or is adjacent to, Galway bay Complex SAC and lies adjacent to Inner Galway Bay SPA (the Bearna Greenway also forms part of the proposals in this area and is described separately under that heading)
- F4.2 Salthill – includes Threadneedle Road, Salthill Road Upper and Whitestrand Road, sections of which either lie within or adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA
- F4.6 Newcastle & Dangan – includes the N6/Quincentenary Bridge, NUIG and Chestnut Lane sections of which lie either within or adjacent to Lough Corrib SAC (the Galway to Oughterard Greenway also forms part of the proposals in this area and is described separately under that heading)
- F4.7 City Centre – includes new bridges over the River Corrib at the site of the Old Clifden Railway bridge, the Salmon Weir Bridge and Wolfe Tone Bridge, and proposed works along College Road. The first two locations cross Lough Corrib SAC, the area south of Wolfe Tone Bridge crosses Galway Bay Complex SAC, and the proposed works along College Road lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA
- F4.8 Terryland and Ballinfoyle – includes the N6/Quincentenary Bridge, which crosses Lough Corrib SAC, and Dyke Road, sections of which lie adjacent to Lough Corrib SAC

- F4.10 Renmore & Dublin Road – includes College Road, the Dublin Road and Doughiska Road. The northern end of College Road lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA, the western end of the Dublin Road lies within and in close proximity to Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA, and the southern end of Doughiska Road lies adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA (the proposed Galway City to Oranmore section of the Galway to Dublin Cycleway also forms part of the proposals in this area and is described separately under that heading)
- Supporting measures to expand the bike share scheme, provide for and upgrade bicycle parking facilities, and improve cycling permeability across the city are not location specific and could potentially affect European Sites within Galway City – Lough Corrib SAC, Galway Bay Complex SAC and Inner Galway Bay SPA
- A greenway connecting Eyre Square and Renmore (in the vicinity of Galway Port or the existing rail crossing over Lough Atalia) would cross Galway Bay Complex SAC and Inner Galway Bay SPA

Mitigation measures: refer to Box 9 in Section 3.2 below

Barrier effect

Construction works associated with the new structures, or the structures themselves, have the potential to create a barrier to fauna species movement (e.g. within foraging areas or along commuting routes):

- The secondary cycle network includes for a proposed new bridge over the River Corrib along the line of the Old Clifden Railway at NUI Galway/Waterside which crosses Lough Corrib SAC
- Facilitating city cycling relies upon the Cross-City Link which includes for a new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge
- Connecting a greenway between Eyre Square and Renmore may impact on Galway Bay Complex SAC at Lough Atalia
- A proposed new cycle/pedestrian bridge over the River Corrib, to the south of Wolfe Tone Bridge, must cross Galway Bay Complex SAC

Mitigation measures: refer to Box 10 in Section 3.2 below

Mortality Risk

Construction works associated with the new structures have the potential to result in the mortality of QI/SCI species as a result of construction debris/materials accidentally falling onto aquatic/estuarine habitats:

- The secondary cycle network includes for a proposed new bridge over the River Corrib along the line of the Old Clifden Railway at NUI Galway/Waterside which crosses Lough Corrib SAC.
- Facilitating city cycling relies upon the Cross-City Link which includes for a new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge.
- Connecting a greenway between Eyre Square and Renmore may impact on Galway Bay Complex SAC and Inner Galway Bay SPA at Lough Atalia.

- A proposed new cycle/pedestrian bridge over the River Corrib, to the south of Wolfe Tone Bridge, must cross Galway Bay Complex SAC

Mitigation measures: refer to Box 11 in Section 3.2 below

Pedestrian Network

The potential impact pathways associated with the proposed Pedestrian Network and the European Site(s) which are potentially at risk of adverse effects on Site integrity are summarised below:

Habitat Loss

Aside from the three principle greenway projects (which are discussed separately), the provision of infrastructure associated with the pedestrian network in areas within or adjacent to European Sites has the potential to result in the permanent loss of habitat in Lough Corrib SAC, Galway Bay Complex SAC or Inner Galway Bay SPA; habitat fragmentation is directly associated with this impact pathway. Loss of habitat from these European Sites, and indeed in any potential ex-situ sites supporting SCI bird species of the SPA (e.g. roost sites or feeding sites), has the potential to affect the conservation objectives supporting the Site's QI/SCI species:

- The Cross-City Link includes for a new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge
- Connecting a greenway between Eyre Square and Renmore (in the vicinity of Galway Port or the existing rail crossing over Lough Atalia) may impact on Galway Bay Complex SAC and Inner Galway Bay SPA
- The proposed new bridge over the River Corrib along the line of the Old Clifden Railway at NUI Galway/Waterside which crosses Lough Corrib SAC
- A proposed new cycle/pedestrian bridge to the south of Wolfe Tone Bridge must cross Galway Bay Complex SAC

Mitigation measures: refer to Box 1b in Section 3.2 below

Habitat degradation – hydrogeology

Although unlikely, there is the possibility that excavations associated with the installation of pedestrian network elements may affect the existing hydrogeological regime which in turn may affect groundwater dependant habitats (and in some cases supported species) within European Sites. Given the likely nature of works associated with the majority of the pedestrian network described in the GTS they would be minimally invasive in terms of excavation requirements and, with any such works being undertaken in the urban environment, pose little risk of interacting with groundwater – only elements adjacent to Lough Corrib SAC, Galway Bay Complex SAC or Inner Galway Bay SPA are likely to be at any real risk of effects (see list above under habitat loss). Installation of new bridge structures may be more likely to interact with groundwater. However, as these bridges are all associated with a modified urban landscape in the city centre, the risk is likely to remain low.

Mitigation measures: refer to Box 2a in Section 3.2 below

Habitat degradation – water quality impacts during construction

Many of the pedestrian network elements may be connected to the existing drainage network which ultimately discharges to Galway Bay via the River Corrib or other watercourses within the city and environs. Construction works therefore, have the potential to affect surface and/or groundwater quality which in turn could affect aquatic/wetland habitats, and potentially QI/SCI species, in Lough Corrib SAC, Galway Bay Complex SAC, Inner Galway Bay SPA and/or ex-situ sites which may support SCI species of Inner Galway Bay SPA or Lough Corrib SPA. Some elements are (or could potentially be) located within or in close proximity to European Sites and therefore may pose a greater risk in this regard:

- The Cross-City Link includes for a new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge
- Connecting a greenway between Eyre Square and Renmore (in the vicinity of Galway Port or the existing rail crossing over Lough Atalia) may impact on Galway Bay Complex SAC and Inner Galway Bay SPA
- The proposed new bridge over the River Corrib along the line of the Old Clifden Railway at NUI Galway/Waterside which crosses Lough Corrib SAC
- A proposed new cycle/pedestrian bridge to the south of Wolfe Tone Bridge must cross Galway Bay Complex SAC

Mitigation measures: refer to Box 4 in Section 3.2 below

Habitat degradation – shading

Upgrading the pedestrian network will/may require the provision of (or may be dependent on the delivery of) additional transport infrastructure in areas within or adjacent to European Sites which have the potential to affect habitat areas within those Sites as a result of direct shading:

- A proposed new bridge over the River Corrib along the line of the Old Clifden Railway at NUI Galway/Waterside which crosses Lough Corrib SAC
- A proposed new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge
- Connecting a greenway between Eyre Square and Renmore may impact on Galway Bay Complex SAC and Inner Galway Bay SPA at Lough Atalia
- A proposed new cycle/pedestrian bridge over the River Corrib, to the south of Wolfe Tone Bridge, must cross Galway Bay Complex SAC

New bridge structures have the potential to result in shading effects (i.e. reduced sunlight and levels of direct precipitation) on habitats beneath the structure. Such impacts could potentially affect QI habitats and/or habitats which may support QI/SCI species of Lough Corrib SAC, Galway Bay Complex SAC or Inner Galway Bay SPA.

Mitigation measures: refer to Box 6 in Section 3.2 below

Habitat degradation – non-native invasive species

Introducing or spreading non-native invasive species during construction and/or operation (e.g. maintenance works) of any pedestrian network elements has the potential to affect habitats, and may as a consequence affect supported species, in Lough Corrib SAC, Lough Corrib SPA,

Galway Bay Complex SAC, Inner Galway Bay SPA and/or ex-situ sites which may support SCI species of Inner Galway Bay SPA or Lough Corrib SPA.

Mitigation measures: refer to Box 8 in Section 3.2 below

Disturbance/displacement

Construction works and/or operation associated with elements of the pedestrian network has the potential to result in levels of disturbance that could potentially displace QI/SCI species from important habitat areas (e.g. breeding/resting places, such as roost sites for wintering birds, or foraging areas) within Lough Corrib SAC, Lough Corrib SPA, Galway Bay Complex SAC, Inner Galway Bay SPA and/or ex-situ sites which may support SCI species of Inner Galway Bay SPA or Lough Corrib SPA. Those in closest proximity to European Sites, and posing the greatest risk of effects, are:

- The proposed new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge
- Connecting a greenway between Eyre Square and Renmore (in the vicinity of Galway Port or the existing rail crossing over Lough Atalia) may impact on Galway Bay Complex SAC and Inner Galway Bay SPA
- The proposed new bridge over the River Corrib along the line of the Old Clifden Railway at NUI Galway/Waterside which crosses Lough Corrib SAC
- A proposed new cycle/pedestrian bridge to the south of Wolfe Tone Bridge must cross Galway Bay Complex SAC

Mitigation measures: refer to Box 9 in Section 3.2 below

Barrier effect

Construction works associated with the new structures, or the structures themselves, have the potential to create a barrier to fauna species movement (e.g. within foraging areas or along commuting routes):

- A proposed new bridge over the River Corrib along the line of the Old Clifden Railway at NUI Galway/Waterside which crosses Lough Corrib SAC
- A proposed new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge
- Connecting a greenway between Eyre Square and Renmore may impact on Galway Bay Complex SAC at Lough Atalia
- A proposed new cycle/pedestrian bridge over the River Corrib, to the south of Wolfe Tone Bridge, must cross Galway Bay Complex SAC

Mitigation measures: refer to Box 10 in Section 3.2 below

Mortality Risk

Construction works associated with the new bridge structures, or the structures themselves, have the potential to result in the mortality of QI/SCI species as a result of construction debris/materials accidentally falling onto aquatic/estuarine habitats:

- The proposed new bridge over the River Corrib along the line of the Old Clifden Railway at NUI Galway/Waterside which crosses Lough Corrib SAC
- A proposed new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge
- Connecting a greenway between Eyre Square and Renmore may impact on Galway Bay Complex SAC and Inner Galway Bay SPA at Lough Atalia
- A proposed new cycle/pedestrian bridge over the River Corrib, to the south of Wolfe Tone Bridge, must cross Galway Bay Complex SAC

Mitigation measures: refer to Box 11 in Section 3.2 below

3.2 Mitigation Measures

This section details the mitigation measures required to ensure that the GTS elements do not affect the conservation objectives of the QIs/SCIs of any European Sits, and therefore will not result in adverse effects on Site integrity as a result of the potential impacts described above in Section 3.1. This includes not inhibiting any future efforts to repair or remediate any legacy impacts to European Sites that have occurred since their designation in cases where the conservation objectives are to restore favourable conservation condition rather to maintain it. The references to the mitigation measures in that section correspond with the relevant text boxes below.

In the hierarchy of land use plans, the Galway County Development Plan 2015-2021, the Galway City Development Plan 2011-2017 and the Galway City Draft Development Plan 2017-2023 and subsequent land use Plans have an overarching role in ensuring the protection of European Sites whilst guiding the future development of Galway City. This includes implementing the measures set out in the GTS over the next 20 years.

The relevant land use Plans include a range of environmental protection policies, to which all projects proposed under the GTS will be subject. These environmental protection policies will serve, in many cases, to safeguard against the GTS resulting in adverse effects on the integrity of any European Sites. These environmental protection policies are extracted from the relevant Plans and included in Appendix D of this NIS. They are also referenced under the mitigation measures column in Appendix B (Table B-1) of this NIS, using the reference numbers from Appendix D of this NIS, as this table sets out how they serve to protect European Sites from being impacted by GTS elements.

Many of the GTS elements are described at a level of geographic specificity where more project-specific mitigation measures are required to adequately address the various potential impact pathways at the project-level to be able to demonstrate that the GTS will not adversely affect the integrity of any European Sites. These project-level mitigation measures are presented below, under the heading of each of the identified impact pathways. These are also referenced, using the reference numbers from the sections below, under the mitigation measures column in Appendix B (Table B-1) of this NIS.

3.2.1 Habitat Loss

Mitigation measures to ensure that any habitat loss associated with the Cycle Network Greenways do not pose a risk of adversely affecting the integrity of any European Sites are included below in Box 1a. Those relating to the Public Transport Network, Non-greenway Cycle Network, and the Pedestrian Network are included in Box 1b, and those relating to the N6 GCRR in Box 1c.

Box 1a: Mitigation measures in relation to habitat loss affecting European Sites – Cycle Network Greenways

GTS – Habitat Loss: Cycle Network Greenways

If the alignment of the Bearna Greenway, the Galway to Dublin Cycleway (Galway City to Oranmore), or the Galway to Oughterard Greenway will result in habitat loss within a European Site:

- a habitat survey of the affected area will be carried out to identify and classify the habitat types present (in accordance with the most recently published Annex I habitat classification guidance documents) to determine whether impacted habitat areas correspond with any of the QI Annex I habitats for which Lough Corrib SAC, Galway Bay Complex SAC or Ross Lake and Woods SAC are selected. A loss of any area of QI habitat, or any area of supporting habitat that in turn affects the QI habitat, would affect the conservation objectives supporting the habitat’s conservation condition, resulting in an adverse effect on Site integrity
- if habitats in Lough Corrib SAC are likely to be affected and are assessed as being suitable to support the Sites’ QI plant species (Slender green feather-moss - *Drepanocladus (Hamatocaulis) vernicosus* and Slender Naiad - *Najas flexilis*) an appropriate level of survey will be carried out to definitively support an assessment and conclusion of whether the proposed project will affect the conservation objectives supporting the species’ favourable conservation status, and thus adversely affect the integrity of the SAC
- if aquatic habitats in Lough Corrib SAC are likely to be affected and are assessed as being suitable to support the Sites’ aquatic QI species (Otter, Atlantic salmon, Sea lamprey, Brook lamprey, White-clawed crayfish or Freshwater pearl mussel) an appropriate level of survey will be carried out to definitively support an assessment and conclusion as to whether the proposed project will affect the conservation objectives supporting the species’ favourable conservation status, and thus adversely affect the integrity of the SAC
- if aquatic and/or coastal habitats in Galway Bay Complex SAC are likely to be affected and are assessed as being suitable to support the Sites’ aquatic/marine QI species (Otter and Harbour seal) an appropriate level of survey will be carried out to definitively support an assessment and conclusion as to whether the proposed project will affect the conservation objectives supporting the species’ favourable conservation status, and thus adversely affect the integrity of the SAC
- an assessment will be made, based on an appropriate level of survey work to definitively support its conclusion, as to whether any habitat loss associated with the Galway to Oughterard Greenway will affect the conservation objectives supporting the favourable conservation status of the Lesser horseshoe bat roost for which the Ross Lake and Woods SAC is designated, and thus adversely affect the integrity of the SAC[10]
- if the greenways will result in habitat loss within Lough Corrib SPA/Inner Galway Bay SPA, an assessment will be made, based on an appropriate level of survey work to definitively support its conclusion, as to whether the habitat loss will affect the conservation objectives supporting the species’ favourable conservation status, and thus adversely affect the integrity of the SPA. This assessment will also consider the effects of habitat loss in areas outside of the SPA in the context of whether these areas are important in supporting the SCI populations (i.e. constitute ex-situ sites as defined in the conservation objectives)

Any sections of the proposed greenways which will adversely affect the integrity of any European Site as a result of habitat loss or fragmentation, either alone or in-combination with any other plans or projects, or where

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[10] Although the Lesser horseshoe bat is known to be present within the Galway City and environs (*N6 Galway City Transport Project Route Selection Report,* (Arup, 2015)), the roost that forms the QI population for this European Site (Eborhall House) is 11km away from the nearest GTS project (the Galway to Oughterard Greenway), on the northern shore of Lough Corrib. This distance would be regarded to be beyond the normal core foraging range of the Eborhall House population and beyond the normal commuting range of this species except on exceptional occasions or over long periods of time – for example, bats dispersing and moving between areas in the wider landscape over a period of many years/generations.

such effects cannot be definitively ruled out, will not be progressed and an alternative will be implemented which avoids this impact.

Box 1b: Mitigation measures in relation to habitat loss affecting European Sites - Public Transport Network, Non-greenway Cycle Network and Pedestrian Network (proposed bridge structures)

GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network

Generally, the Public Transport Network, Non-greenway Cycle Network, and Pedestrian Network project elements are currently described at a strategic level in terms of their location and function/role within the GTS. However, some, such as the proposed pedestrian bridge near the Salmon Weir Bridge or providing public transport infrastructure along the R336 in Salthill, have a more definite location described. The required ecological information and assessment required, as documented below, will be required to inform the development of the detailed design at the project stage.

Survey and assessment requirements to inform the detailed design of Public Transport Network, Non-Greenway Cycle Network, and Pedestrian Network project elements are listed below.

If elements of the Public Transport Network, the Non-Greenway Cycle Network or the Pedestrian Network will result in habitat loss within a European Site:

- a habitat survey of the affected area will be carried out to identify and classify the habitat types present (in accordance with the most recently published Annex I habitat classification guidance documents) to determine whether impacted habitat areas correspond with any of the QI Annex I habitats for which Lough Corrib SAC or Galway Bay Complex SAC are selected. A loss of any area of QI habitat, or any area of supporting habitat that in turn affects the QI habitat, would affect the conservation objectives supporting the habitat’s conservation condition, resulting in an adverse effect on Site integrity
- if aquatic habitats in Lough Corrib SAC are likely to be affected and are assessed as being suitable to support the Sites’ aquatic QI species (Otter, Atlantic salmon, Sea lamprey, Brook lamprey, White-clawed crayfish or the Freshwater pearl mussel) an appropriate level of survey will be carried out to definitively support an assessment and conclusion as to whether the proposed project will affect the conservation objectives supporting the species’ favourable conservation status, and thus adversely affect the integrity of the SAC
- if aquatic and/or coastal habitats in Galway Bay Complex SAC are likely to be affected and are assessed as being suitable to support the Sites’ aquatic/marine QI species (Otter and Harbour seal) an appropriate level of survey will be carried out to definitively support an assessment and conclusion as to whether the proposed project will affect the conservation objectives supporting the species’ favourable conservation status, and thus adversely affect the integrity of the SAC
- if habitat areas within Inner Galway Bay SPA will be lost as a result of implementing any of these elements, an assessment will be made, based on an appropriate level of survey work to definitively support its conclusion, as to whether the habitat loss will affect the conservation objectives supporting the species’ favourable conservation status, and thus adversely affect the integrity of the SPA. This assessment will also consider the effects of habitat loss in areas outside of the SPA in the context of whether these areas are important in supporting the SCI populations (i.e. constitute ex-situ sites as defined in the conservation objectives)

All of the assessments must also consider whether there is any potential for adverse effects on European Site integrity in-combination with other plans and/or projects.

Considering the general locations provided, the type of infrastructure development envisaged for each of these project elements, and the ecological information and assessment required to be carried out to inform their design, it is reasonable to assume that at the detailed design stage any potential for a project element to impact on the European Site as a result of habitat loss could, and will, be resolved through the exploration of alternative locations or designs whilst still fulfilling their function/role in supporting the overarching vision, guiding principles and strategic objectives/aims of the GTS.

Any proposed projects which will adversely affect the integrity of any European Site as a result of habitat loss or fragmentation, either alone or in-combination with any other plans or projects, or where such effects cannot be definitively ruled out, will not be progressed and an alternative will be implemented which avoids this potential impact.

Box 1c: Mitigation measures in relation to habitat loss affecting European Sites – N6 GCRR

GTS – Habitat Loss: N6 GCRR

Where the N6 GCRR landtake, to include lands for the site compounds and drainage design (or any other landtake requirements not specified at this stage in the project design), falls outside of the current corridor for the proposed road development, they will not be located in areas where they would adversely affect the integrity of Lough Corrib SAC, either alone or in-combination with any other plans or projects, as a result of habitat loss or fragmentation.

3.2.2 Habitat Degradation – Hydrogeology

Mitigation measures to ensure that all GTS elements, aside from the N6 GCRR, do not pose a risk of adversely affecting the integrity of any European Sites are included below in Box 2a. Specific mitigation measures to address the potential hydrogeological impacts associated with the N6 GCRR are included below in Box 2b.

Box 2a: General mitigation measures (excluding the N6 GCRR) relating to potential hydrogeological impacts affecting European Sites

GTS – Hydrogeology General

As part of the design phase, all GTS projects will establish at the earliest possible stage of the feasibility/design process whether their construction or operation will interact with or affect groundwater. If groundwater impacts are likely, an assessment of the zone of influence of any such interaction will be carried out with respect to identifying if there is any risk of groundwater impacts affecting the hydrogeological regime supporting QI habitats/species in any European Sites.

Where any such impacts are identified, appropriate mitigation measures will be designed and implemented to ensure that the GTS project element will not adversely affect the integrity of any European Sites, either alone or in-combination with any other plans or projects, by impacting on the existing hydrogeological regime.

Box 2b: Specific mitigation measures relating to the proposed N6 GCRR and potential hydrogeological impacts affecting European Sites

GTS – Hydrogeology N6 GCRR

During construction/operation of the proposed tunnel at Lackagh Quarry there is a risk of groundwater impacts which could affect habitats within Lough Corrib SAC. The following mitigation measures are proposed to ensure that the proposed tunnel, and construction of western and eastern approaches to same, will not adversely affect the integrity of Lough Corrib SAC. These mitigation measures are based upon the results of a study carried out to qualify and quantify the potential impacts that may be associated with a tunnel at Lackagh Quarry. If additional mitigation measures are required at the detailed design stage of the N6 GCRR, these will be designed and implemented to ensure that any tunnel or excavations in this area will not adversely affect the integrity of any European Sites, either alone or in-combination with any other plans or projects, by impacting on the existing hydrogeological regime.

Works in the quarry outside and east of the SAC (Section 1)

A composite support system of rock bolts, steel mesh and sprayed concrete will be used to stabilise the quarry face. In the event that sprayed concrete is used, groundwater seepage from the quarry face will be facilitated by installing weep holes. The frequency of weep holes will be based on the expected groundwater seepage from the quarry face to reduce any water build-up behind the shotcrete layer.

The drainage network for the proposed road within Lackagh Quarry will collect all surface water from both carriageways on the eastern approach to the tunnel. The road drainage will be sealed and directed to a hydrocarbon interceptor and then to a containment pond. Following containment all water will enter an infiltration pond with a 1m constructed subsoil bed that will allow the treated water to recharge to ground. The

pond is designed to accommodate a 100-year storm event, with 50% of volume to infiltrate to ground within 24 hours.

The proposed finished level of the proposed road will lie above the groundwater table, however, the embankment starter layer would in part be submerged during the winter groundwater high. In this regard the starter layer will be constructed so as not to dam groundwater in parts of the quarry floor. Similarly, the drainage network will not be installed during the seasonal groundwater high so as to avoid the need for dewatering and groundwater lowering.

Construction of the tunnel section beneath the SAC (Section 2)

No groundwater dewatering of the bedrock aquifer will be permitted during construction works. No construction works will be permitted during periods of high groundwater periods where groundwater dewatering would be required to facilitate works. When the groundwater rise occurs all construction activities within the zone below the high winter groundwater level for the tunnel will cease and the operation made safe until groundwater levels drop, which may include the installation of berms to prevent groundwater entering or exiting the tunnel from the tunnel portal.

The hydrogeological study of Lackagh Quarry has identified a potential perched water table and flow path along a clay wayboard in the limestone sequence. The clay wayboard will be intersected by the tunnel and there may be inflows along it. These inflows will be managed during construction and allowed to infiltrate to ground along the tunnel section.

On sealing of the tunnel these inflows will be transferred laterally around the outside of the tunnel box section and to the groundwater table below.

To facilitate groundwater flow around the completed tunnel a drainage blanket up to the winter groundwater level (16.7m OD) will be incorporated during construction. It is envisaged that this will take the form of a drainage layer, drainage pipes or similar placed outside the permanent cast in-situ reinforced concrete tunnel lining and waterproof membrane.

Construction of western approach to the tunnel outside the SAC (Section 3)

No dewatering of the bedrock aquifer will be permitted due to the sensitive nature at the groundwater dependant habitat at nearby Coolagh Lakes.

Where excavation into subsoils below the winter groundwater level is required, an additional geotechnical investigation to establish the overburden permeability will be required to determine if inflows to the excavation will occur from the bedrock aquifer. In the case that inflow is likely below the winter groundwater level then construction below the winter groundwater level will not be permitted. The additional geotechnical investigation will calculate groundwater seepage based on an assessment of permeability, thickness of overburden between the excavation and the bedrock aquifer and geotechnical stability.

A watertight seal will be installed on the underside of the road base and the cutting sides to protect against groundwater inflow. This area will be sealed during construction (and permanently) to 17.7mOD; which is derived from the groundwater high (15.7m OD) plus 2m free board. Slope or retaining structures will be utilised from +17.7mOD to existing ground level where required.

Runoff will be collected by a sealed drainage system and discharged to ground by infiltration ponds to the west.

Operation of the tunnel

All wash water entering the tunnel on vehicles will be collected in a sealed drainage system and pumped to foul sewer for treatment at a municipal facility.

3.2.3 Habitat degradation – tunnelling/excavation

Mitigation measures relating to the risk of tunnelling or excavations, associated with the proposed N6 GCRR, in the vicinity of Lackagh Quarry are included in Box 3.

Box 3: Mitigation measures relating to habitat degradation from construction of the tunnel at Lackagh Quarry affecting European Sites

GTS – Habitat degradation – tunnelling/excavation (N6 GCRR)

During construction of the proposed tunnel at Lackagh Quarry there is a risk of impacts to habitats above in Lough Corrib SAC or to adjacent habitats in the SAC along the alignment of the western approach to the tunnel. The following mitigation measures are proposed to ensure that the proposed Lackagh Tunnel, and construction of the western and eastern approaches to same, will not adversely affect the integrity of Lough Corrib SAC via

this impact pathway. These mitigation measures are based upon the results of a study carried out to qualify and quantify the potential impacts that may be associated with a tunnel/excavations at Lackagh Quarry. If additional mitigation measures are required at the detailed design stage of the N6 GCRR, these will be designed and implemented to ensure that any tunnel or excavations in this area will not adversely affect the integrity of any European Sites, either alone or in-combination with any other plans or projects, via this impact pathway.

<u>Works to the quarry face (Section 1)</u>

A composite support system of rock bolts, steel mesh and sprayed concrete will be used to stabilise the quarry face. The proposed works will be completed prior to the tunnel excavation and be limited to the quarry face. These rock face protective measures will limit movement within the rock mass resulting in no adverse impact to the Limestone pavement.

During the construction of the tunnel the Lackagh Quarry stabilised face will be monitored for movement and cracks to ensure no impact to the Limestone pavement. In the unforeseen event that movement is observed additional support systems will be installed.

During operational phase of the tunnel continued monitoring will take place to ensure that further stabilisation measures are implemented to protect against any further movement or instability within the rock mass surrounding the tunnel portal. During the operational stage of the tunnel there will be no adverse impact on the Limestone pavement.

<u>Construction of the tunnel (Section 2)</u>

- Each individual tunnel will maintain at least 8m of clear rock above the tunnel crown to the ground level of Lough Corrib SAC. This eight meters allows a sufficiently stable rock arch to develop around the tunnel which will ensure the stability of the tunnel in the temporary case
- The minimum clear distance of seven meters will be maintained between the twin mined tunnel based on the strength of the rock and expected size of the tunnels
- Pre-support measures will be installed at the quarry face around the proposed tunnel portal to prevent collapse into the quarry
- The blasting charge weights used for excavation will be limited to cater for the proximity of sensitive receivers. Following a preliminary assessment, vibrations of 25mm/sec will not adversely impact the Limestone pavement environment. During the blasting period the Limestone pavement will be monitored to establish if vibration in excess of 25mm/sec are feasible whilst not affecting the Limestone pavement
- Pre-support measures when required in the form of sub-horizontal spiles will be implemented which provide a stiffer support in addition to the rock bolts and sprayed concrete. These additional measures provide an extra level of safety to the temporary works ensuring there is no impact
- Temporary works in the tunnel in the form of steel arch supports, rock bolts and sprayed concrete will be installed to form a reinforced rock arch support allowing the tunnel to be excavated without causing risk of collapse

<u>Construction of western approach to the tunnel (Section 3)</u>

Retaining systems will be installed to retain the Annex I habitat where required, this is generally where there is insufficient area (footprint) for self-supporting earthworks slopes between the existing ground level and to 17.7mOD as outlined in Box 2b. These locations area known as ‘pinch points’.

Retaining systems are dependent on the ground conditions in the pinch point locations. The proposed retaining systems that will be used to control these impacts include:

1. Rock bolts, rock dowels, steel mesh, sprayed concrete in areas of rock only
2. Piled retaining walls, supported with ground anchors in areas of overburden only and in areas with a combination of overburden and rock

The exposed rockface surrounding the western tunnel portal will be continuously assessed during excavation. Where required stability control measures will be implemented in the form of rock bolts, steel mesh and sprayed concrete.

3.2.4 Habitat degradation – water quality (construction)

Mitigation measures relating to the risk to water quality posed by construction works associated with all GTS elements are included in Box 4.

Box 4: Mitigation measures relating to habitat degradation, through construction-related water quality impacts, affecting European Sites

GTS – Habitat degradation – water quality (construction)

As part of the design phase, all GTS projects will assess the risk of construction works affecting water quality. This will consider factors such as: the nature and scale of the works proposed; materials to be used (e.g. hazardous chemicals/substances such as hydrocarbons and cement based products); and the presence of, or proximity of the construction site to, potential pollution pathways via surface water or drainage features.

Best practice construction methodologies will be followed in relation to the protection of watercourses in accordance with the following guidance, where applicable:

- Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters (Inland Fisheries Ireland, 2016)
- Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes (National Roads Authority, 2008)
- CIRIA C648: *Control of water pollution from linear construction projects: Technical Guidance*
- CIRIA C649: *Control of water pollution from linear construction projects: Site guide*

Where risks are identified, a pollution control plan will be prepared. The pollution control plan will include sufficient pollution control measures to ensure that silt, runoff, water pumped from excavations, cement based compounds, hydrocarbons, or any other hazardous chemicals would not significantly affect water quality in any receiving drainage features, watercourses, or waterbodies. Sufficient detail will be included in the pollution control plan to demonstrate that all measures included therein, will adequately address all the identified impact pathways and associated risks and will not affect water quality in receiving watercourses to a degree, either alone or in-combination with any other plans or projects, that would adversely affect the integrity of any European Sites.

3.2.5 Habitat degradation – water quality (operation)

Mitigation measures relating to the implementation of the Park & Ride facilities are included in Box 5a; those relating to the operational risk to water quality posed by new road infrastructure are included in Box 5b.

Box 5a: Mitigation measures relating to habitat degradation as a result of water quality impacts during operation affecting European Sites – Park & Ride Facilities

GTS – Habitat degradation – water quality (operation) – Park & Ride Facilities

The design of Park & Ride facilities will include sufficient pollution control measures to ensure that run-off or drainage discharges do not impact upon water quality in receiving watercourses resulting in adverse effects on the integrity of any European Sites, either alone or in-combination with any other plans or projects.

The type, design and scale of all pollution control measures will be appropriate to the scale and capacity of each Park & Ride site.

Pollution control measures will be monitored and maintained to ensure their effectiveness.

If required, at such time that future expansion or increases in capacity at the Park & Ride sites are required, pollution control measures will be upgraded to maintain the levels of pollution control required to protect water quality in receiving European Sites.

Box 5b: Mitigation measures relating to habitat degradation as a result of water quality impacts during operation affecting European Sites – New Road Developments

GTS – Habitat degradation – water quality (operation) – New Road Developments

The design of new road developments will include sufficient pollution control measures to ensure that run-off or drainage discharges do not impact upon water quality in receiving watercourses resulting in adverse effects on the integrity of any European Sites, either alone or in-combination with any other plans or projects.

The type, design and scale of all pollution control measures will be appropriate to the scale and capacity of the proposed road development. These may include grassed channels, swales, filter drains, wetlands, attenuation/detention/infiltration ponds, or other Sustainable Urban Drainage System (SUDS) measures.

Pollution control measures will be monitored and maintained to ensure their effectiveness.

3.2.6 Habitat degradation – shading

Mitigation measures relating to habitat degradation as a result of shading impacts are included in Box 6.

Box 6: Mitigation measures relating to habitat degradation through shading impacts affecting European Sites

GTS – Habitat degradation – shading

To inform the bridge designs, a habitat survey of all areas potentially at risk of shading impacts from a bridge structure will be carried out. The survey will identify and classify the habitat types present (in accordance with the most recently published Annex I habitat classification guidance documents) to determine whether affected habitat areas correspond with any of the QI Annex I habitats for which Lough Corrib SAC or Galway Bay Complex SAC are selected, and are at risk of shading related impacts. Effects on any area of QI habitat could affect the conservation objectives supporting the habitat’s conservation condition, resulting in an adverse effect on Site integrity.

Where any such impacts are identified, alternative locations and/or designs will be developed to ensure that the bridge structures will not adversely affect the integrity of any European Sites, either alone or in-combination with any other plans or projects, as a result of shading impacts.

Considering the general locations provided for these bridge structures, and the ecological information and assessment required to be carried out to inform their design, it is reasonable to assume that at the detailed design stage any potential for a project element to impact on the European Site as a result of shading impacts could, and will, be resolved through the exploration of alternative locations or designs whilst still fulfilling their function/role in supporting the overarching vision, guiding principles and strategic objectives/aims of the GTS.

3.2.7 Habitat Degradation – Air Quality

Mitigation measures to protect European Sites from potential air quality impacts are included in Box 7.

Box 7: Mitigation measures relating to European Sites from air quality impacts associated with the GTS

GTS - Habitat Degradation – Air Quality

As part of the N6 GCRR design phase, an air quality assessment will be carried out to determine the air quality baseline and model/predict the air quality ZoI and increases in contaminants associated with the proposed road development (e.g. nitrogen oxides, particulate matter and heavy metals).

All habitats within European Sites, and within the air quality ZoI, will be surveyed to identify and classify the habitat types present (in accordance with the most recently published Annex I habitat classification guidance documents) to determine whether impacted habitat areas correspond with any of the QI Annex I habitats for which Lough Corrib SAC is selected and are at risk of air quality impacts, or any area of supporting habitat that in turn affects the QI habitat. These habitats will also be assessed in the context of whether they support any QI species of the SAC.

Where it is determined that there are habitats at risk from air quality related impacts, appropriate mitigation measures will be designed and implemented to ensure that the N6 GCRR will not adversely affect the integrity of Lough Corrib SAC, either alone or in-combination with any other plans or projects.

Best practice construction methods will be applied in relation to all construction work associated with GTS projects to minimise dust emissions during construction. Mitigation measures to prevent wind-blown dust affecting sensitive habitats will be implemented to prevent any long-term effects on QI habitats or adverse effects on the integrity of any European Sites. Such mitigation measures may include watering of the construction site/access roads, road cleaning, vehicle speed restrictions, and temporary physical barriers to prevent wind-blown dust.

3.2.8 Habitat Degradation – Non-native Invasive Species

Mitigation measures to protect European Sites from impacts associated with non-native invasive species are included in Box 8.

Box 8: Mitigation measures relating to habitat degradation from non-native invasive species affecting European Sites

GTS - Habitat Degradation – Non-native Invasive Species

All elements of the GTS will establish, through an appropriate level of survey, whether non-native species (listed on Schedule 3 of the European Communities (Birds and Natural Habitats) Regulations, 2011) are present in any areas affected by the proposed construction works or operational maintenance works.

If present, the species will be identified, locations mapped and an invasive species management plan prepared detailing the handling and control measures that will be implemented to ensure that the species concerned, or contaminated vector material, will be eradicated from the construction site and will not be allowed to spread or be introduced to other areas.

The invasive species management plan will also include management and control measures to prevent maintenance regimes during operation from spreading non-native invasive species where there is a risk of the project site becoming recolonised from any other infested areas.

3.2.9 Disturbance/Displacement

Mitigation measures to protect European Sites from potential impacts associated with disturbance or displacement effects are included in Box 9.

Box 9: Mitigation measures relating to disturbance or displacement effects affecting European Sites

GTS – Disturbance/Displacement

Otter, Atlantic salmon, Sea lamprey, Brook lamprey (Lough Corrib SAC)

Otter, Harbour seal (Galway Bay Complex SAC)

An appropriate level of survey will be required to identify if, and how, QI species utilise habitat areas potentially affected by disturbance/displacement effects associated with any elements in the GTS. The results of these surveys and any assessment defining the disturbance/displacement ZoI, will be sufficient to adequately inform an assessment (and definitively support its conclusions) as to whether the predicted disturbance/displacement effects would affect the conservation objectives supporting the species' favourable conservation status, and thus adversely affect the integrity of the SPA.

Where disturbance or displacement effects are predicted, appropriate mitigation measures will be designed and implemented to ensure that GTS elements will not adversely affect the integrity of the SPA, either alone or in-combination with any other plans or projects, via this impact pathway.

If, despite the implementation of mitigation measures, there remains a risk that disturbance or displacement will adversely affected the integrity of any European Site(s), the project will not be progressed unless an alternative solution can be implemented which avoids/reduces the impact to a level that the integrity of the European Site(s) is(are) unaffected.

Lesser horseshoe bat (Ross Lake and Woods SAC)

An assessment will be made, based on an appropriate level of survey work to definitively support its conclusion, as to whether any disturbance or displacement effects associated with the Galway to Oughterard Greenway will affect the conservation objectives supporting the favourable conservation status of the Lesser horseshoe bat roost for which the Ross Lake and Woods SAC is designated, and thus adversely affect the integrity of the SAC; and

Where disturbance or displacement effects are predicted, appropriate mitigation measures will be designed and implemented to ensure that the greenway will not adversely affect the integrity of the SAC, either alone or in-combination with any other plans or projects, via this impact pathway.

If, despite the implementation of mitigation measures, there remains a risk that disturbance or displacement will adversely affected the integrity of Ross Lake and Woods SAC, the portion of the greenway concerned will not be progressed unless an alternative can be implemented which avoids/reduces the impact to a level that the integrity of the European Site(s) is(are) unaffected..

Wintering and Breeding Birds (Lough Corrib SPA, Inner Galway Bay SPA)

An appropriate level of survey will be required to identify if, and how, SCI bird species utilise habitat areas potentially affected by disturbance/displacement effects associated with any elements in the GTS. This includes habitat areas within the SPA boundaries and important ex-situ habitat areas remote from the SPA. The results of these surveys and any assessment defining the disturbance/displacement ZoI, will be sufficient to adequately inform an assessment (and definitively support its conclusions) as to whether the predicted disturbance/displacement effects would affect the conservation objectives supporting the species' favourable conservation status, and thus adversely affect the integrity of the SPA.

Where disturbance or displacement effects are predicted, appropriate mitigation measures will be designed and implemented to ensure that GTS elements will not adversely affect the integrity of the SPA, either alone or in-combination with any other plans or projects, via this impact pathway.

If, despite the implementation of mitigation measures, there remains a risk that disturbance or displacement will adversely affected the integrity of any European Site(s), the project will not be progressed unless an alternative solution can be implemented which avoids/reduces the impact to a level that the integrity of the European Site(s) is(are) unaffected.

3.2.10 Barrier Effect

Mitigation measures to protect European Sites from impacts associated with barrier effect are included in Box 10.

Box 10: Mitigation measures relating to barrier effects affecting European Sites

GTS – Barrier Effect

Otter, Atlantic salmon, Sea lamprey, Brook lamprey (Lough Corrib SAC)

Otter, Harbour seal (Galway Bay Complex SAC)

Best practice will be followed in relation to bridge/culvert construction and design (including installing dedicated mammal passage facilities) to prevent barrier effects occurring on affected watercourses, in accordance with the following guidance, where applicable:

- Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters (Inland Fisheries Ireland, 2016)
- Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes (National Roads Authority, 2008)

A construction methodology and construction management plan will be prepared in relation to all bridge structures; both permanent structures and those installed temporarily to facilitate construction works. This will contain sufficient detail regarding the construction methodology and control measures in order to demonstrate that the construction works will not pose a barrier to aquatic species and will not adversely affect the integrity of any European Sites, either alone or in-combination with any other plans or projects, via this impact pathway.

If, despite the implementation of mitigation measures, there remains a risk that the project will adversely affected the integrity of any European Site(s) via this impact pathway, the project will not be progressed unless an alternative solution can be implemented which avoids/reduces the impact to a level that the integrity of the European Site(s) is(are) unaffected.

Lesser horseshoe bat (Ross Lake and Woods SAC)

If the Galway to Oughterard Greenway will be located within 2.5km of the Lesser horseshoe bat roost for which the Ross Lake and Woods SAC is designated an assessment will be made, based on an appropriate level of survey work to definitively support its conclusion, as to whether any predicted barrier effect will affect the conservation objectives supporting the species' favourable conservation status, and thus adversely affect the integrity of the SAC.

Where a barrier effect is predicted, appropriate mitigation measures will be designed and implemented to ensure that the greenway will not adversely affect the integrity of the SAC, either alone or in-combination with any other plans or projects, via this impact pathway.

If, despite the implementation of mitigation measures, there remains a risk that the barrier effect will adversely affected the integrity of Ross lake and Woods SAC, the portion of the greenway concerned will not be progressed unless an alternative can be implemented which avoids/reduces the impact to a level that the integrity of the European Site(s) is(are) unaffected.

3.2.11 Mortality Risk

Mitigation measures to protect European Sites from mortality risk impacts are included in Box 11.

Box 11: Mitigation measures relating to mortality risk affecting European Sites

GTS – Mortality Risk

Otter (N6 GCRR operation) – [Lough Corrib SAC, Galway Bay Complex SAC]

Mammal resistant fencing will be required to prevent Otter gaining access to the proposed road carriageway. The fencing will be constructed as per the specification described in the *Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes* (National Roads Authority, 2008). The precise location and extent of mammal resistant fencing in association with providing access under the proposed road will be finalised as part of the design process and will be based upon an appropriate level of survey to ensure that the proposed road development poses no mortality risk to the Otter population of Lough Corrib SAC, either alone or in-combination with any other plans or projects. The effectiveness of the mammal-resistant fencing will be monitored and maintained post-construction.

Otter, Atlantic salmon, Sea lamprey, Brook lamprey, Harbour seal (construction works over water)

Best practice construction methodologies will be followed in relation to the protection of watercourses in accordance with the following guidance, where applicable:

- Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters (Inland Fisheries Ireland, 2016)
- Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes (National Roads Authority, 2008)

A construction methodology and construction management plan will be prepared in relation to each of the proposed bridge structures. This will contain sufficient detail regarding the construction methodology and control measures in order to demonstrate that the construction works pose no mortality risk to aquatic species beneath the construction zone and will not adversely affect the integrity of any European Sites, either alone or in-combination with any other plans or projects, via this impact pathway.

Wintering and Breeding Birds - bridge collision risk [Lough Corrib SPA, Inner Galway Bay SPA]

An appropriate level of survey will be required to identify if, and how, SCI bird species utilise habitat areas where new bridge structures are proposed. This will form the basis of an assessment as to what potential collision risk a bridge structure would pose to the bird species concerned, based on the location of the bridge structure and the design being considered. As part of an iterative process, the results of this assessment will also inform the bridge design. The design process will have regard to those design elements that contribute to the overall level of potential collision risk posed by bridge structures, with a view to minimising any such risk. Such design elements include deck profile and depth, height above the ground/river, and the design of the supporting structures (e.g. extent, height and density of supporting cables or piers). If an unacceptable level of risk remains, additional mitigation strategies will be explored to support a conclusion that any residual risk would not affect the conservation objectives supporting the favourable conservation condition of the SPAs SCI bird species, either alone or in-combination with any other plans or projects.

If, despite the implementation of mitigation measures, there remains a risk that the project will adversely affected the integrity of any European Site(s) via this impact pathway, the project will not be progressed unless an alternative solution can be implemented which avoids/reduces the impact to a level that the integrity of the European Site(s) is(are) unaffected.

3.3 How the Mitigation Measures Ensure the Removal of Risks of Adverse Effects on the Integrity of European Sites

Considering the potential impact pathways associated with the GTS, the relevant plan level environmental protection policies and the mitigation measures specific to the GTS included in Section 3.2, it was concluded that all GTS elements are capable of being implemented without having adverse effects on the integrity of any European Sites, provided all the requirements are met at the planning application/consent level.

Mitigation measures will ensure that any planning application, or consent process to permit any projects proposed in the GTS, that does not provide the required information or prove beyond reasonable scientific doubt that the mitigation provided at the site-specific level will meet the requirements of this NIS and the County/City Development Plan documentation, will not be permitted.

Examples of the different types of mitigation measures that ensure that the GTS will not adversely affect the integrity of any European Sites are provided below:

Mitigation measures that reinforce statutory requirements

The Galway County Development Plan 2015-2021 and the Galway City Council Draft Development Plan 2017-2023 include environmental protection policies that set out the requirement for AA at the project level. Although this is a point of law rather than specific mitigation, they are included in this NIS as overarching policies that will ensure that GTS projects will not adversely affect the integrity of any European Sites, to reinforce its application at the project level and that development applications that do not follow statutory requirements will not be permitted.

For example:

- GCiDP 04 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance)
- GCoDP 01 (Development Strategy Objectives - Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment)

Mitigation measures for GTS elements that lack geographic specificity.

Some projects proposed in the GTS are not described with reference to defined locations (e.g. greenways) which would be needed to permit a “complete” assessment in so far as site-specific impacts could be described. In such cases, the mitigation measures set out the specific baseline information required to inform an assessment and its conclusions, and the mitigation requirements to address any potential impacts. In some cases, this proposed mitigation includes for a scenario that where adverse effects cannot be ruled out, that the project concerned or part thereof, will not be progressed.

Mitigation measures relating to specific strategy elements and specific impacts

Some elements of the GTS are described in relation to a specific location or will result in a specific impact type and therefore, more detail describing and supporting the mitigation measures and its effectiveness are included.

For example:

- Box 2b: GTS – Hydrogeology N6GCRR
- Box 3: GTS – Habitat degradation – tunnelling/excavation
- Box 11: GTS – Mortality Risk Otter (N6 GCRR operation)

3.4 Responsibilities for Implementing Mitigation Policies

The responsibility for implementing the mitigation measures lies with the Planning Authority granting the consent for individual projects proposed by the GTS through the planning consent process: An Bord Pleanála, Galway County Council or Galway City Council.

Planning applications/consents are obliged to ensure that their application is consistent with the policies, objectives and requirements of the GTS and the supporting County and City Development Plans.

The statutory requirement for the Planning Authority to carry out AA Screening for all planning applications/consents is not affected by any of the statements in this NIS. All applications must be tested for the potential for likely significant effects. However, such effects are not likely to occur if the environmental protection policies in the Galway County and City Development Plans and their requirements are adhered to, in conjunction with the specific mitigation measures included within this NIS and the GTS.

All planning applications must provide sufficient information to allow the Competent Authority to screen the application and decide if full AA is required.

Chapter 10 of the GTS sets out the process by which the various GTS project elements will be implemented, with reference to the Appropriate Assessment process and the various steps therein.

3.5 Monitoring the Implementation of Policies

Whilst there is no legal requirement to monitor the outputs of the AA process, there is an obligation to monitor the implementation of the Galway County and City Development Plans through the E.C. SEA Directive as implemented in Ireland. Contingency measures may have to be applied if there is evidence that elements of the GTS cannot be implemented successfully. The European Communities (Environmental Liability) Regulations 2008 will also apply in the event of any significant environmental damage to habitats and species both within and outside of the European Sites.

3.6 In-Combination Assessment

Plans and projects located within the ZoI of the GTS were assessed in terms of their potential to act in-combination with the GTS in adversely affecting European Site integrity, via the identified impact pathways.

European Sites that had the potential to be affected by a specific plan or project, acting in-combination with the GTS, were identified; the results of which are presented in Appendix E Table E-1 of this NIS. In order for any other plan or project to act in-combination with the GTS, there first had to be the potential for any element of the GTS, in isolation, to adversely affect the same European Site as one of these other plans/projects via potential impact pathways. Each of these other plans or projects, where the potential for in-combination effects with the GTS was identified, was further analysed to ascertain the likelihood of this impact occurring; the results of which are presented in Appendix E Table E-2 of this NIS. This analysis involved first determining whether or not any of these other plans or projects alone would have an adverse effect on European Site integrity; referring to the conclusions of the plan or project's Appropriate Assessment Screening Statement or Natura Impact Report/Statement where available, and then assessing the plan or project in terms of the GTS and its specific mitigation measures.

Following on from this strategic-level in-combination assessment, it has been concluded that there is no potential for adverse effects to arise as a consequence of the implementation of any element of the GTS acting in-combination with any other plans or projects located within the ZoI of the GTS. This is due to the following reasons (see Appendix E Table E-2 of this NIS for more details):

- Any plan or proposed project will have to adhere to the overarching policies and objectives of the Galway County Development Plan 2015-2021and the Galway City Draft Development Plan 2017-2023, as dependent on the location of the specific plan or proposed project. These policies and objectives will ensure the protection of European Sites across all identified potential impact pathways, and will include the requirement for any development to undergo Screening for Appropriate Assessment and/or Habitats Directive Assessment and demonstrate that the project will not give rise to any adverse direct, indirect or secondary effects on the integrity of any European Site
- National, regional or local plans contain specific policies, objectives, development standards and/or guidelines that will ensure the protection of European Sites from adverse effects that could arise via any of the potential impact pathways
- No adverse effects on European Site integrity will arise from the specific proposed projects identified as part of the in-combination assessment, due to project-specific mitigation measures outlined in their respective NIS/EIS, where available
- No adverse effects on European Site integrity will arise from the implementation of the GTS alone. This is due to the requirement of any project arising from the GTS to adhere to the mitigation measures for each of its potential impact pathways outlined in Section 3.2 of this NIS

To conclude, no adverse effects on European Site integrity will arise from the implementation of the GTS acting in-combination with any plans or projects located within the ZoI of the strategy.

3.7 NIS Conclusion

As documented in the NIS, following an examination, analysis and evaluation of the GTS, in light of best scientific knowledge, including in particular the nature of the predicted impacts from the GTS elements and with the implementation of the mitigation measures proposed, it has been objectively concluded that the GTS does not pose a risk of adversely affecting the integrity of any European Sites, either alone or in-combination with other plans or projects.

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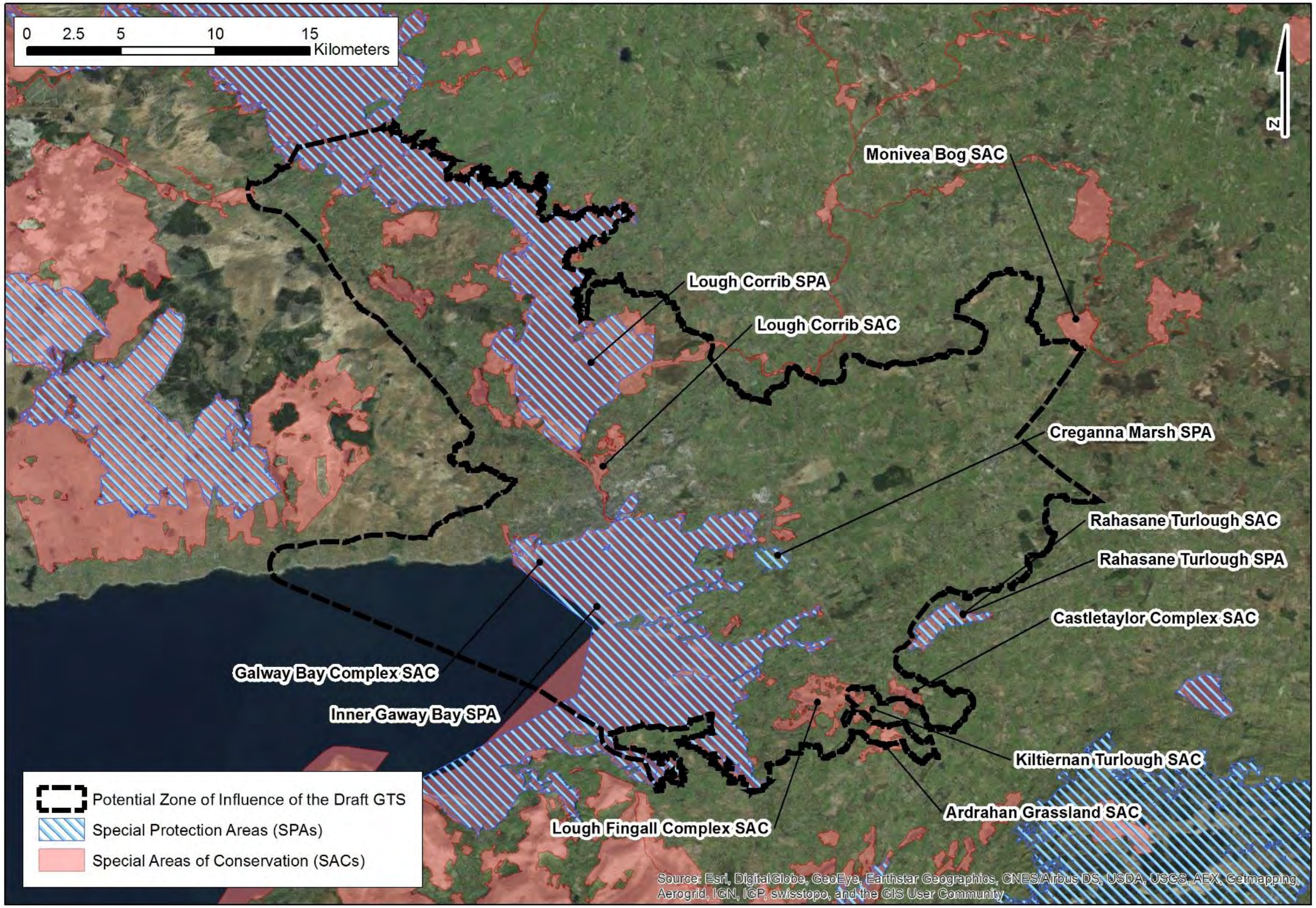
Figures

Figure 1: European Sites within the potential Zone of Influence (ZoI) of the Galway Transport Strategy (GTS)



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 2a: N6 Galway City Ring Road (N6 GCRR) - Habitat Areas within Lough Corrib SAC at the proposed River Corrib Crossing: Habitat Classifications after Fossitt (2000)

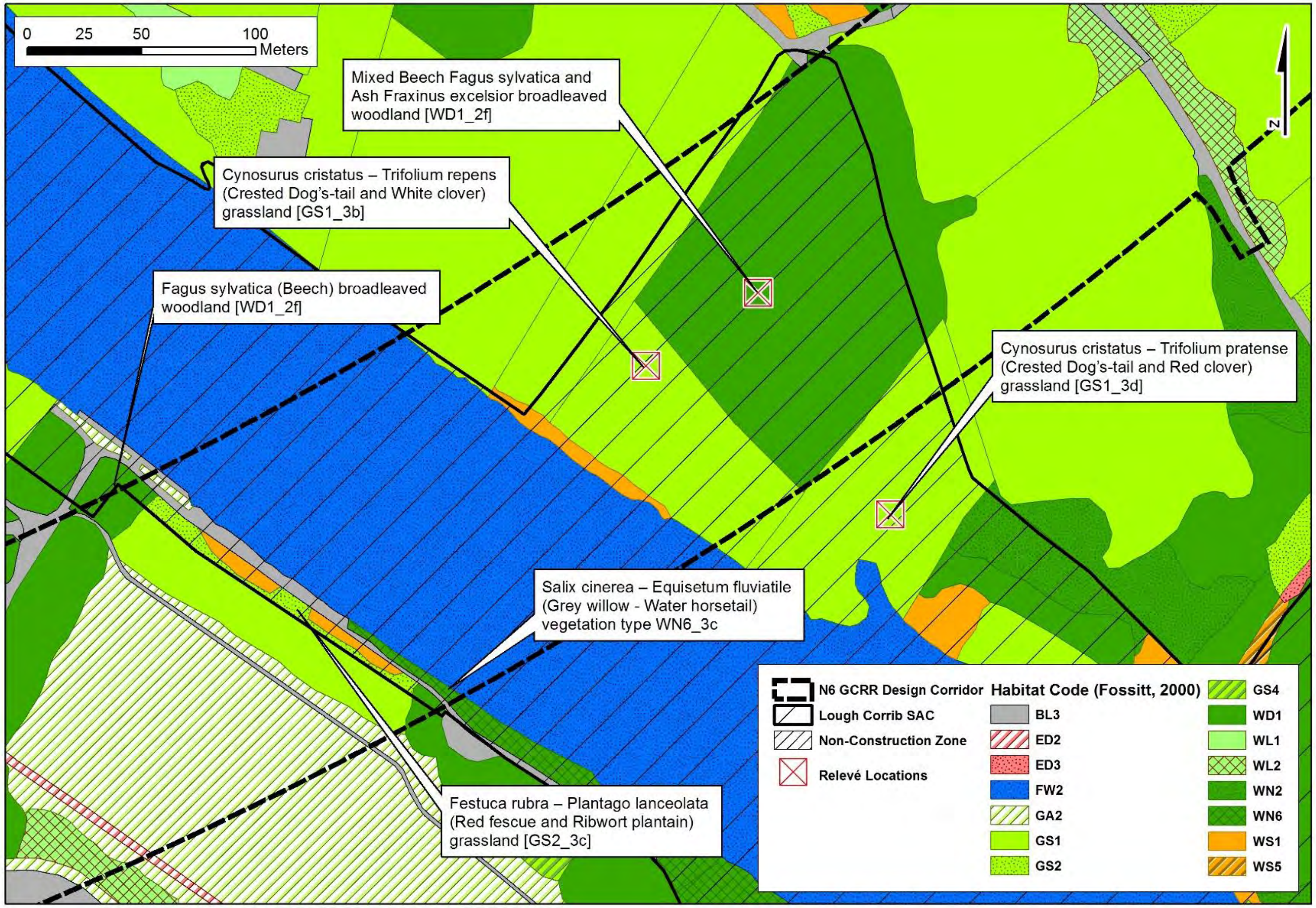


Figure 2b: N6 Galway City Ring Road (N6 GCRR) - Habitat Areas within Lough Corrib SAC at the proposed River Corrib Crossing: Annex I Habitat Classifications

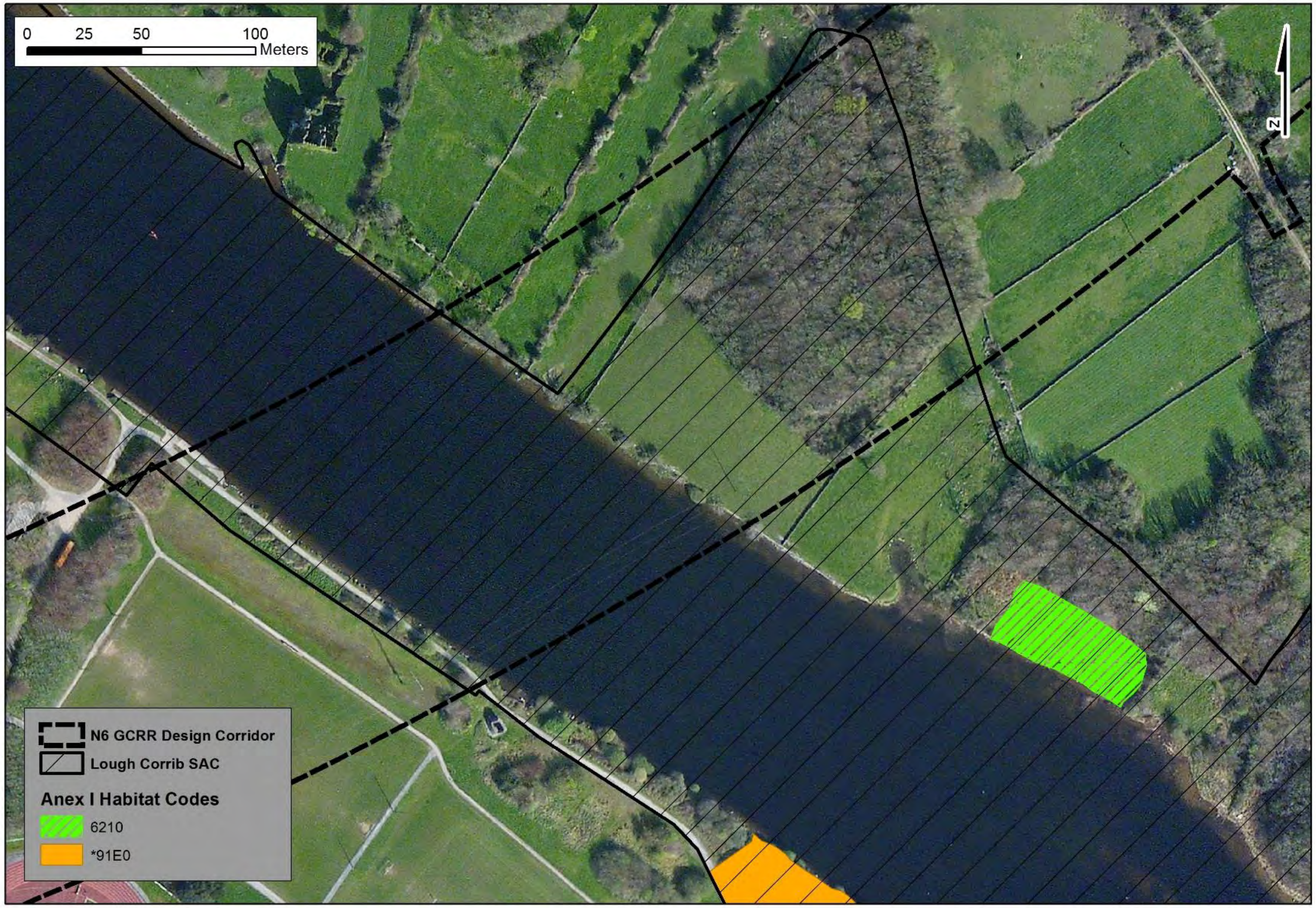
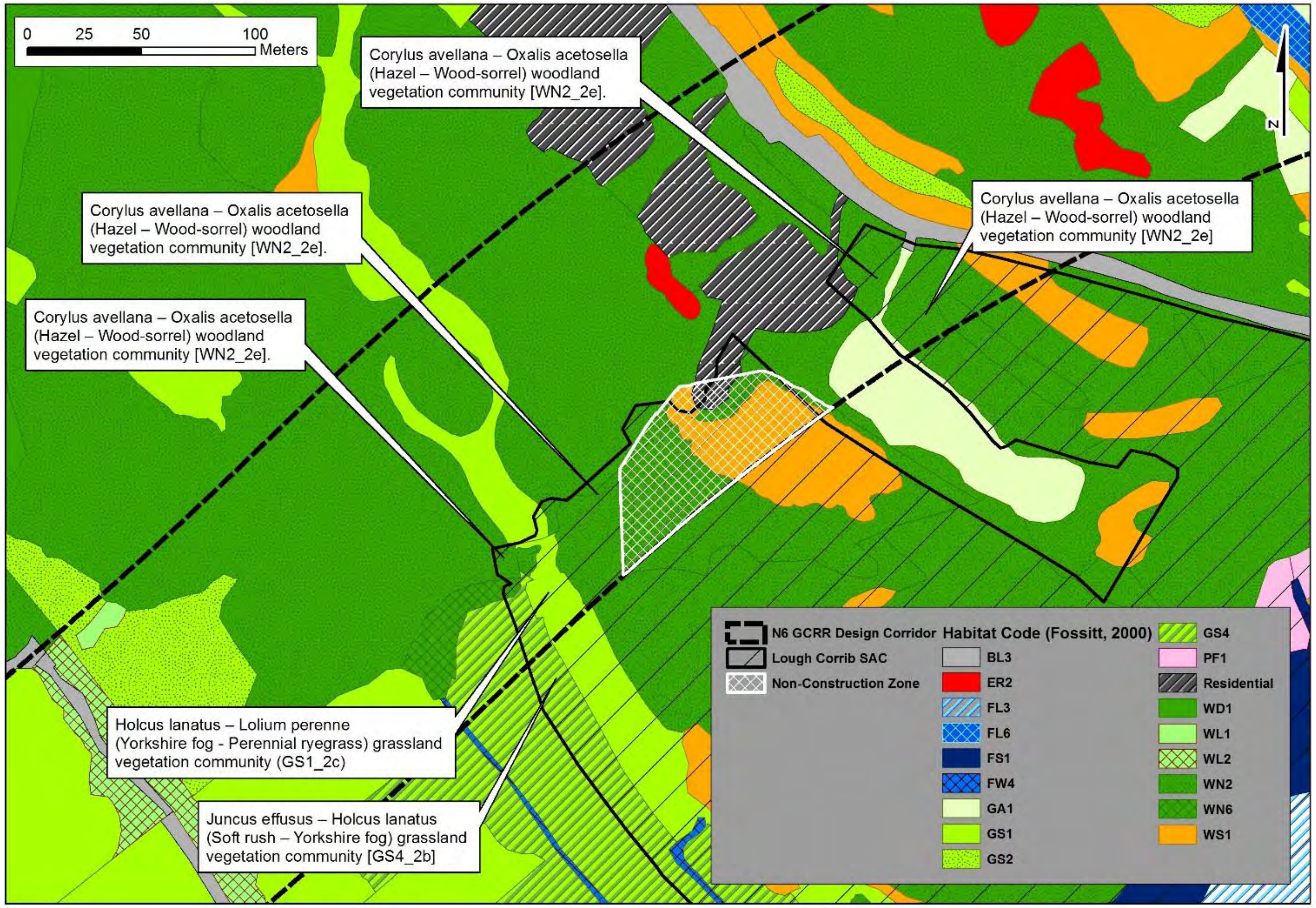


Figure 2c: N6 Galway City Ring Road (N6 GCRR) - Habitat Areas within Lough Corrib SAC west of the Coolagh Lakes: Habitat Classifications after Fossitt (2000)



Corylus avellana – Oxalis acetosella (Hazel – Wood-sorrel) woodland vegetation community [WN2_2e].

Corylus avellana – Oxalis acetosella (Hazel – Wood-sorrel) woodland vegetation community [WN2_2e].

Corylus avellana – Oxalis acetosella (Hazel – Wood-sorrel) woodland vegetation community [WN2_2e].

Corylus avellana – Oxalis acetosella (Hazel – Wood-sorrel) woodland vegetation community [WN2_2e]

Holcus lanatus – Lolium perenne (Yorkshire fog - Perennial ryegrass) grassland vegetation community (GS1_2c)

Juncus effusus – Holcus lanatus (Soft rush – Yorkshire fog) grassland vegetation community [GS4_2b]

Figure 2d: N6 Galway City Ring Road (N6 GCRR) - Habitat Areas within Lough Corrib SAC west of the Coolagh Lakes: Annex I Habitat Classifications

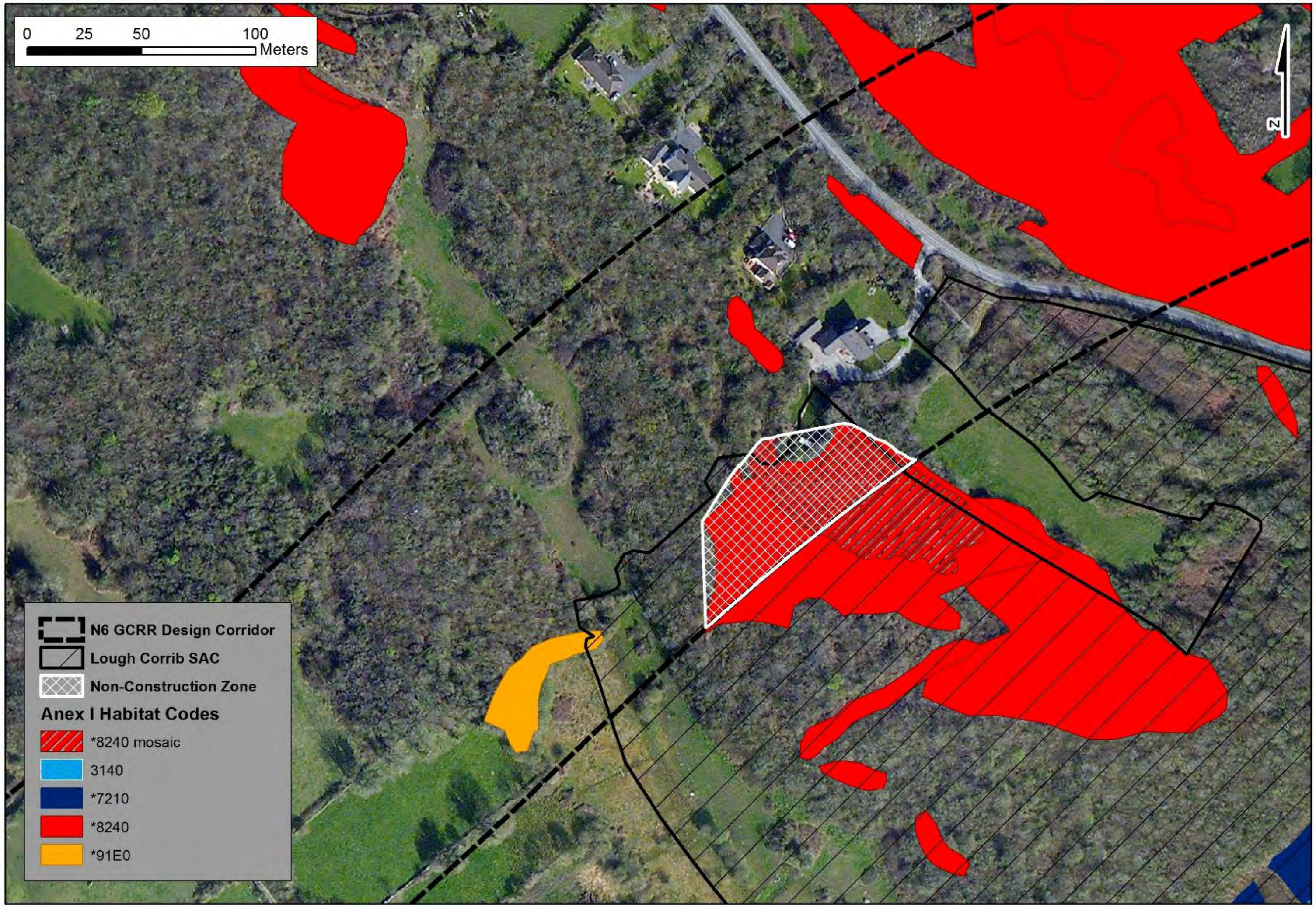


Figure 2e: N6 Galway City Ring Road (N6 GCRR) - Habitat Areas within Lough Corrib SAC at Lackagh Quarry: Habitat Classifications after Fossitt (2000)

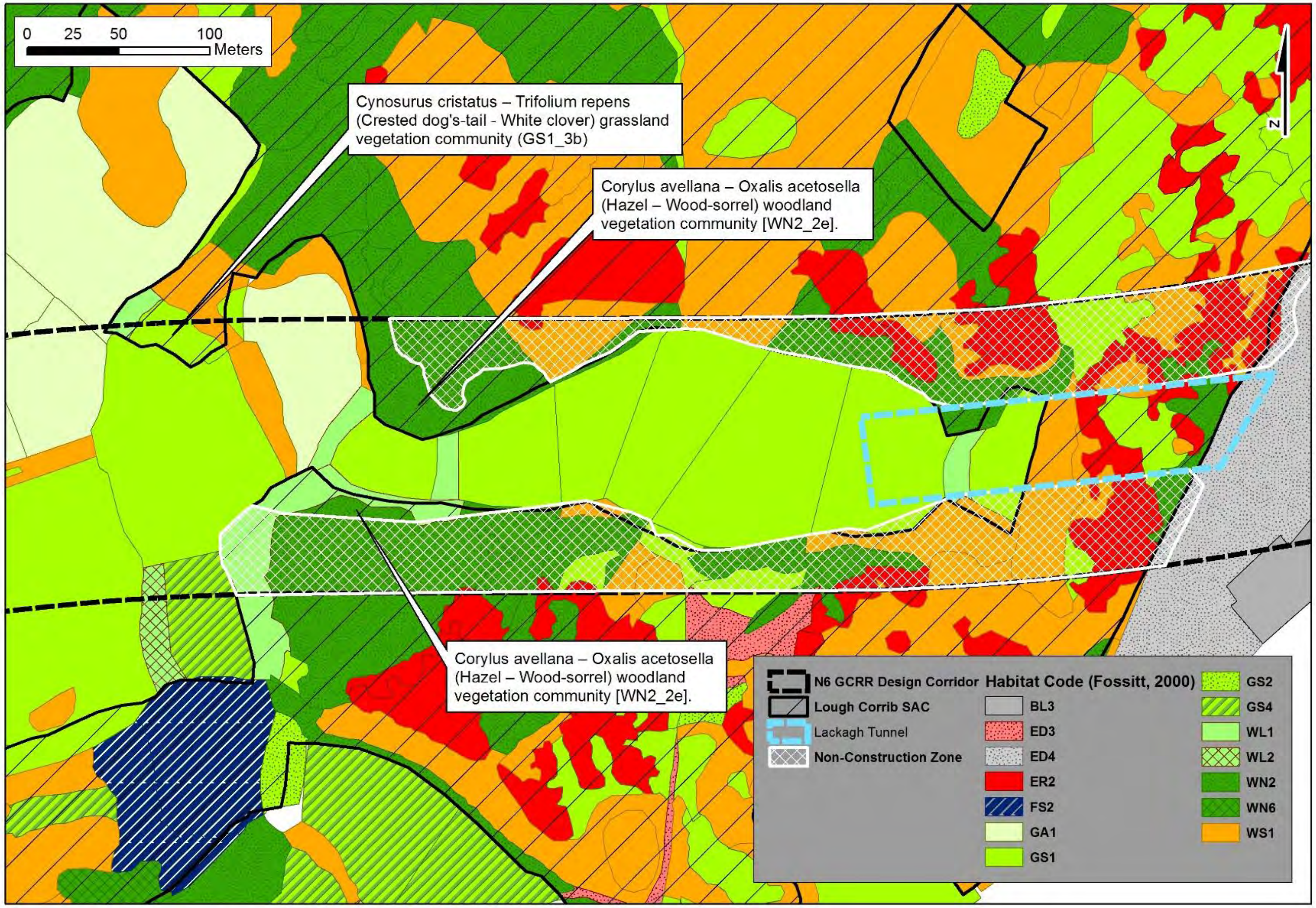
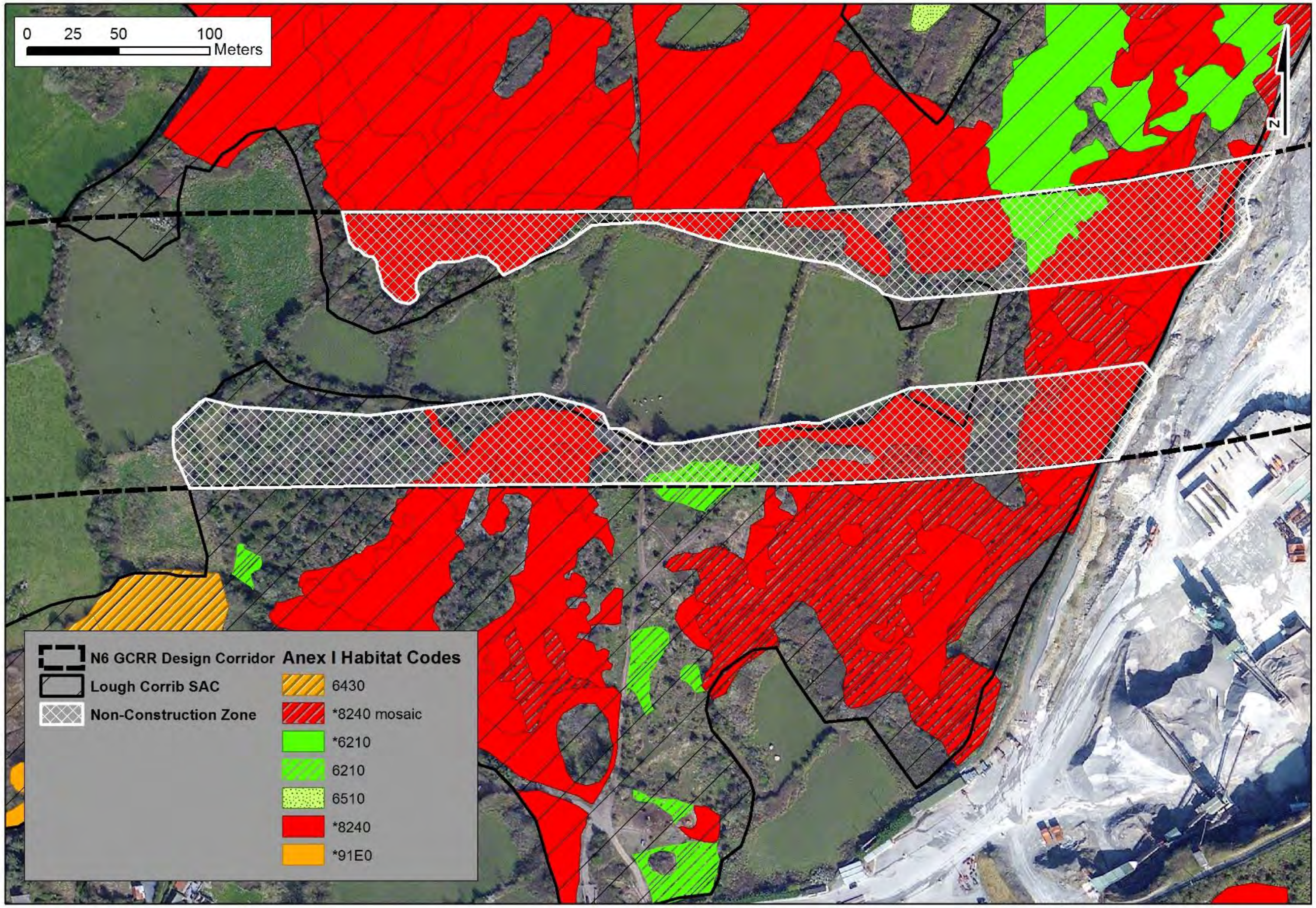


Figure 2f: N6 Galway City Ring Road (N6 GCRR) - Habitat Areas within Lough Corrib SAC at Lackagh Quarry: Annex I Habitat Classifications



Appendix A

Potential for the various Galway Transport Strategy (GTS) Elements to Adversely Affect the Integrity of European Sites

A1

Appendix A presents the results of the first stage of the assessment carried out to examine and analyse all elements of the GTS in order to determine which have the potential to adversely affect the integrity of European Sites.

The more detailed, second stage of this assessment is included in Appendix B.

Table A-1: Potential for Overall Vision, Guiding Principles, Strategic Objectives, Strategic Aims, Supporting Measures, and Complementary Measures to Adversely Affect the Integrity of European Sites and Corresponding Mitigation Measures

Element of the GTS	Potential for adverse effects on European Site integrity?
Overall Vision	
To create a connected city region driven by smarter mobility	Yes. Whilst there is no spatial reference associated with this, achieving the overall vision of the GTS requires the delivery/promotion of additional transport infrastructure which has the potential to adversely affect the integrity of European Sites.
Guiding Principles	
1) To promote and encourage sustainable transport, and in particular to make it convenient and attractive to walk, cycle or use public transport. **2) To improve accessibility and permeability to, and within, the city centre for pedestrians, cyclists and public transport users, while also maintaining an appropriate level of access for vehicular traffic for commercial and retail purposes.** **3) To maximise the safety and security of pedestrians, cyclists and other transport users, particularly within the core city centre.** **4) To manage and increase transport capacity, where necessary, for the efficient movement of people and goods into and within the city.** **5) To provide opportunities to enhance the city centre Public Realm through traffic management and transport interventions.** **6) To maintain and develop transport infrastructure and services to a high degree of quality and resilience.** **7) To adopt a 'smarter technology' approach to all transport interventions, whereby transport infrastructure and services are future-proofed.**	Yes. Whilst there is no spatial reference associated with this, adhering to the guiding principles of the GTS requires the delivery/promotion of additional transport infrastructure which has the potential to adversely affect the integrity of European Sites.
Strategic Objectives and Key Performance Indicators	
Economic	
Ensure value for money in the implementation of proposals Utilisation of existing infrastructure and extent of new infrastructure requirements	No potential to adversely affect the integrity of any European Sites for adverse effects on European Site integrity.

Element of the GTS	Potential for adverse effects on European Site integrity?
Support Galway City's function as a regional centre for employment, education, retail, leisure and tourism by providing access for all through an efficient and reliable transport network Peak hour journey times by mode capacity versus demand congestion	Yes, as creating an efficient and reliable transport network requires the provision of many elements of the GTS, some of which have the potential to adversely affect the integrity of European Sites – refer to Strategic Aims below.
Safety	
Develop a safer environment for all transport modes and users Safety implications of all interventions, and provision of traffic management measures	No potential to adversely affect the integrity of any European Sites
Exploit transport's role in facilitating a healthier lifestyle Measures which support walking and cycling	Yes, as improving the attractiveness and functioning of the cycle and pedestrian network in Galway City and its environs requires the provision of many elements of the GTS, some of which have the potential to adversely affect the integrity of European Sites – refer to Strategic Aims below.
Environmental	
Provide opportunities for better integration between transport and urban form Reduction in traffic volumes in sensitive areas	Yes, as targeted reductions in traffic volumes in unspecified areas may be reliant on the provision of many elements of the GTS, some of which have the potential to adversely affect the integrity of European Sites – refer to Strategic Aims below.
Minimise harmful transport emissions Transport emissions	No potential to adversely affect the integrity of any European Sites
Integration	
Support integration between sustainable transport and land use planning and policies Compatibility of transport measures with local, regional and national spatial planning and transport policy	Yes, as some of the land-use principles have the potential to adversely affect the integrity of European Sites – refer to land-use principles section in Strategic Aims below.
Provide for better transport integration Provision of Park & Ride facilities and public transport interchange opportunities	Yes, as the provision of park & ride facilities has been assessed as having the potential to adversely affect the integrity of European Sites – refer to park & ride principles section in Strategic Aims below.

Element of the GTS	**Potential for adverse effects on European Site integrity?**
Accessibility and Social Inclusion	
Improve multi-modal accessibility within residential, employment and retail centres Accessibility by walking and cycling, public transport, car and HGV	Yes, as improving multi-modal accessibility may require the provision of many elements of the GTS, some of which have the potential to adversely affect the integrity of European Sites – refer to Strategic Aims below.
Provide a socially inclusive transport network Coverage and quality of service of public transport network	Yes, as improving the coverage and quality of the public transport network requires the provision of many elements of the GTS, some of which have the potential to adversely affect the integrity of European Sites – refer to Strategic Aims below.

Strategic Aim	**Proposed Measures**	**Potential for adverse effects on European Site integrity?**
Traffic Network		
City Centre Traffic management		
Reduce through-car movement and traffic speeds in the city centre.	It is proposed to arrange the city centre road network such that there is a 'city centre access network' (made up of sections of road circumventing the core city centre area of Galway, rather than a continuous road) along sections of the following roads: • Lough Atalia Road; • Dock Road/Merchants Road; • Wolfe Tone Bridge; • Father Griffin Road; • The Crescent; • St. Mary's Road; • Lower Newcastle Road; • Quincentenary Bridge; • Sean Mulvoy Road; and • Moneenageisha Road. The city centre access network will provide access to the city centre and a through route for local journeys. A secondary network of road access routes will also	Yes. Whilst designating a series of existing roads as an access network, changing traffic priorities at junctions and changing existing traffic movements in themselves will not adversely affect the integrity of any European Sites, facilitating this process will require the provision of many of the other elements of the GTS, some of which have the potential to adversely affect the integrity of European Sites.

Element of the GTS	**Potential for adverse effects on European Site integrity?**	
	provide access to car parks (including Fairgreen Road, Bóthar Na mBan and Headford Road).	
Prioritise Public Transport movements in the city centre.	A public transport route, the 'Cross-City Link', is to be implemented through the core city centre area (with restrictions on other traffic). The Cross-City Link is routed along University Road, across Salmon Weir Bridge, along Eglinton Street, around Eyre Square and along Forster Street and College Road.	Yes. Whilst designating a series of existing roads as an access network, creating a new link from Browne Roundabout through the University Hospital Galway grounds and on to University Road, changing traffic priorities at junctions and changing existing traffic movements in themselves will not adversely affect the integrity of any European Sites, this element of the GTS is reliant on a new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge.
Road and Street Network		
Provide resilience of operation of the road network such that all travellers have a reliable (not necessarily fast) journey time.	An outer orbital route is recommended in order to enhance resilience of the Galway Transport Strategy, by reducing congestion on other principal roads, and providing opportunity for re-allocation of road-space within the city for bus priority and cycle lanes. In addition to the outer orbital route, a number of ancillary, localised road links are proposed to improve connectivity at a local level for motorised traffic, pedestrians, cyclists and buses.	Yes, as the N6 Galway City Ring Road (GCRR) scheme—which is envisaged as this outer orbital route— will cross Lough Corrib SAC at two locations with the potential for associated habitat loss, fragmentation and degradation (here and downstream in Lough Corrib SAC, Galway Bay Complex SAC and Inner Galway Bay SPA), and the potential for disturbance to qualifying interest species, mortality risk and barrier effect.
Provide road network improvements to cater for those journeys which are not able to be a made (in a viable manner) by public transport, by cycle, or on foot.	An outer orbital route will provide a convenient route for some car-based journeys which are not able to be made easily by other modes – such as through-journeys.	Yes, as the N6 GCRR scheme will cross Lough Corrib SAC at two locations with the potential for associated habitat loss, fragmentation and degradation (here and downstream in Lough Corrib SAC, Galway Bay Complex SAC and Inner Galway Bay SPA), and the potential for disturbance to qualifying interest species, mortality risk and barrier effect to affect those Sites and Lough Corrib SPA. Other road infrastructure improvements also have the potential to affect Galway Bay Complex SAC and Inner Galway Bay SPA due to their close proximity -

Element of the GTS	Potential for adverse effects on European Site integrity?	
		Lough Atalia Road / College Road Junction and junction upgrades along the coast road (R336) between the city centre and Salthill.
Parking		
To provide efficient access arrangements for city centre car parks.	It is proposed to rationalise the city centre street hierarchy such that well-signed routes to car parks are available via the city centre access network and local access routes. Variable Message Signage is also proposed on approaches to the city as well as an associated Parking Guidance System.	No potential to adversely affect the integrity of any European Sites
To ensure that parking is not significantly cheaper than public transport.	To adopt a philosophy that parking fees are similar or more than typical bus fares. E-parking (parking by phone or text) fees may assist in equalising parking and bus prices.	No potential to adversely affect the integrity of any European Sites
To reduce the impact of parking on the city centre environment and movement of buses and cycles.	It is proposed to remove most of the on-street parking in the city centre to provide more road-space for pedestrians and public transport, while retaining disabled driver parking. Improved enforcement is also proposed. Some rationalisation of on-street parking on radial access routes will also assist bus movement.	No potential to adversely affect the integrity of any European Sites
HGV Management		
Restrict HGV access to the city centre to only those vehicles with destinations (or origins) in the city centre.	HGV movement around the city will be accommodated via the city centre access network, including access to the city centre and the port.	No potential to adversely affect the integrity of any European Sites

Element of the GTS	Potential for adverse effects on European Site integrity?	
Manage the routing and timing of deliveries to the central area.	A loading and delivery strategy for the core city centre area is proposed, restricting access to off-peak hours, similar to the current arrangements on Shop Street and Quay Street.	No potential to adversely affect the integrity of any European Sites
Local Public Transport		
Local Public Transport[1]		
Maximise patronage attraction by providing a high-frequency core public transport network.	The existing main bus corridors are proposed to be upgraded to 'high frequency' public transport routes which will form a 'fixed' spine of future public transport in Galway City and its environs. These routes are proposed as follows: ▪ Western Distributor Road – Seamus Quirke Road – University Hospital Galway – University Road, and on to Eyre Square ▪ Knocknacarra - R336 Coast Road – Salthill – Newcastle Road – University Hospital Galway – University Road, and on to Eyre Square East ▪ Parkmore – Ballybrit – Monivea Road – Wellpark Road –College Road – Eyre Square ▪ Parkmore – Doughiska – Old Dublin Road – College Road – Eyre Square City Centre ▪ University Road - Salmon Weir Bridge - Eglinton Street - Eyre Square – Forster Street – College Road	Yes, as upgrading of the bus network will require the provision of additional transport infrastructure in areas with a potential impact pathway to European Sites: ▪ R336 Coast Road - within and adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA ▪ Salmon Weir Bridge (and associated with this measure a new pedestrian bridge to the south) - crosses Lough Corrib SAC and poses collision risk to SCIs of Lough Corrib SPA and Inner Galway Bay SPA ▪ College Road & Old Dublin Road - within/adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA at Lough Atalia

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[1] The infrastructural interventions are set out in Table 9 of Appendix D – Galway City Public Transport Network

Element of the GTS	Potential for adverse effects on European Site integrity?	
Provide city-wide network coverage /connectivity to all parts of the city.	Local buses may also be required to maximise the coverage of the overall bus network and to provide bus connectivity to areas that lie outside of the principal bus network. Local buses will also provide connection and transfer to and from the city bus network. This ancillary local network will necessarily evolve over time (e.g. as developments proceed), and hence does not represent a fixed network. As patronage increases over time, these routes may be upgraded to higher frequency services, where practical to do so.	Yes, as upgrading the bus network will require the provision of additional transport infrastructure in areas with a potential impact pathway to European Sites: ▪ R336 Coast Road - within and adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA ▪ Salmon Weir Bridge (and associated with this measure a new pedestrian bridge to the south) - crosses Lough Corrib SAC and poses collision risk to SCIs of Lough Corrib SPA and Inner Galway Bay SPA ▪ College Road & Old Dublin Road - within/adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA at Lough Atalia Also subsidiary network elements are acknowledged as elements which are not fixed and therefore, the provision of additional infrastructure in the future could be proposed in areas with a potential impact pathway to European Sites.
Provide guaranteed and reliable journey times.	Bus Lanes and Bus Priority measures have been deigned at a conceptual level along the network corridors as follows: • Western Distributor Road – Seamus Quirke Road Corridor; • Salthill Road / St Mary's Road / Newcastle Road Corridor; • Old Dublin Road Corridor; • Wellpark Road / Monivea Road Corridor; and • City Centre Corridor (University Road - Salmon Weir Bridge - Eglinton Street - Eyre Square – Forster Street – College Road).	Yes, as upgrading the bus network will require the provision of additional transport infrastructure in areas with a potential impact pathway to European Sites: ▪ R336 Coast Road - within and adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA ▪ Salmon Weir Bridge (and associated with this measure a new pedestrian bridge to the south) - crosses Lough Corrib SAC and poses collision risk to SCIs of Lough Corrib SPA and Inner Galway Bay SPA ▪ College Road & Old Dublin Road - within/adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA at Lough Atalia

Element of the GTS	Potential for adverse effects on European Site integrity?	
Supporting measures for Local Public Transport[2]	Segregation of pedestrians from buses at Salmon Weir Bridge through provision of a new, parallel pedestrian bridge adjacent to the existing structure	Yes, as this element of the Strategy relies upon delivering a new pedestrian bridge south of the Salmon Weir Bridge, which crosses Lough Corrib SAC
City Centre Public Transport Interchange		
Maximise range of destinations served by providing convenient interchange between public transport services	Eyre Square has been identified as the main hub for Bus/Bus transfer – as well as Bus/Train and Bus/Coach at Ceannt Station/Fairgreen Station. Other key bus transfer hubs will be located at: University Hospital Galway; and University Road/Cathedral.	Yes, as providing bus transfer hubs may require the provision of (or may be dependent on the delivery of) additional transport infrastructure in areas with a potential impact pathway to European Sites: ▪ Ceannt Station/Fairgreen Station - adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA at Lough Atalia ▪ University Road/Cathedral area - adjacent to Lough Corrib SAC
Implement multi-mode ticketing which allows transfer between modes	It is proposed that all services will allow for cross-ticketing such that passengers can transfer between routes without extra charges.	No potential to adversely affect the integrity of any European Sites
Regional Public Transport		
Regional Public Transport		
Coaches/buses should have reliable journey times in the city	Bus lanes proposed for city bus services are in general also suitable for buses and coaches with origins outside the city.	Yes, as delivery of this aim is reliant on the new transport infrastructure proposed in this strategy, some of which will intersect with European Sites or is located in areas with a potential impact pathway to European Sites.
Good access in and out of bus/coach termini in the city centre	The proposed city centre traffic management, with reduced through-traffic and local distributor routes	Yes, as delivery of this aim is reliant on the new transport infrastructure proposed in this strategy, some

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[2] Only those with an identified impact pathway are included from Section 5.7 of the Galway Transport Strategy

Element of the GTS	Potential for adverse effects on European Site integrity?	
	will ensure that coaches are able to access termini with minimal congestion.	of which will intersect with European Sites or is located in areas with a potential impact pathway to European Sites.
Interchange between regional and local public transport	A high-quality city bus network will provide interchange opportunities for regional bus travellers – such that passengers can switch modes at a small number of hubs outside the city centre.	Yes, as delivery of this aim is reliant on the new transport infrastructure proposed in this strategy, some of which will intersect with European Sites or is located in areas with a potential impact pathway to European Sites.
Rail		
Increase frequency of rail services	Rail services will be increased in frequency, subject to sufficient passenger demand and usage.	No potential to adversely affect the integrity of any European Sites
Interchange between regional and local public transport	Ceannt Station will remain the terminus for rail services to Galway City, and pending major upgrades at the station will significantly improve the offering for passengers. In addition, pending redevelopment works in the vicinity at Ceannt Quarter will re-energise this part of the city centre, and this will complement Eyre Square and Fairgreen as a collective hub for interchange between services within Galway City Centre.	Yes, as promoting Ceannt Station/Fairgreen Station as an important transport interchange/hub may require the provision of (or may be dependent on the delivery of) additional transport infrastructure in areas with a potential impact pathway to European Sites: ▪ Ceannt Station/Fairgreen Station - adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA at Lough Atalia
Park and Ride		
Maximise destinations reachable by Park & Ride services	It is proposed to base Park & Ride on the city-wide core high-frequency public transport network – such that a range of destinations can be reached.	Yes, as specific locations are not identified Park & Ride facilities could potentially be located in areas with a potential impact pathway to European Sites.
Ensure that Park & Ride is financially sustainable	Basing Park & Ride on the city-wide public transport network will maximise the financial viability of Park & Ride services. It is intended that the cost of Park & Ride will be integrated with the overall public transport journey fare for passengers.	No potential to adversely affect the integrity of any European Sites

Element of the GTS	Potential for adverse effects on European Site integrity?	
Appendix G – GTS Park & Ride Locations Analysis	It is intended that the capacity of these Park & Ride locations will grow organically over time as demand increases.	As specific locations are not identified for the Park & Ride facilities, other than that they are likely to be situated on the outskirts of Galway City, on the M6, the N17, and the Western Distributor Road/R336 corridors, they could potentially be located in areas with a potential impact pathway to European Sites.
Tourist Coach Parking Management		
Suitable drop-off/pick-up locations; **Controlled coach drop-off/pick-up in the core city centre area;** **Provision of managed layover coach parking areas outside of the core city centre area.**	Possible sites identified to eliminate layover in city centre proper are: ▪ Galway Cathedral; ▪ Galway Harbour; and ▪ Merchants Road.	Yes, as achieving this aim may require the provision of additional transport infrastructure in areas with a potential impact pathway to European Sites: ▪ Galway Cathedral - adjacent to Lough Corrib SAC ▪ Galway Harbour - within Galway Bay Complex SAC and Inner Galway Bay SPA ▪ Ceannt Station site – adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA
Cycling, Walking and Public Realm		
Cycle Network Infrastructural Design Measures		
To provide a primary 'trunk' cycle network which will provide a convenient and safe route for medium-distance radial commuter / leisure journeys	The primary network comprises two Greenways providing connectivity for cyclists from nearby towns and villages; one along the coast from An Spidéal to Oranmore, passing through Galway City; and one along the western bank of the River Corrib from Galway City to Oughterard, via Maigh Cuilinn. Furthermore the cycle network will continue east via the Galway-Dublin cycleway.	Yes, as all three greenways intersect with, and/or are in close proximity to, European Sites: ▪ Galway to Dublin Cycleway - within/adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA ▪ Connemara Greenway (Galway to Oughterard) - within Lough Corrib SAC and Ross lake and Woods SAC, and adjacent to Lough Corrib SPA

Element of the GTS	Potential for adverse effects on European Site integrity?	
	As part of the greenway network, it is proposed to carry out investigations to determine the feasibility of connecting from Eyre Square to Renmore barracks via the existing rail crossing over Lough Atalia or via lands at Galway Port. Additional primary routes include a cross-city route to the north of the city, building on existing facilities, along with some key north-south links. In general, primary routes are either segregated, off-road cycle only paths, or dedicated cycle lanes along new or existing roads. Wherever possible, these routes are separated from traffic by kerbs or edge markings.	▪ Bearna Greenway - within/adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA Also, connecting a greenway between Eyre Square and Renmore may impact on Galway Bay Complex SAC and Inner Galway Bay SPA.
To provide a secondary cycle network which will provide a recognisable grid network for local journeys, and will be connected to the primary network for longer journeys.	The secondary network provides connections from residential areas and areas of employment to the primary network, accessing key destinations. Secondary links are a combination of off-road cycle paths, cycle lanes along existing roads, shared bus and cycle lanes, and traffic-calmed roads. They often run parallel to primary routes, providing an alternative link. In addition to this network, feeder links have been identified on streets and roads which are highly constrained or more suited to other modes, but need to cater for cyclists also. These are generally cycle-friendly advisory routes where traffic calming and management measures allow cyclists and motorists to mix safely.	Yes, as the secondary cycle network includes for a proposed new bridge over the River Corrib along the line of the Old Clifden Railway at NUI Galway/Waterside which crosses Lough Corrib SAC.
To increase options for cycling in and across the city centre	Through-traffic will be removed from the core city centre area. This will reduce the amount of traffic on these roads, creating a shared environment where cyclists can safely use the existing street network. Cyclists will be permitted to use Salmon Weir Bridge, which is to be designated as public-transport only as part of the Cross-City Link.	Yes, as this element of the Strategy relies upon the Cross-City Link which includes for a new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge.

Element of the GTS	Potential for adverse effects on European Site integrity?	
Supporting Measures for Cycling	Expansion of bike share scheme	Yes, as specific locations are not identified, additional infrastructure may be required and could potentially be located in areas with a potential impact pathway to European Sites.
	Provide for and upgrade bicycle parking facilities	Yes, as specific locations are not identified, additional infrastructure may be required and could potentially be located in areas with a potential impact pathway to European Sites.
	Permeability and Wayfinding Permeability is a key constraint for cyclists and pedestrians in Galway. Links between residential areas and/or workplaces will be improved for use by active modes, providing more direct routes. In addition, a cycle route signage programme is proposed in parallel to the development of the cycle network.	Yes, as specific locations are not identified, additional infrastructure may be required and could potentially be located in areas with a potential impact pathway to European Sites.
Galway Transport Strategy Appendix E - Cycle Network & Infrastructure Development	Knocknacarra South – Feeder route along R336 proposed for upgrade and footpath installation which lies within/adjacent to Galway Bay Complex SAC boundary Salthill – elements of the cycle network are within/adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA Newcastle and Dangan – the primary route through NUIG, which connects with the Galway to Oughterard Greenway, lies within/adjacent to Lough Corrib SAC City Centre – upgrade of University Road and associated installation of dedicated pedestrian bridge crosses Lough Corrib SAC; Proposal to construct a new pedestrian and cyclist bridge over the River Corrib to the south of the Wolfe Tone Bridge crosses Galway Bay Complex SAC; cycleway from the Long Walk around the Docks as far as Lough Atalia Road runs adjacent to Galway Bay Complex SAC; proposal	Yes, as many of the transport infrastructure developments referenced in this appendix will be constructed, or operate, in areas with potential impact pathways to European Sites.

Element of the GTS		Potential for adverse effects on European Site integrity?
	to install a cycleway along Lough Atalia Road could potentially be within/adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA; proposal to construct a pedestrian and cyclist bridge across the existing piers of the former Clifden Railway Line bridge would cross Lough Corrib SAC; noted that along Dyke Road footpaths are not continuous and the provision of additional footpath space would be adjacent to Lough Corrib SAC Terryland and Ballinfoyle - a new road is proposed from the N84 Headford Road to the N6 Bóthar na dTreabh which would require a new bridge crossing the Terryland River which connects with the River Corrib downstream and Lough Corrib SAC, Galway Bay Complex SAC, and Inner Galway Bay SPA Renmore and Dublin Road – additional off-road cycle paths required to connect existing cycle network in an area within/adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA. Park & Ride proposal along Dublin Road also noted (location unspecified).	
Walking Network Design		
To provide improvements for pedestrians along city centre public transport corridors	Provide a new pedestrian river crossing at Galway Cathedral, adjacent to Salmon Weir Bridge; and Establish and implement a city centre public realm improvement programme (signage, surface materials and lighting), including pedestrianisation schemes, to create a comfortable, well connected walking environment.	Yes. As s a new pedestrian bridge at this location must cross Lough Corrib SAC.
To increase priority given to pedestrians over road traffic	Transform the character of the core city centre area with a clear emphasis on pedestrians through extended pedestrianised areas, traffic management, reducing pedestrian wait times at crossings, removal of through traffic, limiting on-street parking availability and revised road and junction layouts; and	Yes. Whilst there is no spatial reference associated with this aim additional transport infrastructure could be located in areas where there is the potential to adversely affect the integrity of European Sites.

Element of the GTS		Potential for adverse effects on European Site integrity?
	Enhancing the pedestrian offering through upgrade of major roundabout junctions to include signalisation, and providing dedicated pedestrian facilities and priority.	
Increase legibility and wayfinding	Define a safe, legible city centre pedestrian network, providing for ease of movement for all users, including persons with mobility, visual and hearing impairments, and for those using buggies and prams; and Implement a Smart Information and Integrated Wayfinding strategy for the city centre for all modes, including pedestrians. This will include wayfinding signage across the city and provision of information on walking, cycling and public transport networks, to benefit the community and visitors alike.	No potential to adversely affect the integrity of any European Sites
To increase the quality, comfort and safety of the pedestrian facilities	A structured, prioritised programme of improvements will be undertaken across the pedestrian network, including providing new footpath facilities, widening existing facilities, providing new and improved crossing facilities, removal of street clutter, adapting junction layouts in order to minimise crossing distances and reduce vehicle speeds, and an intensive program of improvements of pedestrian permeability through residential areas in order to create safe, secure environments that encourage and foster a strong walking culture.	Yes, as some of these pedestrian facilities are within, or in close proximity to European Sites - proposed new pedestrian bridge at the Salmon Weir Bridge, proposed new pedestrian/cycle bridge on the Old Clifden Railway Line
Supporting Measures for Walking	Revision of road junction layouts, where appropriate, to provide dedicated pedestrian crossings, reduce pedestrian crossing distances, provide more direct pedestrian routes and reduce the speed of turning traffic.	Yes. Whilst there is no spatial reference associated with this aim additional (or upgrading of) transport infrastructure could be located in areas where there is the potential to adversely affect the integrity of European Sites.

Element of the GTS	Potential for adverse effects on European Site integrity?	
	Creation of permeable pedestrian environments in residential areas, amenable to walking, and maximising accessibility to the proposed bus network.	Yes. Whilst there is no spatial reference associated with this aim additional (or upgrading of) transport infrastructure could be located in areas where there is the potential to adversely affect the integrity of European Sites.
	In conjunction with An Garda Síochána the Local Authorities will evaluate and, where appropriate, seek the introduction of lower speed limits in the core city centre area and on residential streets.	No potential to adversely affect the integrity of any European Sites
	Cooperation with An Garda Síochána in the enforcement of laws in relation to parking on footpaths.	No potential to adversely affect the integrity of any European Sites
	Removal of unnecessary street clutter to facilitate ease of movement along streets and through ‘places’.	No potential to adversely affect the integrity of any European Sites
	Leisure Walking: Advance the roll-out of the greenway network, including the Oranmore-City Centre-Bearna Greenway and the extension of the Dangan Greenway to Oughterard via Maigh Cuilinn.	Yes, as all three greenways intersect with, and/or are in close proximity to, European Sites; ▪ Galway to Dublin Cycleway - within/adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA ▪ Connemara Greenway (Galway to Oughterard) - within Lough Corrib SAC and Ross lake and Woods SAC, and adjacent to Lough Corrib SPA ▪ Bearna Greenway - within/adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA
Public Realm – Cross-City Link **The Cross-City Link Includes the Following:**		
Bus Priority	The route will be subject to traffic restrictions such that road sections become essentially bus only – but with local access and deliveries allowed on a permitted basis.	No potential to adversely affect the integrity of any European Sites

Element of the GTS	**Potential for adverse effects on European Site integrity?**	
General Traffic	General traffic will be excluded from the corridor from Salmon Weir Bridge to the north-eastern end of Forster Street. There is a further bus priority section proposed for College Road to prevent general traffic from entering and leaving the city centre via College Road, with Lough Atalia Road designated as the main access route for general traffic.	Yes, as this element of the Strategy relies upon delivering a new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge.
Deliveries and Local Access	Certain permitted vehicles will be allowed to travel on the Cross-City Link route for delivery and business purposes. A management system will be implemented in respect of permits, delivery times and locations of access. Local businesses and residents will continue to be able to access their property.	No potential to adversely affect the integrity of any European Sites
Legibility and Linkage	The Cross-City Link will provide corridor legibility in terms of linking places which currently have high pedestrian footfall and movement within the city centre, stretching from the NUIG Campus and University Hospital, past the Cathedral and Courthouse, through Eyre Square and on towards the Sportsgrounds. It creates a space within the city and immediate environs that asserts the place of pedestrians, cyclists and public transport above the private car, and will greatly strengthen these modes as viable choices for commuters and visitors alike.	No potential to adversely affect the integrity of any European Sites
Key Locations	**University Road** - the gateway to the city from the west, accessing the canal network, NUIG and Nun's Island (from the junction with Newcastle Road to Salmon Weir Bridge).	Yes, as the University Road/Salmon Weir Bridge crosses Lough Corrib SAC
	Cathedral Quarter - comprising the front entrance to Galway Cathedral and surrounding street space.	No potential to adversely affect the integrity of any European Sites
	A New Pedestrian Bridge adjacent to Salmon Weir Bridge, and removal of pedestrian traffic from Salmon Weir Bridge.	Yes, as a new bridge here would cross over Lough Corrib SAC and poses a collision risk to SPA bird species

Element of the GTS	**Potential for adverse effects on European Site integrity?**	
	Courthouse (Waterside) - a key riverfront area adjacent to the Cathedral Quarter.	Yes, as this area is immediately adjacent to Lough Corrib SAC
	St. Francis Street/Eglinton Street - providing connectivity to the existing pedestrian areas on William Street, Shop Street and environs.	No potential to adversely affect the integrity of any European Sites
	Eyre Square - the principal destination within the city centre for shopping and recreation.	No potential to adversely affect the integrity of any European Sites
	Ceannt Quarter - incorporating Ceannt station, and rail/bus interchange.	Yes, as Ceannt Station lies immediately adjacent to Galway Bay Complex SAC (Lough Atalia)
	College Road - the gateway to the city from the east.	Yes, as the road lies in close proximity to Galway Bay Complex SAC (Lough Atalia)
Complementary Measures		
Smarter Mobility	Smarter Mobility uses technology to increase efficiency, safety and co-ordination across transport networks to manage traffic demand and capacity; but also includes projects which provide additional capacity to the transportation network which will be reliant on delivery of many other elements of the GTS.	Yes. Whilst there is no spatial reference associated with this aim additional (or upgrading of) transport infrastructure could be located in areas where there is the potential to adversely affect the integrity of European Sites.
	Smarter mobility Policies (refer to **Galway Transportation Strategy Appendix H – ITS Proposals**) **SM Policy 1:** Galway City's transport network shall be safe, usable and equitable to all road users **SM Policy 2:** Ensure Galway City's transport system is resilient and adaptable to future trends **SM Policy 3:** Capitalise on investment made to date in Galway's transportation network and systems **SM Policy 4:** Encourage the economic viability of Galway through ease of movement to and around the City	Yes, as some of these policies (**SM Policy 2**, **SM Policy 4**, **SM Policy 5**, **SM Policy 7** and **SM Policy 11**) are directly linked to the provision of additional transport infrastructure, some of which is proposed in areas with a potential impact pathway to European Sites.

Element of the GTS		Potential for adverse effects on European Site integrity?
	SM Policy 5: Maximise the Efficiency of the existing transport infrastructure in Galway **SM Policy 6:** Reduce the environmental impact created by transportation **SM Policy 7:** Increase the capacity of Galway's transportation network **SM Policy 8:** Remove unnecessary car-trips to Galway City Centre **SM Policy 9:** Increase the mode share of sustainable transport across the network **SM Policy 10:** Galway City Centre is a destination, not a route **SM Policy 11:** Improve the operational efficiency of necessary car movements **SM Policy 12:** Enable users of the transportation network to make informed decisions on journey choice **SM Policy 13:** Ensure Galway City Centre is an enjoyable and vibrant place to live, work and visit **SM Policy 14:** Galway shall adopt the principles of "Mobility as a Service"	
	Smarter mobility Projects (refer to **Galway Transportation Strategy Appendix H – ITS Proposals**) **SM Project 1:** Create a Bus Network with a High Level of Service **SM Project 2:** Salmon Weir Bridge to allow Public Transport only **SM Project 3:** Remove Private cars from inner city cordon **SM Project 4:** Maintain, Expand, Integrate and actively operate Galway City Councils Urban Traffic Management Centre (GCC UTMC)	Yes, as some of these policies are directly or indirectly linked to the provision of additional transport (or transport related) infrastructure (**SM Project 1, SM Project 2, SM Project 11, SM Project 12, SM Project 16, SM Project 18)**, some of which is proposed in areas with a potential impact pathway to European Sites.

Element of the GTS		Potential for adverse effects on European Site integrity?
	SM Project 5: Provide an integrated ticketing / universal method of payment across all modes **SM Project 6:** Create and operate a smart parking system for Galway **SM Project 7:** Create a Smart Street Lighting System for Galway **SM Project 8:** Provide an integrated way-finding system for all modes **SM Project 9:** Carry out a review of each traffic signal junction to ensure correct layout, configuration and operation is in place **SM Project 10:** Create Smart Priority Routes for Pedestrians and Cyclists **SM Project 11:** Provide Smart Parking facilities for Cyclists **SM Project 12:** Facilitate smart City Centre Coach Parking **SM Project 13:** Provide a "Last Mile" taxi service for bus users **SM Project 14:** Provide zone based, variable pricing structure for Public Transport **SM Project 15:** Examine demand based variable pricing for parking **SM Project 16:** Encourage and provide for Electric Vehicle Usage **SM Project 17:** Enforcement of red light running **SM Project 18:** Ensure all proposals are future-proofed for Co-Operative ITS	
Travel to Places of Education	Behavioural change programmes which encourages students and schoolchildren to travel to school by modes other than the car.	No potential to adversely affect the integrity of any European Sites
	General strategic improvements of bus, cycle and walking networks will provide safe opportunities for	Yes.

Element of the GTS	Potential for adverse effects on European Site integrity?	
	students to use non-car modes – especially if bus and cycle networks are planned to run close to educational centres.	Whilst there is no spatial reference associated with this aim, some additional (or upgrading of) transport infrastructure associated with the GTS will be located in areas where there is the potential to adversely affect the integrity of European Sites.
	Permeability improvements targeted at walking and cycling modes, improving accessibility to the bus network, and also minimising excessive routing for those who wish to walk or cycle to school.	Yes, as improvements to the transport network permeability directly linked to the provision of additional transport infrastructure, some of which is proposed in areas with a potential impact pathway to European Sites.
	Promotion of school travel plans, and participation in the Green Schools Travel initiative.	No potential to adversely affect the integrity of any European Sites
	At second level and third level, implementing mobility management planning for student travel, combined with targeted promotion of alternatives to the private car to better inform students of their travel options.	No potential to adversely affect the integrity of any European Sites
Land-use Integration	**Land-use Planning Principles**	
	High-volume, trip intensive developments, such as offices and retail, should primarily be focused into the city centre, or areas well served by public transport. Residential development located proximate to high capacity public transport should be prioritised over development in less accessible locations. All non-residential development proposals should be subject to maximum parking standards – these standards should vary with location with regard to the centrality of the proposal within the city and the level of public transport provision. Area-based parking standards could be considered. For all major employment developments and all new and extended schools, travel plans should be conditioned as part of planning permissions and be carried out in a manner consistent with existing NTA guidance.	Some of these principles seek to influence the location and, to some degree, design and layout considerations for proposed developments; particularly with regard to development permeability for walking and cycling. Others relate to considering development sequencing with respect to the public transport network or promoting the use of walking, cycling and public transport. Due to the non-specific nature of these with regard to scale and location in particular, and that by their nature they could influence land-use zonings and development locations in the future, it is not possible to fully assess their implications with respect to potential impacts to European Sites. On that basis, and applying the precautionary principle, the land-use integration principles are considered to have the

Element of the GTS	**Potential for adverse effects on European Site integrity?**	
	To the extent practicable, residential development should be carried out sequentially, whereby lands which are, or will be, most accessible by walking, cycling and public transport – including infill and brownfield sites – are prioritised. Planning at the local level should promote walking, cycling and public transport by maximising the number of people living within walking and cycling distance of their neighbourhood or district centres, public transport services, and other services at the local level such as schools. New development areas should be fully permeable for walking and cycling and the retrospective implementation of walking and cycling facilities should be undertaken where practicable in existing neighbourhoods, in order to a give competitive advantage to these modes. Where possible, developments should provide for filtered permeability. This would provide for walking, cycling, public transport and private vehicle access but at the same time would restrict or discourage through trips by private car. To the extent practicable, proposals for right-of-way extinguishments or other requirements should only be considered where these do not result in more circuitous walking and cycling trips for local residents accessing public transport or local destinations. In urban areas, including the numerous towns, villages and settlements, the Design Manual for Urban Roads and Streets (DMURS) will guide localised proposals with a view to reaffirming walking, cycling and public transport modes over the private car.	potential to adversely affect the integrity of European Sites.
Behaviour Change	Encouraging the use of more sustainable travel choices	No potential to adversely affect the integrity of any European Sites
Implementation and Outcomes		

Element of the GTS	Potential for adverse effects on European Site integrity?	
Implementation Plans	Short Term, Medium Term and Long Term implementation plans for delivery of the strategy elements over a 20 year period	Setting an implementation timeline has no potential to adversely affect the integrity of any European Sites

Appendix B

Source-Pathway-Receptor Analysis

Potential Impact Pathways Connecting elements of the Galway Transport Strategy (GTS) to European Sites

B1

Appendix B1 presents the results of the second stage of the assessment carried out to examine and analyse all elements of the GTS in order to determine which have the potential to adversely affect the integrity of European Sites.

This stage involved a more detailed examination and analysis of the potential impact pathways between the impact source and receptor. Additional detail on how the various impact pathways could potentially affect the conservation objectives supporting the QI habitats/QI species/SCI species is presented in Appendix C.

Also included in this appendix are the corresponding mitigation measures to ensure such potential adverse effects are fully addressed as a result of implementing the GTS.

The mitigation measure references used, correspond with those presented in Appendix D, which are derived from the Galway County Development Plan 2015-2021 and the Galway City Council Draft Development Plan 2017-2023, and Section 3.2 of the main NIS text which are mitigation measures specific to the GTS.

Table B-1: Source-Pathway-Receptor Analysis—potential impact pathways connecting elements of the Galway Transport Strategy (GTS) to European Sites, supporting environmental protection policies and mitigation measures

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
Habitat Loss **Direct loss of habitat (terrestrial or freshwater) in European Site – habitat fragmentation is directly associated with this impact pathway**	**N6 Galway City Ring Road (N6 GCRR)** The only European Site at risk from habitat loss associated with the N6 GCRR is Lough Corrib SAC. The road corridor crosses Lough Corrib SAC at two locations[1]: at the site of the proposed River Corrib Bridge between NUI Galway and Menlough and to the west of Lackagh Quarry where the road will consist of a tunnel and approach road infrastructure. The corridor shown to represent the N6 GCRR also overlaps with the SAC boundary to the west of the Coolagh Lakes; this is discussed further below. Habitat mapping of each of these areas is provided showing both the Fossitt (2000) habitat classifications and where these correspond with priority Annex I or Annex I habitat types as follows: ▪ River Corrib area on Figures 2a (Fossitt habitat classifications) and 2b (Annex I habitats); ▪ Coolagh Lakes area on Figures 2c (Fossitt habitat classifications) and 2d (Annex I habitats); and ▪ Lackagh Quarry area on Figures 2e (Fossitt habitat classifications) and 2f (Annex I habitats). Further information on the non-Annex I habitat classifications is also provided in Appendix G. Loss of QI habitat from an SAC, would negatively affect the conservation objectives of the Site and constitute an adverse effect on the integrity of the European Site. The corridor shown for the N6 GCRR is, in general, broader than is required to construct the road infrastructure. To more accurately reflect this, there are areas identified on Figures 2c, 2d, 2e and 2f where no works will be undertaken. As these areas will not be	Lough Corrib SAC	**Galway City Council Draft Development Plan 2017-2023** GCiDP 01, GCiDP 02, GCiDP 03, GCiDP 04, GCiDP 05, GCiDP 06, GCiDP 07, GCiDP 08, GCiDP 10, GCiDP 11, GCiDP 21, GCiDP 22, GCiDP 23 **Galway County Development Plan 2015-2021** GCoDP 01, GCoDP 02, GCoDP 03, GCoDP 04, GCoDP 06, GCoDP 07, GCoDP 18, GCoDP 19	GTS – Habitat Loss: N6 GCRR See Box 1c in Section 3.2 of the NIS

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[1] The current versions of the digital designated area boundaries that can be downloaded from the NPWS website do not always accurately represent the legally defined boundaries, as shown on the official Department of Arts, Heritage and the Gaeltacht boundary maps, as they relate to features on the ground such as field boundaries, road margins etc. This is on account of the scale difference between the 6-inch maps used to originally define the European site boundaries and current larger scale vector mapping/orthophotography. The descriptions of habitat locations in this report, with respect to whether they are inside/outside of the SAC boundary, are an interpretation of their intended locations with respect to the field boundaries and designated area boundary as shown on the official Department of Arts, Heritage and the Gaeltacht boundary maps.

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	affected by any habitat loss, they are not discussed any further in this section. This includes the area where the corridor overlaps with Lough Corrib SAC west of the Coolagh Lakes. River Corrib On the east bank, the grassland fields were classified as Dry calcareous and neutral grassland (GS1) habitat types (Figure 2a). The westernmost field corresponded with a *Cynosurus cristatus – Trifolium repens* grassland (3b)[2]; the easternmost field with a *Cynosurus cristatus – Trifolium pratense* grassland (3d). Neither corresponded with any Annex I habitat types. The woodland block was classified as a mixed Beech *Fagus sylvatica* and Ash *Fraxinus excelsior* broadleaved woodland which also did not correspond with any Annex I habitat types. On the west bank, the habitat types corresponded with the following Fossitt categories: Buildings and artificial surfaces (BL3), Amenity grassland (improved) (GA2), Scrub (WS1), rank grassland categorised as Dry meadows and grassy verges (GS2), a small copse of young Beech trees (WD1) and a narrow linear strip of Wet willow-alder-ash woodland (WN6)/Scrub (WS1) along the river bank. None of these habitat types corresponded with any Annex I habitat classifications. The River Corrib was also surveyed as part of the habitat survey work carried out for the route selection phase of the N6 GCRR project and was classified as a Depositing/lowland river (FW2). Which did not correspond with any Annex I habitat type. For more information refer to Appendix A.4.2 of the Route Selection Report (Arup, 2015). As none of these habitat types are QIs of Lough Corrib SAC, and they do not provide a supporting role to any QI habitats elsewhere in the cSAC, or to QI species, their loss will not affect the conservation objective attributes and targets supporting the conservation condition of any of the QI habitats or species of Lough Corrib SAC and, will not adversely affect the integrity of this European Site.			

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[2] Grassland vegetation community classifications are as per the classification system described in O'Neill, F.H., Martin, J.R., Devaney, F.M. & Perrin, P.M. (2013) *The Irish semi-natural grasslands survey 2007-2012. Irish Wildlife Manuals, No. 78*. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Ireland..

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	Coolagh Lakes Habitats within Lough Corrib SAC in this area that could potentially be impacted by the proposed N6 GCRR include semi-natural Oak-Ash-Hazel woodlands, scrub, wet grassland and calcareous grassland. The woodlands corresponded with the *Fraxinus excelsior – Hedera helix* woodland groups *Corylus avellana – Oxalis acetosella* woodland type (2e[3]). The wet grassland corresponded with the *Juncus effusus – Ranunculus repens* group/*Juncus effusus – Holcus lanatus* vegetation community (2b); the calcareous grassland with the *Holcus lanatus – Lolium perenne* vegetation community of that same group. The area of Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0] in this area lies outside of the SAC boundary (see footnote [1] above). None of these habitat types are QIs of Lough Corrib SAC, and they do not provide a supporting role to any QI habitats elsewhere in the cSAC, or to QI species. Therefore if affected, their loss would not affect the conservation objective attributes and targets supporting the conservation condition of any of the QI habitats or species of Lough Corrib SAC and, will not adversely affect the integrity of this European Site. Lackagh Quarry Only the western approach road to Lackagh Quarry is likely to result in habitat loss within Lough Corrib SAC, where it may impact upon areas of Oak-ash-hazel woodland (WN2), Scrub (WS1), and a mosaic of Ash treeline (WL2), Scrub (WS1), rank grassland (GS2) and bare ground (ED2). The woodland and scrub areas lacked the requisite cover of thin soils and/or limestone pavement underlying the canopy to qualify as the priority Annex I habitat type Limestone pavement (*8240). None of these habitat types corresponded with any Annex I habitat classifications. As none of these habitat types are QIs of Lough Corrib SAC, and they do not provide a supporting role to any QI habitats elsewhere in the SAC, or to QI species, their loss will not affect the attributes and targets of the conservation objective supporting the			

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[3] Woodland vegetation community classifications are as per the classification system described in Perrin, P., Martin, J., Barron, S., O'Neill, F., McNutt, K. & Delaney, A. (2008) *National Survey of Native Woodlands 2003-2008. Volume II: Woodland classification*.

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	conservation condition of any of the QI habitats or species of Lough Corrib SAC and, will not adversely affect the integrity of this European Site. Otter As there were no Otter breeding or resting places, holt or couch sites, present within the proposed road corridor there will there will be no decline in the number of available holt or couch sites within the SAC. The full results of the Otter surveys carried out in 2014 are detailed in the Appendix A.4.2 of the Route Selection Report (Arup, 2015). In the context of river systems, the *Threat Response Plan Otter* Lutra lutra *2009-2011* document (Department of the Environment, Heritage and the Gaeltacht, 2011) defines terrestrial Otter habitat as a 10m zone of riparian habitat along the river banks. The bankside piers associated with the proposed River Corrib Bridge, some vegetation cutting/removal would likely be required to facilitate the construction works and on an ongoing basis to avoid any impact to the proposed road infrastructure during operation. Some effects to any remaining vegetation underneath the bridge structure would also be expected as a result of shading. This type of change to any terrestrial Otter habitat within the SAC is not considered to be significant, even in a case where it would be partially converted to hard surfaces as Otter will routinely use habitat underneath bridges which is highly modified, and would not constitute a significant decline in the extent of available terrestrial Otter habitat within the European Site. The same applies in the event that the bridge requires the installation of in-stream piers; the loss of freshwater habitat, at the scale of bridge piers, is not considered to be significant. Therefore any habitat loss associated with construction of the proposed development, will not affect the conservation objective attributes and targets supporting the conservation condition of Otter in Lough Corrib SAC and, will not adversely affect the integrity of this European Site. Sea lamprey Sea lamprey are not known from the River Corrib upstream of the Salmon Weir in Galway City (O'Connor, 2007) and as such will			

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	not be subject to any habitat loss effects as a result of the proposed development. Therefore any habitat loss associated with construction of the proposed development, will not affect the conservation objective attributes and targets supporting the conservation condition of Sea lamprey in Lough Corrib SAC and, will not adversely affect the integrity of this European Site. Brook lamprey Impacts on this species will be dependent on the proposed River Corrib Bridge design. Instream habitat loss resulting from the pier installation will not affect the Brook lamprey conservation objectives—habitat at the crossing point is not suitable for spawning nor is it suitable holding habitat for Brook lamprey ammocoetes. Similarly, the river bank substrate present at the crossing point is not suitable ammocoete habitat and construction works here will not result in any significant habitat loss. Therefore any habitat loss associated with construction of the proposed development, would not affect the conservation objective attributes and targets supporting the conservation condition of Brook lamprey in Lough Corrib SAC and, will not adversely affect the integrity of this European Site. Atlantic salmon As the river habitat at the proposed river crossing is not salmonid spawning habitat, any habitat loss associated with construction of the proposed development, will not affect the conservation objective attributes and targets supporting the conservation condition of Atlantic salmon in Lough Corrib SAC and, will not adversely affect the integrity of this European Site			
	Bearna Greenway The proposed Bearna Greenway will require the construction of new cycle infrastructure, most likely along the existing road and pathway network and within existing green spaces in close proximity to the coastline. The existing green spaces include areas managed for amenity purposes (e.g. public parks), lands managed	Galway Bay Complex SAC Inner Galway Bay SPA		GTS – Habitat Loss: Cycle Network Greenways See Box 1a in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	for agricultural purposes, and semi-natural habitat types (e.g. rank grassland areas, scrub, woodland and saltmarsh). The Bearna Greenway could result in habitat loss within Galway Bay Complex SAC and Inner Galway Bay SPA given that the boundaries of these European Sites not only follow the coastline but include a portion of terrestrial habitat above the intertidal zone which may be directly affected by construction works. This includes areas of existing hard standing and amenity grassland between Nimmo's Pier through South Park, along Grattan Road and the Coast Road (R336) to the junction with Threadneedle Road where upgrades to existing cycle infrastructure are described in the GTS (see Sections 4.1.7 and 4.1.8 of *Appendix D - Public Transport Infrastructure Development*) and may form part of the Bearna Greenway. Loss of QI habitat from an SAC would negatively affect the conservation objectives of the Site and constitute an adverse effect on the integrity of the European Site. Loss of habitat from an SAC or SPA (including ex-situ sites) which provides an essential supporting role to QI habitats or QI/SCI species, may negatively affect the conservation objectives of the Site and constitute an adverse effect on the integrity of the European Site. The construction of the greenway infrastructure could potentially result in the loss of Otter habitat[4] and/or impacts to Otter breeding or resting places (holts or couches) along the coastline. It could also result in the loss of habitat areas outside of Inner Galway Bay SPA which are important in supporting the Special Conservation Interest (SCI) bird species (defined as ex-situ sites in the conservation objectives supporting document for Inner Galway Bay SPA[5]) either in the form of foraging habitat or high tide roost sites, as examples. Loss of Otter habitat has the potential to affect the Site's conservation objectives and result in an adverse effect on the			

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[4] In the context of river systems or terrestrial habitat along the coastline, the *Threat Response Plan Otter* Lutra lutra *2009-2011* document (Department of the Environment, Heritage and the Gaeltacht, 2011) defines Otter terrestrial Otter habitat as a 10m zone of riparian habitat along the river banks or a 10m zone of shoreline above the high water mark.

[5] The need to consider use of habitat areas outside of an SPA by SCI bird species is set out in Section 3.1 and 5.2 of the *Inner Galway Bay Special Protection Area (Site Code 4031), Conservation Objectives Supporting Document, Version 1* (National Parks & Wildlife Service, 2013d). These areas are termed 'ex-situ' sites and are defined as areas of habitat situated within the immediate hinterland of the SPA, or in areas ecologically connected to it, which support SCI bird species. There is no information or evidence to confirm whether any of the bird species recorded in habitats outside of European Sites, which are within the ZoI of the proposed development, are birds from either Lough Corrib SPA and/or Inner Galway Bay SPA, or are not part of the population from either European Site. Therefore, a precautionary approach is being taken in assuming that any habitat areas supporting SCI bird species are 'ex-situ' sites under that definition, and are assessed accordingly.

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	integrity of that European Site – see Appendix C, Table C-2 for more detail. Although this project has the potential to result in habitat loss within the aforementioned European Sites, its location is not fixed. There is therefore a large degree of flexibility in selecting its final alignment and avoiding habitat loss within the European Sites that would adversely affect the Site's integrity, whilst still fulfilling the greenways role to connect Bearna and Galway City. This scenario is reflected in the mitigation strategy proposed.			
	Galway to Dublin Cycleway (Galway City to Oranmore) This section of the proposed greenway will require the construction of new cycle infrastructure along the coastline between Galway City and Oranmore. The greenway could result in habitat loss within Galway Bay Complex SAC and Inner Galway Bay SPA given that the boundaries of these European Sites not only follow the coastline but include a portion of terrestrial habitat above the intertidal zone which may be directly affected by construction works. Loss of QI habitat from an SAC would negatively affect the conservation objectives of the Site and constitute an adverse effect on the integrity of the European Site. Loss of habitat from an SAC or SPA (including ex-situ sites) which provides an essential supporting role to QI habitats or QI/SCI species, may negatively affect the conservation objectives of the Site and constitute an adverse effect on the integrity of the European Site. The construction of the greenway infrastructure could result in the loss of Otter habitat[6] and/or impacts to Otter breeding or resting places (holts or couches) along the coastline. It could also result in the loss of habitat areas outside of Inner Galway Bay SPA which are important in supporting the Special Conservation Interest (SCI) bird species (defined as ex-situ sites in the conservation objectives supporting document for Inner Galway Bay SPA) either in the form of foraging habitat or high tide roost sites, as examples.	Galway Bay Complex SAC Inner Galway Bay SPA		GTS – Habitat Loss: Cycle Network Greenways See Box 1a in Section 3.2 of the NIS

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[6] In the context of river systems or terrestrial habitat along the coastline, the *Threat Response Plan Otter* Lutra lutra *2009-2011* document (Department of the Environment, Heritage and the Gaeltacht, 2011) defines Otter terrestrial Otter habitat as a 10m zone of riparian habitat along the river banks or a 10m zone of shoreline above the high water mark.

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	Loss of Otter habitat has the potential to affect the Site's conservation objectives and result in an adverse effect on the integrity of that European Site – see Appendix C, Table C-2 for more detail. Although this project has the potential to result in habitat loss within the aforementioned European Sites, its location is not fixed. There is therefore a large degree of flexibility in selecting its final alignment and avoiding habitat loss within the European Sites that would adversely affect the Site's integrity, whilst still fulfilling the greenways role to connect Galway City to Oranmore. This scenario is reflected in the mitigation strategy proposed.			
	Galway to Oughterard Greenway Whilst the specific alignment of the Galway to Oughterard Greenway has not yet been determined, it is envisaged that it will utilise the disused Galway to Clifden rail line along much of its length[7]. Therefore, the greenway has the potential to result in habitat loss within Lough Corrib SAC as the rail line crosses the SAC at a number of locations. The construction of the greenway infrastructure could potentially result in the loss of Otter habitat[8] and/or impacts to Otter breeding or resting places (holts or couches) within Lough Corrib SAC. Although the disused rail line is remote from Lough Corrib SPA, the fact that the alignment is not yet known means that there is the potential that it could intersect with the SPA, and there is also the potential that it may result in habitat loss affecting important ex-situ sites for SCI bird species of Lough Corrib SPA. The greenway also has the potential to result in habitat loss within Ross Lake and Woods SAC, as the rail line passes through the SAC. If the greenway were to cross the SAC, or result in habitat loss within the foraging/commuting range of the Lesser horseshoe roost for which the site is designated (potentially the key habitat area supporting the roost), there is the potential for habitat loss and	Lough Corrib SAC Lough Corrib SPA Ross Lake and Woods SAC		GTS – Habitat Loss: Cycle Network Greenways See Box 1a in Section 3.2 of the NIS

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[7] Section 4.5.1 of the *Draft Galway City Development Plan 2017-2013* (Galway City Council, 2016) Section 4.12.13 of the *Galway County Development Plan 2015-2021* (Galway County Council, 2015)

[8] In the context of river systems or terrestrial habitat along the coastline, the *Threat Response Plan Otter* Lutra lutra *2009-2011* document (Department of the Environment, Heritage and the Gaeltacht, 2011) defines Otter terrestrial Otter habitat as a 10m zone of riparian habitat along the river banks or a 10m zone of shoreline above the high water mark.

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	fragmentation to occur which could affect the SACs Lesser horseshoe population. Loss of QI habitat from an SAC would negatively affect the conservation objectives of the Site and constitute an adverse effect on the integrity of the European Site. Loss of habitat from an SAC or SPA (including ex-situ sites) which provides an essential supporting role to QI habitats or QI/SCI species, may negatively affect the conservation objectives of the Site and constitute an adverse effect on the integrity of the European Site. Loss of Otter habitat has the potential to affect the Site's conservation objectives and result in an adverse effect on the integrity of that European Site – see Appendix C, Table C-2 for more detail. Although this project has the potential to result in habitat loss within the aforementioned European Sites, its location is not fixed. There is therefore a large degree of flexibility in selecting its final alignment and avoiding habitat loss within the European Sites that would adversely affect the Site's integrity, whilst still fulfilling the greenways role to connect Galway City and Oughterard. This scenario is reflected in the mitigation strategy proposed.			
	Public Transport Network (All Elements of the GTS)[9] Upgrading the public transport network will/may require the provision of (or may be dependent on the delivery of) additional transport infrastructure in areas within or adjacent to European Sites which have the potential to result in the permanent loss of habitat area within SACs and/or SPAs (and important ex-situ sites): ▪ Park & Ride Facilities – the indicative location of the Western Distributor Road/R336 Bearna Road could affect habitats within Galway Bay Complex SAC, Inner Galway Bay or ex-situ sites linked with the latter and Lough Corrib SPA ▪ Rail – additional transport infrastructure at Ceannt Station and surrounding lands lie within or adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA		GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network See Box 1b in Section 3.2 of the NIS

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[9] The infrastructural interventions required in relation to the bus network are set out in Table 9 of Appendix D – Galway City Public Transport Network

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	▪ Providing additional coach parking at Ceannt Station/Galway Harbour may include lands within or adjacent to Galway bay Complex SAC and/or Inner Galway Bay SPA ▪ Salmon Weir Bridge (and associated with this measure is the provision of a new pedestrian bridge to the south of the Salmon Weir Bridge which must cross Lough Corrib SAC) ▪ D2.1.3 UHG Grounds/University Road[10] – terminates at the Salmon Weir Bridge which is within Lough Corrib SAC ▪ D2.1.7 Coast Road – the existing road and associated hard standing lies within, or is adjacent to, Galway bay Complex SAC and lies adjacent to Inner Galway Bay SPA ▪ D2.1.8 Salthill Road Upper – the southern end of this corridor lies within Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA ▪ D2.2.1 St. Vincent's Avenue/St. Francis Street/Eglington Street – this corridor includes the Salmon Weir Bridge which is within Lough Corrib SAC ▪ D2.2.3 Forster Street/College Road – the northern end of this corridor lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA ▪ D2.2.4 Old Dublin Road – the western end of this corridor lies within and in close proximity to Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA Loss of QI habitat from an SAC would negatively affect the conservation objectives of the Site and constitute an adverse effect on the integrity of the European Site. Loss of habitat from an SAC or SPA (including ex-situ sites) which provides an essential supporting role to QI habitats or QI/SCI species, may negatively affect the conservation objectives of the Site and constitute an adverse effect on the integrity of the European Site.			

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[10] [10] (numerical references when given are as per Appendix D of the GTS)

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	Cycle Network (Non-Greenway Elements of the GTS) Aside from the three principle greenway projects, achieving the strategic aims for the cycle network will/may require the provision of (or may be dependent on the delivery of) additional transport infrastructure in areas within or adjacent to European Sites which have the potential to result in the permanent loss of habitat areas within SACs and/or SPAs, including: ▪ F4.1 Knocknacarra South – includes a feeder cycle corridor along the coast road/R336 which lies within, or is adjacent to, Galway bay Complex SAC and lies adjacent to Inner Galway Bay SPA (the Bearna Greenway also forms part of the proposals in this area and is described separately under that heading) ▪ F4.2 Salthill – includes Threadneedle Road, Salthill Road Upper and Whitestrand Road, sections of which either lie within or adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA ▪ F4.6 Newcastle & Dangan – includes the N6/Quincentenary Bridge, NUIG and Chestnut Lane sections of which lie either within or adjacent to Lough Corrib SAC (the Galway to Oughterard Greenway also forms part of the proposals in this area and is described separately under that heading) ▪ F4.7 City Centre – includes new bridges over the River Corrib at the site of the Old Clifden Railway bridge, the Salmon Weir Bridge and Wolfe Tone Bridge, and proposed works along College Road. The first two locations cross Lough Corrib SAC, the area south of Wolfe Tone Bridge crosses Galway Bay Complex SAC, and the proposed works along College Road lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA ▪ F4.8 Terryland and Ballinfoyle – includes the N6/Quincentenary Bridge, which crosses Lough Corrib SAC, and Dyke Road, sections of which lie adjacent to Lough Corrib SAC	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA		GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network See Box 1b in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	▪ F4.10 Renmore & Dublin Road – includes College Road, the Dublin Road and Doughiska Road. The northern end of College Road lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA, the western end of the Dublin Road lies within and in close proximity to Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA, and the southern end of Doughiska Road lies adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA (the proposed Galway City to Oranmore section of the Galway to Dublin Cycleway also forms part of the proposals in this area and is described separately under that heading) ▪ Supporting measures to expand the bike share scheme, provide for and upgrade bicycle parking facilities, and improve cycling permeability across the city are not location specific and could potentially affect European Sites within Galway City – Lough Corrib SAC, Galway Bay Complex SAC and Inner Galway Bay SPA ▪ A greenway connecting Eyre Square and Renmore (in the vicinity of Galway Port or the existing rail crossing over Lough Atalia) would cross Galway Bay Complex SAC and Inner Galway Bay SPA Loss of QI habitat from an SAC would negatively affect the conservation objectives of the Site and constitute an adverse effect on the integrity of the European Site. Loss of habitat from an SAC or SPA (including ex-situ sites) which provides an essential supporting role to QI habitats or QI/SCI species, may negatively affect the conservation objectives of the Site and constitute an adverse effect on the integrity of the European Site.			
	Pedestrian Network (All Elements of the GTS) Aside from the three principle greenway projects, achieving the strategic aims for the pedestrian network will/may require the provision of (or may be dependent on the delivery of) additional transport infrastructure in areas within or adjacent to European Sites which have the potential to result in the permanent loss of habitat areas within SACs and/or SPAs:	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA		GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network See Box 1b in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	▪ The Cross-City Link includes for a new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge. ▪ Connecting a greenway between Eyre Square and Renmore (in the vicinity of Galway Port or the existing rail crossing over Lough Atalia) may impact on Galway Bay Complex SAC and Inner Galway Bay SPA. ▪ The proposed new bridge over the River Corrib along the line of the Old Clifden Railway at NUI Galway/Waterside which crosses Lough Corrib SAC. ▪ A proposed new cycle/pedestrian bridge to the south of Wolfe Tone Bridge must cross Galway Bay Complex SAC. Loss of QI habitat from an SAC would negatively affect the conservation objectives of the Site and constitute an adverse effect on the integrity of the European Site. Loss of habitat from an SAC or SPA (including ex-situ sites) which provides an essential supporting role to QI habitats or QI/SCI species, may negatively affect the conservation objectives of the Site and constitute an adverse effect on the integrity of the European Site.			
Habitat degradation – hydrogeology **Tunnelling and/or deep excavations affecting groundwater quality and/or quantity and thereby the existing hydrogeological regime**	**N6 Galway City Ring Road (N6 GCRR)** The N6 GCRR lies within the same karst groundwater bodies as that portion of Lough Corrib SAC which lies between Lough Corrib and Galway Bay and could potentially interact with, and impact on, the existing hydrogeological regime which supports wetland habitats within the European Site. Of particular risk to the existing groundwater regime is the proposed tunnel immediately west of Lackagh Quarry beneath the SAC at Menlough, associated with the N6 GCRR, which is within the same groundwater body that supports the QI Annex I/priority Annex I (*) habitats at the Coolagh Lakes—namely Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. [3140], Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* * [7210], and Alkaline fen [7230]. Other elements of the N6 GCRR with potential karst groundwater impacts are the tunnel at Galway Racecourse and cuttings at Castlegar and at Briarhill, all of which have the potential to interact with groundwater that could affect the	Lough Corrib SAC Lough Corrib SPA Inner Galway Bay SPA Cregganna Marsh SPA Rahasane Turlough SAC Rahasane Turlough SPA Castletaylor Complex SAC Kiltiernan Turlough SAC Lough Fingall Complex SAC	**Galway City Council Draft Development Plan 2017-2023** GCiDP 01, GCiDP 02, GCiDP 03, GCiDP 04, GCiDP 05, GCiDP 06, GCiDP 08, GCiDP 11, GCiDP 12, GCiDP 13, GCiDP 14, GCiDP 15,GCiDP 21, GCiDP 22, **Galway County Development Plan 2015-2021** GCoDP 01, GCoDP 02, GCoDP 03, GCoDP 04, GCoDP 06, GCoDP 07,	GTS – Hydrogeology N6GCRR See Box 2b in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	conservation objectives supporting QI groundwater dependent habitats in Lough Corrib SAC. Hydrogeological impacts could also affect wetland habitat in ex-situ sites that support SCI bird species of Lough Corrib SPA and Inner Galway Bay SPA – most notably is the lake and wetland complex at Ballindooley. Similarly, the N6 GCRR lies within the same groundwater body as a number of other SACs which are selected for the presence of groundwater dependant habitats, and SPAs where groundwater dependant habitats support the SCI bird species, and therefore the conservation objectives supporting QI habitats or SCI species could be affected: Cregganna Marsh SPA, Rahasane Turlough SAC, Rahasane Turlough SPA, Castletaylor Complex SAC, Kiltiernan Turlough SAC, and Lough Fingall Complex SAC.		GCoDP 08, GCoDP 09, GCoDP 10, GCoDP 15, GCoDP 16, GCoDP 18, GCoDP 19	
	Bearna Greenway The proposed Bearna Greenway lies within the same groundwater body as Galway Bay Complex SAC and could potentially interact with, and impact on, the existing hydrogeological regime which supports wetland habitats within the European Site. Hydrogeological impacts could also affect wetland habitat in ex-situ sites that support SCI bird species of Lough Corrib SPA and Inner Galway Bay SPA. However, there are unlikely to be any proposals for tunnels or deep excavations associated with a greenway development. Cycleways are generally built following the existing topography and are minimally invasive with respect to excavation requirements. Even if groundwater were encountered by such a development, any effects would be expected to be confined to the area immediately adjacent. Therefore, this proposed project is unlikely to interact with groundwater and the risk of it affecting ay conservation objectives or resulting in adverse effects on the integrity of any European Site are low.	Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA		GTS – Hydrogeology General See Box 2a in Section 3.2 of the NIS
	Galway to Dublin Cycleway (Galway City to Oranmore) This section of the proposed greenway lies within the same groundwater body as Galway Bay Complex SAC and could potentially interact with, and impact on, the existing	Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA		GTS – Hydrogeology General See Box 2a in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	hydrogeological regime which supports wetland habitats within the European Site. Construction of a cycleway could also affect wetland habitat in ex-situ sites that support SCI bird species of Lough Corrib SPA and Inner Galway Bay SPA. However, there are unlikely to be any proposals for tunnels or deep excavations associated with a greenway development. Cycleways are generally built following the existing topography and are minimally invasive with respect to excavation requirements. Even if groundwater were encountered by such a development, any effects would be expected to be confined to the area immediately adjacent. Therefore, this proposed project is unlikely to interact with groundwater and the risk of it affecting ay conservation objectives or resulting in adverse effects on the integrity of any European Site are low. This is particularly the case in relation to Cregganna Marsh SPA, Rahasane Turlough SAC, Rahasane Turlough SPA, Castletaylor Complex SAC, Kiltiernan Turlough SAC and Lough Fingall Complex SAC; all more than 1.5km away and separated from the greenway by the urban area of Oranmore.	Cregganna Marsh SPA Rahasane Turlough SAC Rahasane Turlough SPA Castletaylor Complex SAC Kiltiernan Turlough SAC Lough Fingall Complex SAC		
	Galway to Oughterard Greenway The proposed Galway to Oughterard Greenway lies within the same groundwater bodies as Lough Corrib SAC, Ross Lake and Woods SAC and Lough Corrib SPA and could potentially interact with, and impact on, the existing hydrogeological regime which supports the conservation objectives of wetland habitats within the European Site. Hydrogeological impacts could also affect wetland habitat in ex-situ sites that support SCI bird species of Lough Corrib SPA. However, there are unlikely to be any proposals for tunnels or deep excavations associated with a greenway development. Cycleways are generally built following the existing topography and are minimally invasive with respect to excavation requirements. Even if groundwater were encountered by such a development, any effects would be expected to be confined to the area immediately adjacent. Therefore, this proposed project is unlikely to interact with groundwater and the risk of it affecting ay conservation objectives or resulting in adverse effects on the integrity of any European Site are low.	Lough Corrib SAC Lough Corrib SPA Ross Lake and Woods SAC		GTS – Hydrogeology General See Box 2a in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	Public Transport Network (All Elements of the GTS) Although unlikely, there is the possibility that excavations associated with the installation of the public transport network may affect the existing hydrogeological regime which in turn may affect hydrogeologically dependant habitats (and in some cases supported species) within European Sites. Given the likely nature of works associated with the infrastructure described in Appendix D of the GTS - which would be minimally invasive in terms of excavation requirements and with any such works being undertaken in the urban environment, poses little risk of interacting with groundwater – only elements adjacent to Lough Corrib SAC, Galway Bay Complex SAC or Inner Galway Bay SPA are likely to be at any risk of effects. However, even in those locations the risk is minimal: ▪ Park & Ride Facilities – the indicative location of the Western Distributor Road/R336 Bearna Road could affect habitats within Galway Bay Complex SAC, Inner Galway Bay or ex-situ sites linked with the latter and Lough Corrib SPA ▪ Rail – additional transport infrastructure at Ceannt Station and surrounding lands lie within or adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA ▪ Providing additional coach parking at Ceannt Station/Galway Harbour may include lands within or adjacent to Galway bay Complex SAC and/or Inner Galway Bay SPA ▪ D2.1.3 UHG Grounds/University Road[11] – terminates at the Salmon Weir Bridge which is within Lough Corrib SAC ▪ D2.1.7 Coast Road – the existing road and associated hard standing lies within, or is adjacent to, Galway bay Complex SAC and lies adjacent to Inner Galway Bay SPA ▪ D2.1.8 Salthill Road Upper – the southern end of this corridor lies within Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA		GTS – Hydrogeology General See Box 2a in Section 3.2 of the NIS

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[11] 11 (numerical references when given are as per Appendix D of the GTS)

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	▪ D2.2.1 St. Vincent's Avenue/St. Francis Street/Eglington Street – this corridor includes the Salmon Weir Bridge which is within Lough Corrib SAC ▪ D2.2.3 Forster Street/College Road – the northern end of this corridor lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA D2.2.4 Old Dublin Road – the western end of this corridor lies within and in close proximity to Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA			
	Cycle Network (Non-Greenway Elements of the GTS) Although unlikely, there is the possibility that excavations associated with the installation of non-greenway cycle network elements may affect the existing hydrogeological regime which in turn may affect hydrogeologically dependant habitats (and in some cases supported species) within European Sites. The likely nature of works associated with the majority of infrastructure described in Appendix F of the GTS and would be minimally invasive in terms of excavation requirements and with any such works being undertaken in the urban environment, poses little risk of interacting with groundwater – only elements adjacent to Lough Corrib SAC, Galway Bay Complex SAC or Inner Galway Bay SPA are likely to be at any real risk of effects (see list above under habitat loss). Installation of new bridge structures may be more likely to interact with groundwater. However, as these bridges are all associated with a modified urban landscape in the city centre, the risk is likely to remain low. These Non-Greenway Cycle Network elements are as follows (numerical references when given are as per Appendix F of the GTS): ▪ F4.1 Knocknacarra South – includes a feeder cycle corridor along the coast road/R336 which lies within, or is adjacent to, Galway bay Complex SAC and lies adjacent to Inner Galway Bay SPA (the Bearna Greenway also forms part of the proposals in this area and is described separately under that heading) ▪ F4.2 Salthill – includes Threadneedle Road, Salthill Road Upper and Whitestrand Road, sections of which either lie	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA		GTS – Hydrogeology General See Box 2a in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	within or adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA ▪ F4.6 Newcastle & Dangan – includes the N6/Quincentenary Bridge, NUIG and Chestnut Lane sections of which lie either within or adjacent to Lough Corrib SAC (the Galway to Oughterard Greenway also forms part of the proposals in this area and is described separately under that heading) ▪ F4.7 City Centre – includes new bridges over the River Corrib at the site of the Old Clifden Railway bridge, the Salmon Weir Bridge and Wolfe Tone Bridge, and College Road. The first two locations cross Lough Corrib SAC, the area south of Wolfe Tone Bridge crosses Galway Bay Complex SAC, and College Road lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA ▪ F4.8 Terryland and Ballinfoyle – includes the N6/Quincentenary Bridge, which crosses Lough Corrib SAC, and Dyke Road, sections of which lie adjacent to Lough Corrib SAC ▪ F4.10 Renmore & Dublin Road – includes College Road, the Dublin Road and Doughiska Road. The northern end of College Road lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA, the western end of the Dublin Road lies within and in close proximity to Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA, and the southern end of Doughiska Road lies adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA (the proposed Galway City to Oranmore section of the Galway to Dublin Cycleway also forms part of the proposals in this area and is described separately under that heading) ▪ Supporting measures to expand the bike share scheme, provide for and upgrade bicycle parking facilities, and improve cycling permeability across the city are not location specific and could potentially affect European Sites within Galway City – Lough Corrib SAC, Galway Bay Complex SAC and Inner Galway Bay SPA ▪ a greenway connecting Eyre Square and Renmore (in the vicinity of Galway Port or the existing rail crossing over			

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	Lough Atalia) would cross Galway Bay Complex SAC and Inner Galway Bay SPA			
	Pedestrian Network (All Elements of the GTS) Although unlikely, there is the possibility that excavations associated with the installation of pedestrian network elements may affect the existing hydrogeological regime which in turn may affect hydrogeologically dependant habitats (and in some cases supported species) within European Sites. Given the likely nature of works associated with the majority of the public transport infrastructure described in the GTS they would be minimally invasive in terms of excavation requirements and, with any such works being undertaken in the urban environment, pose little risk of interacting with groundwater – only elements adjacent to Lough Corrib SAC, Galway Bay Complex SAC or Inner Galway Bay SPA are likely to be at any real risk of effects (see list above under **Cycle Network (Non-Greenway Elements of the GTS**). Installation of new bridge structures may be more likely to interact with groundwater. However, as these bridges are all associated with a modified urban landscape in the city centre, the risk is likely to remain low.	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA		GTS – Hydrogeology General See Box 2a in Section 3.2 of the NIS
<u>Habitat degradation – tunnelling/excavation</u> **Tunnelling and/or deep excavations affecting the structural integrity of surface level habitats**	**N6 Galway City Ring Road (N6 GCRR)** The proposed tunnel at Lackagh Quarry could impact on the surface and sub-surface rock structure above and consequently affect the conservation objectives supporting the QI Annex I habitats, Limestone pavement [*8240] and Calcareous grassland [6210], present on the surface above in Lough Corrib SAC.	Lough Corrib SAC	**Galway City Council Draft Development Plan 2017-2023** GCiDP 01, GCiDP 02, GCiDP 03, GCiDP 04, GCiDP 05, GCiDP 08, GCiDP 11, GCiDP 21, GCiDP 22 **Galway County Development Plan 2015-2021** GCoDP 01, GCoDP 02, GCoDP 03, GCoDP 04, GCoDP 06, GCoDP 07	GTS – Habitat degradation – tunnelling/excavation See Box 3 in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
Habitat degradation – water quality impacts during construction **Construction works affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats**	**N6 Galway City Ring Road (N6 GCRR), Public Transport Network, Cycle Network and the Pedestrian Network** All elements of GTS either intersect European Sites, are immediately adjacent to European Sites, or will cross watercourses that drain to European Sites. Therefore, associated construction works where either new transport infrastructure is proposed or existing infrastructure will be upgraded could impact on water quality in receiving watercourses/waterbodies through the accidental release of contaminated/polluted run-off. A reduction in water quality in receiving watercourses/waterbodies could affect the conservation objectives supporting QI habitats and QI/SCI species in European Sites downstream—Lough Corrib SAC, Lough Corrib SPA, Galway Bay Complex SAC, Inner Galway Bay SPA or Ross Lake and Woods SAC. Considering the various elements of the GTS and their relationship to the hydrological network connecting them to European Sites (e.g. upstream or downstream of): ▪ N6 GCRR is downstream of Lough Corrib SPA and Ross Lake and Woods SAC and therefore, could only potentially affect Lough Corrib SAC, Galway Bay Complex SAC and Inner Galway Bay SPA via this impact pathway. ▪ Bearna Greenway is downstream of Lough Corrib SAC, Lough Corrib SPA and Ross Lake and Woods SAC – although, could be potentially upstream of ex-situ sites used by SCI species of Lough Corrib SPA. Therefore, these GTS elements could only potentially affect Lough Corrib SPA, Galway Bay Complex SAC and Inner Galway Bay SPA via this impact pathway. ▪ Galway to Dublin Cycleway (Galway City to Oranmore) is downstream of Lough Corrib SAC, Lough Corrib SPA and Ross Lake and Woods SAC – although, could be potentially upstream of ex-situ sites used by SCI species of Lough Corrib SPA – and therefore, could only potentially affect Lough Corrib SPA, Galway Bay Complex SAC and Inner Galway Bay SPA via this impact pathway.	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	**Galway City Council Draft Development Plan 2017-2023** GCiDP 01, GCiDP 02, GCiDP 03, GCiDP 04, GCiDP 05, GCiDP 06, GCiDP 08, GCiDP 11, GCiDP 12, GCiDP 13, GCiDP 14, GCiDP 15, GCiDP 16, GCiDP 17, GCiDP 18, GCiDP 21, GCiDP 22, **Galway County Development Plan 2015-2021** GCoDP 01, GCoDP 02, GCoDP 03, GCoDP 04, GCoDP 06, GCoDP 07, GCoDP 12, GCoDP 15, GCoDP 16, GCoDP 18, GCoDP 19	GTS – Habitat degradation – water quality (construction) See Box 4 in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	▪ Galway to Oughterard Greenway is upstream of all five European Sites, and therefore could potentially affect any/all via this impact pathway. ▪ All public transport elements are downstream of Lough Corrib SPA and Ross Lake and Woods SAC – although, could be potentially upstream of ex-situ sites used by SCI species of Lough Corrib SPA. Specific elements in close proximity to European Sites include: ▪ Park & Ride Facilities – the indicative location of the Western Distributor Road/R336 Bearna Road could affect habitats within Galway Bay Complex SAC, Inner Galway Bay or ex-situ sites linked with the latter and Lough Corrib SPA ▪ Rail – additional transport infrastructure at Ceannt Station and surrounding lands lie within or adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA ▪ Providing additional coach parking at Ceannt Station/Galway Harbour may include lands within or adjacent to Galway bay Complex SAC and/or Inner Galway Bay SPA ▪ Salmon Weir Bridge (and associated with this measure is the provision of a new pedestrian bridge to the south of the Salmon Weir Bridge which must cross Lough Corrib SAC) ▪ D2.1.3 UHG Grounds/University Road[12] – terminates at the Salmon Weir Bridge which is within Lough Corrib SAC ▪ D2.1.7 Coast Road – the existing road and associated hard standing lies within, or is adjacent to, Galway bay Complex SAC and lies adjacent to Inner Galway Bay SPA ▪ D2.1.8 Salthill Road Upper – the southern end of this corridor lies within Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA ▪ D2.2.1 St. Vincent's Avenue/St. Francis Street/Eglington Street – this corridor includes the Salmon Weir Bridge which is within Lough Corrib SAC			

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[12] (numerical references when given are as per Appendix D of the GTS)

Potential Impact Pathway	**Description**	**European Sites Potentially Affected**	**Environmental Protection Policies**	**Mitigation Measures**
	▪ D2.2.3 Forster Street/College Road – the northern end of this corridor lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA ▪ D2.2.4 Old Dublin Road – the western end of this corridor lies within and in close proximity to Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA ▪ D2.2.7 Headford Road/Dun na Coiribe/Castlelawn heights/Tirellan Heights – crosses the Terryland River which drains to the River Corrib Therefore, these GTS elements could only potentially affect Lough Corrib SAC, Lough Corrib SPA, Galway Bay Complex SAC and Inner Galway Bay SPA via this impact pathway. The non-greenway cycle network elements are downstream of Lough Corrib SPA and Ross Lake and Woods SAC – although, could be potentially upstream of ex-situ sites used by SCI species of Lough Corrib SPA: ▪ F4.1 Knocknacarra South – includes a feeder cycle corridor along the coast road/R336 which lies within, or is adjacent to, Galway bay Complex SAC and lies adjacent to Inner Galway Bay SPA (the Bearna Greenway also forms part of the proposals in this area and is described separately under that heading) ▪ F4.2 Salthill – includes Threadneedle Road, Salthill Road Upper and Whitestrand Road, sections of which either lie within or adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA ▪ F4.6 Newcastle & Dangan – includes the N6/Quincentenary Bridge, NUIG and Chestnut Lane sections of which lie either within or adjacent to Lough Corrib SAC (the Galway to Oughterard Greenway also forms part of the proposals in this area and is described separately under that heading)			

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	▪ F4.7 City Centre – includes new bridges over the River Corrib at the site of the Old Clifden Railway bridge, the Salmon Weir Bridge and Wolfe Tone Bridge, and proposed works along College Road. The first two locations cross Lough Corrib SAC, the area south of Wolfe Tone Bridge crosses Galway Bay Complex SAC, and the proposed works along College Road lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA ▪ F4.8 Terryland and Ballinfoyle – includes the N6/Quincentenary Bridge, which crosses Lough Corrib SAC, and Dyke Road, sections of which lie adjacent to Lough Corrib SAC ▪ F4.10 Renmore & Dublin Road – includes College Road, the Dublin Road and Doughiska Road. The northern end of College Road lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA, the western end of the Dublin Road lies within and in close proximity to Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA, and the southern end of Doughiska Road lies adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA (the proposed Galway City to Oranmore section of the Galway to Dublin Cycleway also forms part of the proposals in this area and is described separately under that heading) ▪ Supporting measures to expand the bike share scheme, provide for and upgrade bicycle parking facilities, and improve cycling permeability across the city are not location specific and could potentially affect European Sites within Galway City – Lough Corrib SAC, Galway Bay Complex SAC and Inner Galway Bay SPA ▪ A greenway connecting Eyre Square and Renmore (in the vicinity of Galway Port or the			

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	existing rail crossing over Lough Atalia) would cross Galway Bay Complex SAC and Inner Galway Bay SPA Therefore, these GTS elements could only potentially affect Lough Corrib SAC, Lough Corrib SPA, Galway Bay Complex SAC and Inner Galway Bay SPA via this impact pathway. The pedestrian network elements are downstream of Lough Corrib SPA and Ross Lake and Woods SAC – although, could be potentially upstream of ex-situ sites used by SCI species of Lough Corrib SPA: ▪ The Cross-City Link includes for a new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge. ▪ Connecting a greenway between Eyre Square and Renmore (in the vicinity of Galway Port or the existing rail crossing over Lough Atalia) may impact on Galway Bay Complex SAC and Inner Galway Bay SPA. ▪ The proposed new bridge over the River Corrib along the line of the Old Clifden Railway at NUI Galway/Waterside which crosses Lough Corrib SAC. ▪ A proposed new cycle/pedestrian bridge to the south of Wolfe Tone Bridge must cross Galway Bay Complex SAC. Therefore, these GTS elements could only potentially affect Lough Corrib SAC, Lough Corrib SPA, Galway Bay Complex SAC and Inner Galway Bay SPA via this impact pathway.			
Habitat degradation – water quality impacts during operation **Project operation affecting surface, ground and/or coastal water quality, or**	**N6 Galway City Ring Road (N6 GCRR)** Road drainage from the proposed road will discharge to the River Corrib and many other rivers and streams within the strategy area that drain to Galway Bay. Road drainage could contain pollutants that could impact on water quality in receiving watercourses and in Galway Bay and consequently affect the conservation objectives	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA	**Galway City Council Draft Development Plan 2017-2023** GCiDP 01, GCiDP 02, GCiDP 03, GCiDP 04, GCiDP 05, GCiDP 06,	GTS – Habitat degradation – water quality (operation) – New Road Developments See Box 5b in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	supporting QI habitats and QI/SCI species in European Sites downstream – Lough Corrib SAC, Galway Bay Complex SAC and Inner Galway Bay SPA. Facilitating increased use of transport modes such as bus, bicycle and walking over individual car use in Galway City by the implementation of the N6 GCRR would be expected to result in a positive impact on water quality discharges from the city drainage network. Beyond the urban and suburban fringe of the city the GTS consists of Greenways—cycle and pedestrian facilities—which pose no operational risk to water quality in receiving watercourses or to any European Sites downstream.		GCiDP 08, GCiDP 11, GCiDP 12, GCiDP 13, GCiDP 14, GCiDP 15, GCiDP 16, GCiDP 17, GCiDP 18, GCiDP 21, GCiDP 22, GCiDP 23 **Galway County Development Plan 2015-2021** GCoDP 01, GCoDP 02, GCoDP 03, GCoDP 04, GCoDP 06, GCoDP 07, GCoDP 12, GCoDP 13, GCoDP 14, GCoDP 15, GCoDP 16, GCoDP 18, GCoDP 19	
	Public Transport Network (All Elements of the GTS) Park & Ride facilities – although specific locations have not been identified, based on the assessment presented in *Appendix F – Modelling Services Framework, Galway Transport Strategy, Assessment for the Role of Park & Ride*, these are likely to be situated on the outskirts of Galway City, on the M6, the N17, and the Western Distributor Road/R336 corridors. There is the potential for operational run-off from such sites to be contaminated with hydrocarbons or heavy metals and therefore, the potential to impact on water quality in receiving watercourses and in Galway Bay and consequently affect the conservation objectives supporting QI habitats and QI/SCI species in European Sites downstream – Lough Corrib SAC, Lough Corrib SPA, Galway Bay Complex SAC and Inner Galway Bay SPA. Other proposed new road links - The GTS does however include for a number of new road development in Galway City: new road links from Newcastle Road to Bóthar Einde, from Dun na Coiribe to Castlelawn Heights, between the Bóthar na dTreabh and the Tuam Road via Liosbán Industrial Estate, between Ballybrit Business Park and Parkmore Business Park, between Parkmore Link Road and the N17 and two links at Merlin Park (one from the Dublin Road and over the R446 at Doughiska. Drainage from proposed new roads will discharge to rivers or streams (including the River Corrib) that ultimately drain to Galway Bay. Road drainage could contain pollutants that could impact on water quality in receiving watercourses and in Galway Bay and consequently affect the conservation objectives supporting QI	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA		GTS – Habitat degradation – water quality (operation) – Park & Ride Facilities See Box 5a in Section 3.2 of the NIS GTS – Habitat degradation – water quality (operation) – New Road Developments See Box 5b in Section 3.2 of the NIS

Potential Impact Pathway	**Description**	**European Sites Potentially Affected**	**Environmental Protection Policies**	**Mitigation Measures**
	habitats and QI/SCI species in European Sites downstream – Lough Corrib SAC, Galway Bay Complex SAC and Inner Galway Bay SPA.			
<u>Habitat degradation – shading</u> **Shading effects of bridge structures on habitats (e.g. reduction in sunlight and direct precipitation)**	**N6 Galway City Ring Road (N6 GCRR)** The proposed River Corrib Bridge crosses Lough Corrib SAC on an elevated viaduct structure which would affect levels of sunlight and direct precipitation supporting the vegetation beneath. However, none of the habitat types potentially affected are Annex I habitat types, they are not QI habitats of Lough Corrib SAC, and do not provide a supporting role to any QI Annex I habitats of the SAC. Therefore, via this impact pathway, the proposed N6 GCRR does not pose any risk of adverse effects on the integrity of Lough Corrib SAC. *For more information on the habitat descriptions, see the habitat loss section above under N6 Galway City Ring Road (N6 GCRR)*	Lough Corrib SAC	**Galway City Council Draft Development Plan 2017-2023** GCiDP 01, GCiDP 02, GCiDP 03, GCiDP 04, GCiDP 05, GCiDP 06, GCiDP 08, GCiDP 11, GCiDP 21, **Galway County Development Plan 2015-2021** GCoDP 01, GCoDP 02, GCoDP 03, GCoDP 04, GCoDP 06, GCoDP 07	No specific mitigation measures are required to address this impact pathway as the N6 GCRR poses no risk of affecting the conservation objectives of any European Sites via this impact pathway
	Bearna Greenway, Galway to Dublin Cycleway (Galway City to Oranmore) and Galway to Oughterard Greenway Any new bridge structures that may be proposed as part of the greenways that are located within Lough Corrib SAC, Lough Corrib SPA, Galway Bay Complex SAC, Inner Galway Bay SPA and/or Ross Lake and Woods SAC, have the potential to result in shading effects (i.e. reduced sunlight and levels of direct precipitation) on habitats beneath the structure. Such impacts could potentially affect QI habitats and/or habitats which may support QI/SCI species of these European Sites.	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC		
	Public Transport Network (All Elements of the GTS) Upgrading the public transport network will/may require the provision of (or may be dependent on the delivery of) additional transport infrastructure in areas within or adjacent to European Sites which have the potential to affect habitat areas within Lough Corrib SAC as a result of direct shading: ▪ Salmon Weir Bridge (and associated with this measure is the provision of a new pedestrian bridge to the south of	Lough Corrib SAC		GTS – Habitat degradation – shading See Box 6 in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	the Salmon Weir Bridge which must cross Lough Corrib SAC). Shading effects on habitat within an SAC could negatively affect the conservation objectives and constitute an adverse effect on the integrity of the European Site.			
	Cycle Network (All Elements of the GTS) Achieving the strategic aims for the cycle network will/may require the provision of (or may be dependent on the delivery of) additional transport infrastructure in areas within or adjacent to European Sites which have the potential to affect habitat areas within SACs and/or SPAs as a result of direct shading: ▪ The secondary cycle network includes for a proposed new bridge over the River Corrib along the line of the Old Clifden Railway at NUI Galway/Waterside which crosses Lough Corrib SAC. ▪ Facilitating city cycling relies upon the Cross-City Link which includes for a new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge. ▪ Connecting a greenway between Eyre Square and Renmore may impact on Galway Bay Complex SAC and Inner Galway Bay SPA. ▪ A proposed new cycle/pedestrian bridge to the south of Wolfe Tone Bridge must cross Galway Bay Complex SAC Shading effects on habitat within an SAC or SPA (including ex-situ sites) could negatively affect the conservation objectives and constitute an adverse effect on the integrity of the European Site.	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA		GTS – Habitat degradation – shading See Box 6 in Section 3.2 of the NIS
	Pedestrian Network (All Elements of the GTS) Aside from the three principle greenway projects, achieving the strategic aims for the pedestrian network will/may require the provision of (or may be dependent on the delivery of) additional bridge structure within European Sites which have the potential to affect habitat areas within SACs and/or SPAs as a result of direct shading:	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA		GTS – Habitat degradation – shading See Box 6 in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	▪ The Cross-City Link includes for a new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge. ▪ Connecting a greenway between Eyre Square and Renmore (in the vicinity of Galway Port or the existing rail crossing over Lough Atalia) may impact on Galway Bay Complex SAC and Inner Galway Bay SPA. ▪ The proposed new bridge over the River Corrib along the line of the Old Clifden Railway at NUI Galway/Waterside which crosses Lough Corrib SAC. ▪ A proposed new cycle/pedestrian bridge to the south of Wolfe Tone Bridge must cross Galway Bay Complex SAC Shading effects on habitat within an SAC or SPA (including ex-situ sites) could negatively affect the conservation objectives and constitute an adverse effect on the integrity of the European Site.			
<u>Habitat degradation – air quality</u> **A reduction in air quality affecting fauna species and/or habitats (e.g. vegetation composition and structure)**[13]	**N6 Galway City Ring Road (N6 GCRR)** The introduction of a new road into a rural landscape will affect air quality to some degree in comparison with existing baseline levels and could affect the environmental conditions supporting QI habitats and/or QI species in Lough Corrib SAC, through which the N6 GCRR passes. Emissions from car exhausts, and the deposition of particulate matter and heavy metals produced by engine, brake and tyre wear, can contribute to increased deposition of pollutants such as oxides of nitrogen (NO_x), particulate matter (PM) and heavy metals (HM) in the vicinity of a road carriageway. This can affect the ecosystems and vegetation present, influencing plant growth rates and species composition, diversity, and abundance. It is considered unlikely, given the predicted traffic volumes, that any of the proposed road corridor would lead to an increase in NO_x concentration levels that would be above the limit value of 30 $\mu g/m^3$ for the protection of vegetation set out in *Guidelines for the*	Lough Corrib SAC	**Galway City Council Draft Development Plan 2017-2023** GCiDP 01, GCiDP 02, GCiDP 03, GCiDP 04, GCiDP 05, GCiDP 08, GCiDP 11, GCiDP 19, GCiDP 21 **Galway County Development Plan 2015-2021** GCoDP 01, GCoDP 02, GCoDP 03, GCoDP 04, GCoDP 06, GCoDP 07, GCoDP 18	GTS - Habitat Degradation – Air Quality See Box 7 in Section 3.2 of the NIS

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[13] As one of the key principles of the GTS is to “To promote and encourage sustainable transport, and in particular to make it convenient and attractive to walk, cycle or use public transport”, there may be an overall positive impact compared with the “Do-nothing” scenario in urban and suburban areas of Galway City and the associated European Sites (Lough Corrib SAC, Galway Bay Complex SAC and Inner Galway Bay SPA

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	Treatment of Air Quality during the Planning and Construction of National Road Schemes (National Roads Authority, 2011) or affect the conservation objectives supporting qualifying interest habitats, or those of habitats supporting qualifying interest species, within Lough Corrib SAC. Similarly, the dry deposition rate of nitrogen would not be expected to be above the critical load of 5 KG(N)/ha/yr defined in those guidelines and any values would be expected to drop off rapidly at increased distance from a road. In terms of PM and HM, concentrations would be expected to be below the ambient air quality standards. There is likely to be some increases on soil concentrations of elements of PM and HM within the immediate road side verge that would result in some localised effects to vegetation. However, it is unlikely to result in any significant changes to species composition or diversity, to adversely affect the conservation objectives supporting the conservation condition of qualifying interest habitats, or habitats supporting qualifying interest species, within Lough Corrib SAC. Air quality effects on habitat within an SAC or SPA (including ex-situ sites) could negatively affect the conservation objectives and constitute an adverse effect on the integrity of the European Site. Facilitating increased use of transport modes such as bus, bicycle and walking over individual car use in Galway City would be expected to result in a positive impact on air quality in Galway City and any European Sites therein. Beyond the urban and suburban fringe of the City the GTS consists of Greenways—cycle and pedestrian facilities—which pose no operational risk to any European Sites as a result of a reduction in air quality.			
Habitat degradation – non-native invasive species **Introducing or spreading non-native invasive species affecting habitats (e.g. vegetation composition and structure)**	There is the potential for non-native invasive species to be present in habitat areas affected by the GTS. If present, these could potentially be spread to habitats within the SAC/SPA during construction works or during operation, during the course of maintenance works. The introduction of invasive species can significantly affect the conservation objectives supporting the conservation condition of QI habitats or species, adversely affecting the integrity of the European Site concerned. For example, affecting habitat/species diversity, vegetation composition, and species distribution and abundance.	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	**Galway City Council Draft Development Plan 2017-2023** GCiDP 01, GCiDP 02, GCiDP 03, GCiDP 04, GCiDP 05, GCiDP 06, GCiDP 08, GCiDP 11, GCiDP 20, GCiDP 21, GCiDP 22	GTS - Habitat Degradation – Non-native Invasive Species See Box 8 in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
			Galway County Development Plan 2015-2021 GCoDP 01, GCoDP 02, GCoDP 03, GCoDP 04, GCoDP 06, GCoDP 07, GCoDP 17, GCoDP 18	
<u>**Disturbance/displacement**</u> **Disturbance to fauna resulting in displacement from important habitat areas (e.g. breeding/resting places or foraging areas)**	**N6 Galway City Ring Road (N6 GCRR)** The construction and operation of road infrastructure through Lough Corrib SAC has the potential to result in levels of disturbance that would result in displacement effects to QI species along the River Corrib Corridor—Otter, Atlantic salmon, Brook lamprey and Sea lamprey—, along the Bearna Stream at Bearna Woods in Galway Bay Complex SAC, and potentially at ex-situ sites supporting SCI bird species of Lough Corrib SPA and Inner Galway Bay SPA. An assessment of the potential for the N6 GCRR to adversely affect the integrity of either Lough Corrib SAC or Inner Galway Bay SPA was carried out at the route selection stage (Arup, 2015). Based on the predicted noise levels for road construction works, a disturbance ZoI was defined as 300m with respect to wintering birds which as assessed against the winter bird sites surveyed as part of that study. On a precautionary basis, it was assumed that all winter birds recorded outside of either SPA were part of the SPAs SCI population. In consideration of the numbers of wintering birds recorded at each surveyed site, the frequency of use over the winter period, the temporary nature of any construction or operational disturbance, and the abundance of available suitable habitat across the wider locality, this assessment found that none of the route options (of which the emerging preferred route corridor is one) would affect the Site's conservation objectives for the SCI species and would not adversely affect the integrity of either SPA. On that basis, it is reasonable to assume that the risk of the GTS adversely affecting the integrity of any of the SPA sites during construction is extremely low; particularly given that the majority of projects proposed under the strategy will be developed within the city itself, and works will be of a temporary nature.	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	**Galway City Council Draft Development Plan 2017-2023** GCiDP 01, GCiDP 02, GCiDP 03, GCiDP 04, GCiDP 05, GCiDP 06, GCiDP 07, GCiDP 08, GCiDP 11, GCiDP 21, GCiDP 22, GCiDP 23 **Galway County Development Plan 2015-2021** GCoDP 01, GCoDP 02, GCoDP 03, GCoDP 04, GCoDP 06, GCoDP 07, GCoDP 18, GCoDP 19	GTS – Disturbance/Displacement See Box 9 in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	Disturbance/displacement effects to species within an SAC or SPA (including ex-situ sites) could negatively affect the conservation objectives and constitute an adverse effect on the integrity of the European Site.			
	Bearna Greenway The proposed Bearna Greenway will require the construction of new cycle infrastructure, most likely along the existing road and pathway network and within existing green spaces in close proximity to the coastline. This has the potential to intersect with the boundaries of Galway Bay Complex SAC and Inner Galway Bay SPA at numerous points along the coastline between the River Corrib and Bearna. Construction of the greenway has the potential to result in levels of disturbance that would result in displacement effects to QI species along the coastline of Galway Bay—Otter and Harbour seal—and to areas within Inner Galway Bay SPA (foraging and roosting sites) and ex-situ sites supporting SCI bird species of the SPA, and potentially Lough Corrib SPA. Operation of a greenway within, and in such close proximity to, Inner Galway Bay SPA has the potential to result in levels of disturbance that would result in displacement effects to SCI bird species of Inner Galway Bay SPA. Based on that discussed above in relation to the N6 GCRR, construction works are not likely to result in any long-term displacement effects. However during operation, coastal areas supporting SCI bird species are most vulnerable to the more long-term disturbance/displacement effects. These are often associated with increased human presence where coastal walkways/greenways are introduced into formerly undisturbed habitats in areas important in supporting the SCI populations. Addressing this risk is covered in the mitigation strategy. Disturbance/displacement effects to species within an SAC or SPA (including ex-situ sites) could negatively affect the conservation objectives and constitute an adverse effect on the integrity of the European Site.	Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA		GTS – Disturbance/Displacement See Box 9 in Section 3.2 of the NIS
	Galway to Dublin Cycleway (Galway City to Oranmore)	Lough Corrib SPA Galway Bay Complex SAC		GTS – Disturbance/Displacement

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	This section of the proposed greenway will require the construction of new cycle infrastructure along the coastline between Galway City and Oranmore. This has the potential to intersect with the boundaries of Galway Bay Complex SAC and Inner Galway Bay SPA at numerous points along the coastline between the River Corrib and Oranmore. Construction of the greenway has the potential to result in levels of disturbance that would result in displacement effects to QI species along the coastline of Galway Bay—Otter and Harbour seal—and to areas within Inner Galway Bay SPA (foraging and roosting sites) and ex-situ sites supporting SCI bird species of the SPA. Operation of a greenway within, and in such close proximity to, Inner Galway Bay SPA has the potential to result in levels of disturbance that would result in displacement effects to SCI bird species of Inner Galway Bay SPA. Based on that discussed above in relation to the N6 GCRR, construction works are not likely to result in any long-term displacement effects. However during operation, coastal areas supporting SCI bird species are most vulnerable to the more long-term disturbance/displacement effects. These are often associated with increased human presence where coastal walkways/greenways are introduced into formerly undisturbed habitats in areas important in supporting the SCI populations. Addressing this risk is covered in the mitigation strategy. Disturbance/displacement effects to species within an SAC or SPA (including ex-situ sites) could negatively affect the conservation objectives and constitute an adverse effect on the integrity of the European Site.	Inner Galway Bay SPA		See Box 9 in Section 3.2 of the NIS
	Galway to Oughterard Greenway Whilst the specific alignment of the Galway to Oughterard Greenway has not yet been determined, it is envisaged that it will utilise the disused Galway to Clifden rail line along much of its length. Construction of the greenway has the potential to result in levels of disturbance that would result in displacement effects to QI species along the River Corrib (Otter and potentially Otter breeding or resting places; holts or couches), disturbance/displacement effects	Lough Corrib SAC Lough Corrib SPA Ross Lake and Woods SAC		GTS – Disturbance/Displacement See Box 9 in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	to Lesser horseshoe bats in Ross Lake and Woods SAC, and disturbance in areas within Lough Corrib SPA (foraging and roosting sites) and ex-situ sites supporting SCI bird species of the SPA. Operation of a greenway within, and in such close proximity to, Inner Galway Bay SPA has the potential to result in levels of disturbance that would result in displacement effects to SCI bird species of Inner Galway Bay SPA. If lighting is proposed, operation could result in disturbance/displacement effects to Lesser horseshoe bats in Ross Lake and Woods SAC. Based on that discussed above in relation to the N6 GCRR, construction works are not likely to result in any long-term displacement effects. However during operation, any important habitat areas within the SPA, or at ex-situ sites, supporting SCI bird species are most vulnerable to any more long-term disturbance/displacement effects. These are often associated with increased human presence where greenways are introduced into formerly undisturbed habitats in areas important in supporting the SCI populations. Of particular note are Hen harrier, as a winter roosting site is located in the vicinity of the southern shores of Lough Corrib. Disturbance/displacement effects to species within an SAC or SPA (including ex-situ sites) could negatively affect the conservation objectives and constitute an adverse effect on the integrity of the European Site.			
	Public Transport Network (All Elements of the GTS) Upgrading the public transport network will/may require the provision of (or may be dependent on the delivery of) additional transport infrastructure in areas within or adjacent to European Sites which have the potential to result in the disturbance/displacement of QIs/SCIs within SACs and/or SPAs: ▪ R336 Coast Road (and including D2.1.8 Salthill Road Upper[14]) - within and adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA. Construction works have the potential to result in levels of disturbance that would result in displacement effects to QI species along	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA		GTS – Disturbance/Displacement See Box 9 in Section 3.2 of the NIS

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[14] 14 (numerical references when given are as per Appendix D of the GTS)

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	the coastline of Galway Bay—Otter and Harbour seal—and to areas within Inner Galway Bay SPA (foraging and roosting sites) and ex-situ sites supporting SCI bird species of the SPA. ▪ Salmon Weir Bridge and D2.2.1 St. Vincent's Avenue/St. Francis Street/Eglington Street (and associated with this measure is the provision of a new pedestrian bridge to the south of the Salmon Weir Bridge which must cross Lough Corrib SAC). Construction works have the potential to result in levels of disturbance that would result in displacement effects to QI species along the River Corrib Corridor—Otter, Atlantic salmon, Brook lamprey and Sea lamprey. ▪ College Road & Old Dublin Road - within/adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA at Lough Atalia. Construction works have the potential to result in levels of disturbance that would result in displacement effects to QI species along the coastline of Galway Bay—Otter and Harbour seal—and to areas within Inner Galway Bay SPA (foraging and roosting sites) and ex-situ sites supporting SCI bird species of the SPA. ▪ Ceannt Station/Fairgreen Station - adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA at Lough Atalia. Construction works have the potential to result in levels of disturbance that would result in displacement effects to QI species along the coastline of Galway Bay—Otter and Harbour seal—and to areas within Inner Galway Bay SPA (foraging and roosting sites) and ex-situ sites supporting SCI bird species of the SPA. ▪ University Road/Cathedral - adjacent to Lough Corrib SAC. Any construction works here have the potential to result in levels of disturbance that would result in displacement effects to QI species along the River Corrib Corridor—Otter, Atlantic salmon, Brook lamprey and Sea lamprey. ▪ Park & Ride facilities in unspecified locations. Such facilities could be located in areas where potential			

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	disturbance/displacement effects to QIs/SCIs of Lough Corrib SAC, Lough Corrib SPA, Galway Bay Complex SAC and Inner Galway Bay SPA would result. Disturbance/displacement effects to species within an SAC or SPA (including ex-situ sites) could negatively affect the conservation objectives and constitute an adverse effect on the integrity of the European Site. Operation of the public transport network, on the city road network, does not pose a risk of disturbance that would affect species in any of the European Sites discussed above.			
	Cycle Network (Non-Greenway Elements of the GTS) Aside from the three principle greenway projects, achieving the strategic aims for the cycle network will/may require the provision of (or may be dependent on the delivery of) additional transport infrastructure in areas within or adjacent to European Sites which have the potential to result in the disturbance/displacement of QIs/SCIs within SACs and/or SPAs: ▪ F4.1 Knocknacarra South – includes a feeder cycle corridor along the coast road/R336 which lies within, or is adjacent to, Galway bay Complex SAC and lies adjacent to Inner Galway Bay SPA (the Bearna Greenway also forms part of the proposals in this area and is described separately under that heading) ▪ F4.2 Salthill – includes Threadneedle Road, Salthill Road Upper and Whitestrand Road, sections of which either lie within or adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA ▪ F4.6 Newcastle & Dangan – includes the N6/Quincentenary Bridge, NUIG and Chestnut Lane sections of which lie either within or adjacent to Lough Corrib SAC (the Galway to Oughterard Greenway also forms part of the proposals in this area and is described separately under that heading) ▪ F4.7 City Centre – includes new bridges over the River Corrib at the site of the Old Clifden Railway bridge, the Salmon Weir Bridge and Wolfe Tone Bridge, and	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA		GTS – Disturbance/Displacement See Box 9 in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	proposed works along College Road. The first two locations cross Lough Corrib SAC, the area south of Wolfe Tone Bridge crosses Galway Bay Complex SAC, and the proposed works along College Road lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA ▪ F4.8 Terryland and Ballinfoyle – includes the N6/Quincentenary Bridge, which crosses Lough Corrib SAC, and Dyke Road, sections of which lie adjacent to Lough Corrib SAC ▪ F4.10 Renmore & Dublin Road – includes College Road, the Dublin Road and Doughiska Road. The northern end of College Road lies in close proximity to Galway Bay Complex SAC and Inner Galway Bay SPA, the western end of the Dublin Road lies within and in close proximity to Galway Bay Complex SAC and adjacent to Inner Galway Bay SPA, and the southern end of Doughiska Road lies adjacent to Galway Bay Complex SAC and Inner Galway Bay SPA (the proposed Galway City to Oranmore section of the Galway to Dublin Cycleway also forms part of the proposals in this area and is described separately under that heading) ▪ Supporting measures to expand the bike share scheme, provide for and upgrade bicycle parking facilities, and improve cycling permeability across the city are not location specific and could potentially affect European Sites within Galway City – Lough Corrib SAC, Galway Bay Complex SAC and Inner Galway Bay SPA ▪ a greenway connecting Eyre Square and Renmore (in the vicinity of Galway Port or the existing rail crossing over Lough Atalia) would cross Galway Bay Complex SAC and Inner Galway Bay SPA ▪ A proposed new cycle/pedestrian bridge to the south of Wolfe Tone Bridge must cross Galway Bay Complex SAC. Construction works have the potential to result in levels of disturbance that would result in displacement effects to QI species of Galway Bay Complex SAC—			

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	Otter and Harbour seal—and to SCI bird species of Inner Galway Bay in this area. Disturbance/displacement effects to species within an SAC or SPA (including ex-situ sites) could negatively affect the conservation objectives and constitute an adverse effect on the integrity of the European Site.			
	Pedestrian Network (All Elements of the GTS) Aside from the three principle greenway projects, achieving the strategic aims for the pedestrian network will/may require the provision of (or may be dependent on the delivery of) additional transport infrastructure in areas within or adjacent to European Sites which have the potential to result in the disturbance/displacement of QIs/SCIs within SACs and/or SPAs: ▪ The Cross-City Link includes for a new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge. Construction works have the potential to result in levels of disturbance that would result in displacement effects to QI species along the River Corrib Corridor—Otter, Atlantic salmon, Brook lamprey and Sea lamprey. As a host species to the larval (glochidial) stage of the Freshwater pearl mussel's life cycle (also a QI species of Lough Corrib SAC), impacts to salmonid fish species could have knock-on effects on the SACs Freshwater pearl mussel population. ▪ Connecting a greenway between Eyre Square and Renmore (in the vicinity of Galway Port or the existing rail crossing over Lough Atalia) may impact on Galway Bay Complex SAC and Inner Galway Bay SPA. Construction works have the potential to result in levels of disturbance that would result in displacement effects to QI species of Galway Bay Complex SAC—Otter and Harbour seal—and to SCI bird species of Inner Galway Bay in this area. ▪ The proposed new bridge over the River Corrib along the line of the Old Clifden Railway at NUI Galway/Waterside which crosses Lough Corrib SAC. Construction works have the potential to result in levels	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA		GTS – Disturbance/Displacement See Box 9 in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	of disturbance that would result in displacement effects to QI species along the River Corrib Corridor—Otter, Atlantic salmon, Brook lamprey and Sea lamprey. ▪ A proposed new cycle/pedestrian bridge to the south of Wolfe Tone Bridge must cross Galway Bay Complex SAC. Construction works have the potential to result in levels of disturbance that would result in displacement effects to QI species of Galway Bay Complex SAC—Otter and Harbour seal—and to SCI bird species of Inner Galway Bay in this area. Disturbance/displacement effects to species within an SAC or SPA (including ex-situ sites) could negatively affect the conservation objectives and constitute an adverse effect on the integrity of the European Site.			
Barrier effect **Construction works or new structures creating a barrier to fauna species movement**	**N6 Galway City Ring Road (N6 GCRR)** The N6 GCRR will include for the construction of a new bridge structure across the River Corrib. The River Corrib is used by Otter, Atlantic salmon, Brook lamprey and Sea lamprey (QI species of Lough Corrib SAC) and, depending on the bridge design and construction methodology used, could present a barrier to species movement along the River Corrib corridor—as a minimum temporarily during construction. Creating a barrier to species movement within an SAC could negatively affect the conservation objectives and constitute an adverse effect on the integrity of Lough Corrib SAC.	Lough Corrib SAC	**Galway City Council Draft Development Plan 2017-2023** GCiDP 01, GCiDP 02, GCiDP 03, GCiDP 04, GCiDP 05, GCiDP 06, GCiDP 08, GCiDP 11, GCiDP 21, GCiDP 22, GCiDP 23 **Galway County Development Plan 2015-2021** GCoDP 01, GCoDP 02, GCoDP 03, GCoDP 04, GCoDP 06, GCoDP 07, GCoDP 18, GCoDP 19	GTS – Barrier Effect See Box 10 in Section 3.2 of the NIS
	Bearna Greenway and Galway to Dublin Cycleway (Galway City to Oranmore) As these greenways may cross streams or linear habitats within Galway Bay Complex SAC, construction works and/or any proposed new structures have the potential to create a barrier to fauna species movement (e.g. within foraging areas or along commuting routes). Creating a barrier to species movement within an SAC could negatively affect the conservation objectives and constitute an adverse effect on the integrity of Galway Bay Complex SAC.	Galway Bay Complex SAC		

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	Galway to Oughterard Greenway Whilst the specific alignment of the Galway to Oughterard Greenway has not yet been determined, it is envisaged that it will utilise the disused Galway to Clifden rail line along much of its length. Therefore, the greenway has the potential to cross watercourses within Lough Corrib SAC, could require the construction of a new bridge structure and, depending on the bridge design and construction methodology used, could present a barrier to species movement along those river/stream corridors—at least temporarily during construction. The greenway could also impact on Ross Lake and Woods SAC during operation, as the rail line passes through the SAC. If sections of the greenway were to be lit within the foraging/commuting range of the Lesser horseshoe roost for which the site is designated (potentially the key habitat area supporting the roost), there is the potential for a barrier effect to occur which could affect the SACs Lesser horseshoe population through preventing bats following commuting routes or accessing important foraging habitat. Creating a barrier to species movement within an SAC (or in the case of bat species within their foraging/commuting range) could negatively affect the conservation objectives and constitute an adverse effect on the integrity of Lough Corrib SAC.	Lough Corrib SAC Ross Lake and Woods SAC		GTS – Barrier Effect See Box 10 in Section 3.2 of the NIS
	Public Transport Network (All Elements of the GTS) Achieving the strategic aims for the public transport network will/may require the provision of (or may be dependent on the delivery of) additional bridge structures within European Sites which, depending on the bridge design and construction methodology used, have the potential to—at least temporarily during construction— present a barrier to species movement along the River Corrib: ▪ The Cross-City Link includes for a new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge which could affect Otter, Atlantic salmon, Brook lamprey and Sea lamprey in the River Corrib. As a host species to the larval (glochidial) stage of the Freshwater pearl mussel's life cycle (also a QI species of Lough	Lough Corrib SAC		GTS – Barrier Effect See Box 10 in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	Corrib SAC), impacts to salmonid fish species could have knock-on effects on the SACs Freshwater pearl mussel population. Creating a barrier to species movement within an SAC could negatively affect the conservation objectives and constitute an adverse effect on the integrity of Lough Corrib SAC.			
	Cycle Network (Non-Greenway Elements of the GTS) and Pedestrian Network (All Elements of the GTS) Achieving the strategic aims for the cycle and pedestrian networks will/may require the provision of (or may be dependent on the delivery of) additional bridge structures within European Sites which, depending on the bridge design and construction methodology used, have the potential to—at least temporarily during construction— present a barrier to species movement along the River Corrib and the coastline of Galway Bay: ▪ The proposed new cycle/pedestrian bridge over the River Corrib along the line of the Old Clifden Railway at NUI Galway/Waterside crosses Lough Corrib SAC, as does the proposed new bridge south of the existing Salmon Weir Bridge, and could potentially affect Otter, Atlantic salmon, Brook lamprey and Sea lamprey in the River Corrib. As a host species to the larval (glochidial) stage of the Freshwater pearl mussel's life cycle (also a QI species of Lough Corrib SAC), impacts to salmonid fish species could have knock-on effects on the SACs Freshwater pearl mussel population. ▪ The proposed new cycle/pedestrian bridge over the River Corrib, to the south of Wolfe Tone Bridge, must cross Galway Bay Complex SAC and could potentially affect Otter and Harbour seal ▪ Connecting a greenway between Eyre Square and Renmore could potentially affect Otter and Harbour seal in the vicinity of Galway Harbour and Lough Atalia. Creating a barrier to species movement within an SAC could negatively affect the conservation objectives and constitute an adverse effect on the integrity of Lough Corrib SAC.	Lough Corrib SAC Galway Bay Complex SAC		GTS – Barrier Effect See Box 10 in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
Mortality risk **Mortality and/or road traffic collision risk to fauna species**	**N6 Galway City Ring Road (N6 GCRR)** The N6 GCRR will include for the construction of a new bridge structure across the River Corrib and a new road in the vicinity of the Coolagh lakes. Both of these areas are used by Otter (a QI species of Lough Corrib SAC) and there is a permanent risk of mortality/road traffic collision impacts if Otter gain access to the road carriageway. Constructing a new bridge over the River Corrib poses a (temporary) risk of construction materials/debris falling into the river and injuring/killing QI aquatic fish species—Atlantic salmon, Brook lamprey and River lamprey. As a host species to the larval (glochidial) stage of the Freshwater pearl mussel's life cycle (also a QI species of Lough Corrib SAC), impacts to salmonid fish species could have knock-on effects the SACs Freshwater pearl mussel population. A new bridge across the River Corrib poses a permanent collision risk with the bridge structure to SCI bird species of Lough Corrib SPA and/or Inner Galway Bay SPA commuting along the river corridor. Either of these impact pathways has the potential to negatively affect the conservation objectives and constitute an adverse effect on the integrity of these European Sites.	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	**Galway City Council Draft Development Plan 2017-2023** GCiDP 01, GCiDP 02, GCiDP 03, GCiDP 04, GCiDP 05, GCiDP 06, GCiDP 08, GCiDP 11, GCiDP 21, GCiDP 22, GCiDP 23 **Galway County Development Plan 2015-2021** GCoDP 01, GCoDP 02, GCoDP 03, GCoDP 04, GCoDP 06, GCoDP 07	GTS – Mortality Risk See Box 11 in Section 3.2 of the NIS
	Public Transport Network (All Elements of the GTS) Achieving the strategic aims for the public transport network will/may require the provision of (or may be dependent on the delivery of) additional bridge structures within European Sites which have the potential to result in the mortality of QI/SCI species as a result of construction falling onto aquatic/marine habitats: ▪ The Cross-City Link includes for a new pedestrian bridge across Lough Corrib SAC, south of the Salmon Weir Bridge which could affect Otter, Atlantic salmon, Brook lamprey and Sea lamprey in the River Corrib. As a host species to the larval (glochidial) stage of the Freshwater pearl mussel's life cycle (also a QI species of Lough Corrib SAC), impacts to salmonid fish species could have knock-on effects on the SACs Freshwater pearl mussel population. Any new bridge structure poses a collision risk to SCI bird species of Lough Corrib SPA and/or	Lough Corrib SAC Lough Corrib SPA Inner Galway Bay SPA		GTS – Mortality Risk See Box 11 in Section 3.2 of the NIS

Potential Impact Pathway	Description	European Sites Potentially Affected	Environmental Protection Policies	Mitigation Measures
	Inner Galway Bay SPA commuting along the river corridor. The mortality risk posed by new bridges has the potential to negatively affect the conservation objectives and constitute an adverse effect on the integrity of these European Sites.			
	Cycle Network (Non-Greenway Elements of the GTS) and Pedestrian Network (All Elements of the GTS) Achieving the strategic aims for the cycle and pedestrian networks will/may require the provision of (or may be dependent on the delivery of) additional bridge structures within European Sites which have the potential to result in the mortality of QI/SCI species as a result of construction falling onto aquatic/marine habitats: ▪ The proposed new cycle/pedestrian bridge over the River Corrib along the line of the Old Clifden Railway at NUI Galway/Waterside crosses Lough Corrib SAC and could affect Otter, Atlantic salmon, Brook lamprey and Sea lamprey in the River Corrib. ▪ Connecting a greenway between Eyre Square and Renmore could affect Otter and Harbour seal in the vicinity of Galway Harbour and Lough Atalia. ▪ A proposed new cycle/pedestrian bridge to the south of Wolfe Tone Bridge could affect Otter and Harbour seal in the vicinity of Galway Harbour and Lough Atalia. ▪ Any new bridge structures pose a risk of colliding with the bridge structure to SCI bird species of Lough Corrib SPA and/or Inner Galway Bay SPA commuting along the river corridor/coastline. The mortality risk posed by new bridges has the potential to negatively affect the conservation objectives and constitute an adverse effect on the integrity of these European Sites.	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA		GTS – Mortality Risk See Box 11 in Section 3.2 of the NIS

References

Arup (2015) N6 Galway City Transport Project: Route Selection Report.

Galway County Council (2015) Galway County Development Plan 2015-2021

Galway City Council (2016) Galway City Council Draft Development Plan 2017-2023

Table B-1: Source-Pathway-Receptor Summary Matrix—potential impact pathways connecting elements of the Galway Transport Strategy (GTS) to European Sites

	European Sites affected by specific Project Elements of the Galway Transport Strategy						
Potential Impact Pathway	**N6 Galway City Ring Road (N6 GCRR)**	**Bearna Greenway**	**Galway to Dublin Cycleway (Galway City to Oranmore)**	**Galway to Oughterard Greenway**	**Public Transport Network** **All Elements of the GTS**	**Cycle Network** **Non-Greenway Elements of the GTS**	**Pedestrian Network** **All Elements of the GTS**
<u>Habitat Loss</u> **Direct loss of habitat (terrestrial or freshwater) in European Site – habitat fragmentation is directly associated with this impact pathway**	Lough Corrib SAC	Galway Bay Complex SAC Inner Galway Bay SPA	Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Ross Lake and Woods SAC	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA
<u>Habitat degradation – hydrogeology</u> **Tunnelling and/or deep excavations affecting the existing hydrogeological regime**	Lough Corrib SAC Lough Corrib SPA Inner Galway Bay SPA Cregganna Marsh SPA Rahasane Turlough SAC Rahasane Turlough SPA Castletaylor Complex SAC Kiltiernan Turlough SAC Lough Fingall Complex SAC	Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Cregganna Marsh SPA Rahasane Turlough SAC Rahasane Turlough SPA Castletaylor Complex SAC Kiltiernan Turlough SAC Lough Fingall Complex SAC	Lough Corrib SAC Lough Corrib SPA Ross Lake and Woods SAC	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA

	European Sites affected by specific Project Elements of the Galway Transport Strategy						
Potential Impact Pathway	**N6 Galway City Ring Road (N6 GCRR)**	**Bearna Greenway**	**Galway to Dublin Cycleway (Galway City to Oranmore)**	**Galway to Oughterard Greenway**	**Public Transport Network** **All Elements of the GTS**	**Cycle Network** **Non-Greenway Elements of the GTS**	**Pedestrian Network** **All Elements of the GTS**
<u>Habitat degradation – tunnelling/excavation</u> **Tunnelling and/or deep excavations affecting the structural integrity of surface level habitats**	Lough Corrib SAC						
<u>Habitat degradation – water quality impacts during construction</u> **Construction works affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats**	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA
<u>Habitat degradation – water quality impacts during operation</u> **Project operation affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats**	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA				Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA		

	European Sites affected by specific Project Elements of the Galway Transport Strategy						
Potential Impact Pathway	**N6 Galway City Ring Road (N6 GCRR)**	**Bearna Greenway**	**Galway to Dublin Cycleway (Galway City to Oranmore)**	**Galway to Oughterard Greenway**	**Public Transport Network** **All Elements of the GTS**	**Cycle Network** **Non-Greenway Elements of the GTS**	**Pedestrian Network** **All Elements of the GTS**
Habitat degradation – shading **Shading effects of bridge structures (sunlight, direct precipitation) on habitats**	Lough Corrib SAC	~~Lough Corrib SPA~~ ~~Galway Bay Complex SAC~~ ~~Inner Galway Bay SPA~~	~~Lough Corrib SPA~~ ~~Galway Bay Complex SAC~~ ~~Inner Galway Bay SPA~~	~~Lough Corrib SAC~~ ~~Lough Corrib SPA~~ ~~Ross Lake and Woods SAC~~	Lough Corrib SAC	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA
Habitat degradation – air quality **A reduction in air quality affecting fauna species and/or habitats (vegetation composition and structure)[15]**	Lough Corrib SAC						
Habitat degradation – non-native invasive species **Introducing or spreading non-native invasive species affecting habitats (vegetation composition and structure)**	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA
Disturbance/displacement **Disturbance to fauna resulting in displacement from important habitat areas (e.g. breeding/resting places or foraging areas)**	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Ross Lake and Woods SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA

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[15] As one of the key principles of the GTS is to "To promote and encourage sustainable transport, and in particular to make it convenient and attractive to walk, cycle or use public transport", the may be an overall positive impact compared with the "Do-nothing" scenario in urban and suburban areas of Galway City and the associated European Sites (Lough Corrib SAC, Galway Bay Complex SAC and Inner Galway Bay SPA

	European Sites affected by specific Project Elements of the Galway Transport Strategy						
Potential Impact Pathway	**N6 Galway City Ring Road (N6 GCRR)**	**Bearna Greenway**	**Galway to Dublin Cycleway (Galway City to Oranmore)**	**Galway to Oughterard Greenway**	**Public Transport Network** **All Elements of the GTS**	**Cycle Network** **Non-Greenway Elements of the GTS**	**Pedestrian Network** **All Elements of the GTS**
Barrier effect **New structures creating a barrier to fauna species movement (e.g. within foraging areas or along commuting routes)**	Lough Corrib SAC	Galway Bay Complex SAC		Lough Corrib SAC Ross Lake and Woods SAC	Lough Corrib SAC	Lough Corrib SAC Galway Bay Complex SAC	Lough Corrib SAC Galway Bay Complex SAC
Mortality risk **Mortality/road traffic collision risk to fauna species**	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA				Lough Corrib SAC Lough Corrib SPA Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA

Appendix C

Qualifying Interests (QIs) and Special Conservation Interests (SCIs) of Affected European Sites, their Site Specific Conservation Objectives, and Potential Galway Transport Strategy (GTS) Impact Pathways

C1

Table C-1 in Appendix C1 lists the Qualifying Interest (QIs) and Special Conservation Interests (SCIs) of European Sites potentially affected by the GTS.

Table C-2 lists the Impact Pathway Assessment criteria used to identify and analyse the impact pathways between the project elements of the GTS and the European Sites. Table C-2 then lists the site-specific conservation objectives (SSCOs) that support the conservation condition of the QIs/SCIs of potentially affected European Sites and presents the results of analysis of which attributes/targets could potentially be affected by project elements within the GTS.

Where the SSCOs for a given European Site have been published, they are included in this table. However, SSCOs have not been published for many European Sites. In such cases, sample SSCOs have been prepared based on those available for other European Sites with the same QIs/SCIs (as noted in each case in Table C-2 for QI species and in Table C-3 for SCIs).

Where no published SSCOs were available for a given QI/SCI, the text of the generic conservation objective is used.

Table C-1: Qualifying Interests (QIs) and Special Conservation Interests (SCIs) of European Sites potentially affected

Lough Corrib SAC [000297]
Annex I Habitats
[3110] Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)
[3130] Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*
[3140] Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.
[3260] Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation
[6210] Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (*important orchid sites)
[6410] *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)
[7110] Active raised bogs *
[7120] Degraded raised bogs still capable of natural regeneration
[7150] Depressions on peat substrates of the *Rhynchosporion*
[7210] Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* *
[7220] Petrifying springs with tufa formation (*Cratoneurion*) *
[7230] Alkaline fens
[8240] Limestone pavements *
[91A0] Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles
[91D0] Bog woodland *
Annex II Species
[1029] Freshwater Pearl Mussel - *Margaritifera margaritifera*
[1092] White-clawed Crayfish - *Austropotamobius pallipes*
[1095] Sea Lamprey - *Petromyzon marinus*
[1096] Brook Lamprey - *Lampetra planeri*
[1106] Atlantic Salmon - *Salmo salar* (only in fresh water)
[1303] Lesser Horseshoe Bat - *Rhinolophus hipposideros*
[1355] Otter - *Lutra lutra*
[1393] Slender green feather-moss - *Drepanocladus (Hamatocaulis) vernicosus*
[1833] Slender Naiad - *Najas flexilis*

Galway Bay Complex SAC [000268]
Annex I Habitats
[1140] Mudflats and sandflats not covered by seawater at low tide
[1150] Coastal lagoons*
[1160] Large shallow inlets and bays
[1170] Reefs
[1220] Perennial vegetation of stony banks
[1310] *Salicornia* and other annuals colonising mud and sand
[1330] Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
[1410] Mediterranean salt meadows (*Juncetalia maritimi*)
[3180] Turloughs *
[5130] *Juniperus communis* formations on heaths or calcareous grasslands
[6210] Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (*important orchid sites)
[7210] Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* *
[7230] Alkaline fens
Annex II Species
[1355] Otter *Lutra lutra*
[1365] Harbour seal *Phoca vitulina*
Ross Lake and Woods SAC [001312]
Annex I Habitats
[3140] Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.
Annex II Species
[1303] Lesser Horseshoe Bat - *Rhinolophus hipposideros*
Lough Corrib SPA [004042]
Greenland white-fronted goose *Anser albifrons flavirostris* [A395] – Wintering
Gadwall *Anas strepera* [A051] – Wintering
Shoveler *Anas clypeata* [A056] – Wintering
Pochard *Aythya ferina* [A059] – Wintering
Tufted duck *Aythya fuligula* [A061] – Wintering
Common scoter *Melanitta nigra* [A065] – Breeding

Hen harrier *Circus cyaneus* [A082] – Wintering
Coot *Fulica atra* [A125] – Wintering
Golden plover *Pluvialis apricaria* [A140] – Wintering
Black-headed gull *Chroicocephalus ridibundus* [A179] – Breeding/Wintering
Common gull *Larus canus* [A182] – Breeding/Wintering
Common tern *Sterna hirundo* [A193] – Breeding
Arctic tern *Sterna paradisaea* [A194] – Breeding
Wetlands and Waterbirds [A999]
Inner Galway Bay SPA [004031]
Great northern diver *Gavia immer* [A003] – Wintering
Cormorant *Phalacrocorax carbo* [A017] – Breeding/Wintering
Grey heron *Ardea cinerea* [A028] – Wintering
Light-bellied brent goose *Branta bernicla hrota* [A046] – Wintering
Wigeon *Anas penelope* [A050] – Wintering
Teal *Anas crecca* [A052] – Wintering
Shoveler *Anas clypeata* [A056] – Wintering
Red-breasted merganser *Mergus serrator* [A069] – Wintering
Ringed plover *Charadrius hiaticula* [A137] – Wintering
Golden plover *Pluvialis apricaria* [A140] – Wintering
Lapwing *Vanellus vanellus* [A142] – Wintering
Dunlin *Calidris alpina* [A149] – Wintering
Bar-tailed godwit *Limosa lapponica* [A157] – Wintering
Curlew *Numenius arquata* [A160] – Wintering
Redshank *Tringa totanus* [A162] – Wintering
Turnstone *Arenaria interpres* [A169] – Wintering
Black-headed gull *Chroicocephalus ridibundus* [A179] – Wintering
Common gull *Larus canus* [A182] – Wintering
Sandwich tern *Sterna sandvicensis* [A191] – Breeding
Common tern *Sterna hirundo* [A193] – Breeding
Wetlands and Waterbirds [A999]

Cregganna Marsh SPA
Greenland white-fronted goose *Anser albifrons flavirostris* [A395] – Wintering
Rahasane Turlough SAC
Annex I Habitats
[3180] Turloughs *
Rahasane Turlough SPA
Whooper swan *Cygnus cygnus* [A038] – Wintering
Wigeon *Anas penelope* [A050] – Wintering
Golden plover *Pluvialis apricaria* [A140] – Wintering
Black-tailed godwit *Limosa limosa* [A156] – Wintering
Greenland white-fronted goose *Anser albifrons flavirostris* [A395] – Wintering
Wetlands and Waterbirds [A999]
Castletaylor Complex SAC
Annex I Habitats
[3180] Turloughs *
[4060] Alpine and Boreal heaths
[5130] *Juniperus communis* formations on heaths or calcareous grasslands
[6210] Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (*important orchid sites)
[8240] Limestone pavements *
Kiltiernan Turlough SAC
Annex I Habitats
[3180] Turloughs *
Lough Fingall Complex SAC
Annex I Habitats
[3180] Turloughs *
[4060] Alpine and Boreal heaths
[5130] *Juniperus communis* formations on heaths or calcareous grasslands
[6210] Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (*important orchid sites)
[7210] Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* *
[8240] Limestone pavements *

Annex II Species
[1303] Lesser Horseshoe Bat - *Rhinolophus hipposideros*

Table C-2: Site specific conservation objectives of the Qualifying Interests of European Sites within the zone of Influence (ZoI) of the GTS and analysis of likely significant effects as a result of impact along the identified impact pathways

Impact Pathway Assessment Criteria

Impact Pathway Assessment criteria:

1) Are there elements of the GTS that lie within, or in close proximity to, the boundary of a European Site and therefore could result in habitat loss, habitat fragmentation, or habitat degradation (as a result of tunnelling/excavation works or shading from built structures):
   - Habitat loss
   - Habitat fragmentation
   - Habitat degradation – tunnelling/excavation
   - Habitat degradation – shading
2) Are there elements of the GTS with hydrogeological linkages to European Sites and therefore the potential for habitat degradation as a result of impacts to groundwater quality and/or quantity:
   - Habitat degradation – hydrogeology
3) Are there elements of the GTS (either during construction or operation) with hydrological linkages to European Sites and therefore the potential for habitat degradation as a result of impacts to the hydrological regime and/or surface and coastal water quality, or effects to the tidal regime supporting coastal/estuarine habitats:
   - Habitat degradation – water quality
4) Are there elements of the GTS that lie within, or in close proximity to, the boundary of a European Site and therefore could result in habitat degradation as a result of a reduction in air quality affecting fauna species and/or vegetation composition and structure:
   - Habitat degradation – air quality
5) Are there elements of the GTS that could result in habitat degradation as a result of introducing or spreading non-native invasive plant species:
   - Habitat degradation – non-native invasive species
6) Are there elements of the GTS that lie within, or in close proximity to, the boundary of a European Site (or an important ex-situ site for SCI bird species) and therefore could result in the disturbance or displacement of fauna species:
   - Disturbance/displacement
7) Are there elements of the GTS that could pose a barrier to QI/SCI species movement within their range(s):
   - Barrier effect
8) Are there elements of the GTS that could pose a direct mortality risk to QI/SCI species:
   - Mortality risk

🟥 Indicates where the GTS could affect the listed attributes/targets here via the potential impact pathways listed above in the assessment criteria. The numbers in the table below correspond to the impact pathway assessment criteria listed above.

1029 Freshwater Pearl Mussel *Margaritifera margaritifera*

To maintain or restore the favourable conservation condition of Freshwater Pearl Mussel in the Lough Corrib SAC, which may be defined by the following list of attributes and targets (based upon *Conservation Objectives: Lower River Shannon SAC 002165. Version 1.0*):

** Note that based on available records, within Lough Corrib SAC this conservation objective applies to the Freshwater pearl mussel population in the Owenriff River catchment and the Galway to Oughterard Greenway could potentially affect this population. As a host species for the glochidial stage of the Freshwater pearl mussel's life cycle, any impacts to salmonid fish species in the Corrib catchment could potentially affect the number of host fish, recruitment, the population size and the population structure.*

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Distribution	Kilometres	Unknown								
Population size	Number of adult mussels	Unknown			🟥			🟥	🟥	🟥
Population structure: recruitment	Percentage per size class	Restore to least 20% of population no more than 65mm in length; and at least 5% of population no more than 30mm in length			🟥			🟥	🟥	🟥
Population structure: adult mortality	Percentage	No more than 5% decline from previous number of live adults counted; dead shells less than 1% of the adult population and scattered in distribution			🟥			🟥	🟥	🟥
Habitat extent	Kilometres	Restore suitable habitat and any additional stretches necessary for salmonid spawning			🟥					
Water quality: macroinvertebrate and phytobenthos (diatoms)	Ecological quality ratio (EQR)	Restore water quality			🟥					
Substratum quality: filamentous algae (macroalgae), macrophytes (rooted higher plants)	Percentage	Restore substratum quality-filamentous algae: absent or trace (<5%); macrophytes: absent or trace (<5%)								
Substratum quality: sediment	Occurrence	Restore substratum quality-stable cobble and gravel substrate with very little fine material; no artificially elevated levels of fine sediment			🟥					
Substratum quality: oxygen availability	Redox potential	Restore to no more than 20% decline from water column to 5cm depth in substrate								

Hydrological regime: flow variability	Metres per second	Restore appropriate hydrological regimes								
Host fish	Number	Maintain sufficient juvenile salmonids to host glochidial larvae			🟥			🟥	🟥	🟥

1092 White-clawed crayfish *Austropotamobius pallipes*

To maintain or restore the favourable conservation condition of White-clawed crayfish, which is defined by the following list of attributes and targets (based upon *Conservation Objectives: Lower River Shannon SAC 002165. Version 1.0*):

** Note that the absence of the White-clawed crayfish has been confirmed from that portion of Lough Corrib SAC downstream of Menlough[1] but its distribution elsewhere is the River Corrib System is unknown. Therefore in applying the precautionary principle, there is the potential for works associated with the construction of the greenway between Galway City and Oughterard to impact in this species within Lough Corrib SAC as the greenway will cross watercourses within, or that drain to, the SAC.*

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Distribution	Occurrence	No reduction from baseline.	🟥		🟥			🟥	🟥	
Population structure: recruitment	Percentage occurrence of juveniles and females with eggs	Juveniles and/or females with eggs in at least 50% of positive samples.			🟥			🟥	🟥	
Negative indicator species	Occurrence	No alien crayfish species.					🟥			
Disease	Occurrence	No instances of disease.			🟥		🟥			
Water quality	EPA Q value	At least Q3-4 at all sites sampled by EPA.			🟥					

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[1] N6 Galway City Transport Project: Route Selection Report – A.4.2 Ecological Constraints Report (Arup, 2015)

Habitat quality: heterogeneity	Occurrence of positive habitat features	No decline in heterogeneity or habitat quality			🟥					

1095 Sea Lamprey *Petromyzon marinus*

To maintain or restore the favourable conservation condition of Sea Lamprey which is defined by the following list of attributes and targets (based upon *Conservation Objectives: Lower River Shannon SAC 002165. Version 1.0*):

** Note that Sea lamprey are only known from that portion of the River Corrib catchment below the Salmon Weir in Galway City (O'Connor, 2007) but there may be a resident non-migratory population in Lough Corrib (*Galway Harbour Company, 2014*). It's not known whether the species spawns here but despite the fact that there is not suitable nursery habitat present along the river channel, there may be suitable ammoceote habitat in the docks area of the City. Therefore a precautionary approach is taken which assumes construction works associated with surface water bodies or discharges to surface water features during operation has the potential to affect this species and its supporting habitats.*

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Distribution: extent of anadromy	% of river accessible	Greater than 75% of main stem length of rivers accessible from estuary						🟥	🟥	
Population structure of juveniles	Number of age/size groups	At least three age/size groups present			🟥			🟥		🟥
Juvenile density in fine sediment	Juveniles/m²	Juvenile density at least 1/m²	🟥		🟥			🟥		🟥
Extent and distribution of spawning habitat	m² and occurrence	No decline in extent and distribution of spawning beds	🟥		🟥			🟥		

Availability of juvenile habitat	Number of positive sites in 3rd order channels (and greater), downstream of spawning areas	More than 50% of sample sites positive	🟥	⬜	🟥	⬜	⬜	🟥	⬜	⬜

1096 Brook Lamprey *Lampetra planeri*

To maintain or restore the favourable conservation condition of Brook Lamprey which is defined by the following list of attributes and targets (based upon *Conservation Objectives: Lower River Shannon SAC 002165. Version 1.0*):

** Note that Brook lamprey are known from throughout the River Corrib catchment (O'Connor, 2007). In the absence of survey data to the contrary, a precautionary approach is taken which assumes construction works associated with surface water bodies or discharges to surface water features during operation has the potential to affect this species and its supporting habitats.*

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Distribution	% of river accessible	Access to all water courses down to first order streams	⬜	⬜	⬜	⬜	⬜	🟥	🟥	⬜
Population structure of juveniles	Number of age/size groups	At least three age/size groups of brook/river lamprey present	⬜	⬜	🟥	⬜	⬜	🟥	⬜	🟥
Juvenile density in fine sediment	Juveniles/m²	Mean catchment juvenile density of brook/river lamprey at least 2/m²	🟥	⬜	🟥	⬜	⬜	🟥	⬜	🟥
Extent and distribution of spawning habitat	m² and occurrence	No decline in extent and distribution of spawning beds	🟥	⬜	🟥	⬜	⬜	🟥	⬜	⬜

Availability of juvenile habitat	Number of positive sites in 2nd order channels (and greater), downstream of spawning areas	More than 50% of sample sites positive	🟥		🟥			🟥		

1106 Atlantic Salmon *Salmo salar* (only in fresh water)

To maintain or restore the favourable conservation condition of Salmon which is defined by the following list of attributes and targets (based upon *Conservation Objectives: Lower River Shannon SAC 002165. Version 1.0*):

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Distribution: extent of anadromy	% of river accessible	100% of river channels down to second order accessible from estuary						🟥	🟥	
Adult spawning fish	Number	Conservation Limit (CL) for each system consistently exceeded	🟥		🟥			🟥		🟥
Salmon fry abundance	Number of fry/5 minutes electrofishing	Maintain or exceed 0+ fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry/5 min sampling	🟥		🟥			🟥		🟥
Smolt abundance	Number	No significant decline	🟥		🟥			🟥		🟥
Number and distribution of redds	Number and occurrence	No decline in number and distribution of spawning redds due to anthropogenic causes	🟥		🟥					
Water quality	EPA Q value	At least Q4 at all sites sampled by EPA			🟥					

1140 Mudflats and sandflats not covered by seawater at low tide

To maintain the favourable conservation condition of Mudflats and sandflats not covered by seawater at low tide which is defined by the following list of attributes and targets (taken from *Conservation Objectives: Galway Bay Complex SAC 000268. Version 1*):

** Note that the full extent of this habitat type in Galway Bay Complex SAC is not known or mapped and therefore, a precautionary approach is taken which assumes that construction works associated with coastal elements of the GTS (e.g. Bearna Green way and the Galway to Dublin Cycleway) have the potential to affect coastal/intertidal habitats.*

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Habitat area	Hectares	The permanent habitat area is stable or increasing, subject to natural processes.	🟥		🟥					

Community distribution	Hectares	Conserve the following community types in a natural condition: Intertidal sand with *Scolelepis squamata* and *Pontocrates spp*. community; and Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex.	🟥		🟥					

1150* Coastal lagoons

To restore the favourable conservation condition of Coastal lagoons which is defined by the following list of attributes and targets (taken from *Conservation Objectives: Galway Bay Complex SAC 000268. Version 1*):

** Note – Lough Atalia and Renmore Lough are the Coastal Lagoons that could potentially be impacted by elements of the GTS.*

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Habitat area	Hectares	Area stable or increasing, subject to natural processes.	🟥		🟥					
Habitat distribution	Occurrence	No decline, subject to natural processes.	🟥		🟥					
Salinity regime	Practical salinity units (psu)	Median annual salinity and temporal variation within natural ranges.		🟥	🟥					
Hydrological regime	Metres	Annual water level fluctuations and minima within natural ranges.		🟥	🟥					
Barrier connectivity: between lagoon and sea	Permeability	Appropriate hydrological connections between lagoons and sea, including where necessary, appropriate management.	🟥							
Water quality: chlorophyll a	µg/L	Annual median chlorophyll a within natural ranges and less than 5µg/L.								
Water quality: Molybdate Reactive Phosphorus (MRP)	mg/L	Annual median MRP within natural ranges and less than 0.1mg/L.								
Water quality: Dissolved Inorganic Nitrogen (DIN)	mg/L	Annual median DIN within natural ranges and less than 0.15mg/L.								
Depth of macrophyte colonisation	Metres	Macrophyte colonisation to maximum depth of lagoons.								

Typical plant species	Number and m^2	Maintain number and extent of listed lagoonal specialists, subject to natural variation.	🟥	🟥	🟥					
Typical animal species	Number	Maintain listed lagoon specialists, subject to natural variation.	🟥	🟥	🟥					
Negative indicator species	Number and %cover	Negative indicator species absent or under control.					🟥			

1160 Large shallow inlets and bays

To maintain the favourable conservation condition of Large shallow inlets and bays which is defined by the following list of attributes and targets (taken from *Conservation Objectives: Galway Bay Complex SAC 000268. Version 1*):

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Habitat area	Hectares	The permanent habitat area is stable or increasing, subject to natural processes.								
Community extent	Hectares	Maintain the extent of the Zostera-dominated community complex and the maërl-dominated community, subject to natural processes								
Community structure: *Zostera* density	Shoots per m²	Conserve the high quality of *Zostera*-dominated communities, subject to natural processes			🟥					
Community structure	Biological composition	Conserve the high quality of the maërl-dominated community, subject to natural processes			🟥					
Community distribution	Hectares	Conserve the following community types in a natural condition: Intertidal sandy mud community complex; Intertidal sand community complex; Fine to medium sand with bivalves community complex; Sandy mud to mixed sediment community complex; Mixed sediment dominated by *Mytilidae* community complex; Shingle; Fucoid-dominated community complex; *Laminaria*-dominated community complex; and Shallow sponge-dominated community complex			🟥					

1170 Reefs

To maintain the favourable conservation condition of Reefs which is defined by the following list of attributes and targets (taken from *Conservation Objectives: Galway Bay Complex SAC 000268. Version 1*):

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Habitat distribution	Occurrence	The distribution of Reefs is stable, subject to natural processes.								
Habitat area	Hectares	The permanent habitat area is stable, subject to natural processes.								
Community extent	Hectares	Maintain the extent of the *Mytilus*-dominated reef community, subject to natural processes.			🟥					
Community structure: *Mytilus* density	Individuals per m²	Conserve the high quality of the *Mytilus*-dominated reef community, subject to natural processes			🟥					
Community structure	Biological composition	Conserve the following community types in a natural condition: *Fucoid*-dominated community complex; *Laminaria*-dominated community complex; and Shallow sponge-dominated community complex			🟥					

1220 Perennial vegetation of stony banks

To maintain the favourable conservation condition of Perennial vegetation of stony banks which is defined by the following list of attributes and targets (taken from *Conservation Objectives: Galway Bay Complex SAC 000268. Version 1*):

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession.	🟥		🟥					
Habitat distribution	Occurrence	No decline, or change in habitat distribution, subject to natural processes.	🟥		🟥					

Physical structure: functionality and sediment supply	Presence/absence of physical barriers	Maintain the natural circulation of sediment and organic matter, without any physical obstructions.	🟥		🟥					
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.	🟥		🟥					
Vegetation composition: typical species and sub-communities	Percentage cover at a representative sample of monitoring stops	Maintain the typical vegetated shingle flora including the range of sub-communities within the different zones.	🟥		🟥		🟥			
Vegetation composition: negative indicator species	Percentage cover	Negative indicator species (including non-natives) to represent less than 5% cover.					🟥			

1303 Lesser Horseshoe Bat *Rhinolophus hipposideros* - Lough Corrib SAC and Lough Fingall Complex SAC [2]

To maintain the favourable conservation condition of Lesser Horseshoe Bat which is defined by the following list of attributes and targets (*based upon Conservation Objectives: Kenmare River SAC 002158. Version 1*) :

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Population per roost	Number	Minimum number for the winter roost X; Minimum of X for summer roost.								
Winter roosts	Condition	No decline								

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[2] Although the Lesser horseshoe bat was present within the scheme study area, the roost that forms the QI population for this European site (Eborhall House) is 11km away from the nearest GTS project (the Galway to Oughterard Greenway), on the northern shore of Lough Corrib. This distance would be regarded to be beyond the normal core foraging range of the Eborhall House population and beyond the normal commuting range of this species except on exceptional occasions or over long periods of time – for example, bats dispersing and moving between areas in the wider landscape over a period of many years/generations.
Similarly, Lough Fingall Complex SAC is 8km from the nearest of the GTS projects (the proposed bus network in Oranmore town centre), beyond the normal core foraging range of bats in the SAC.

Summer roosts	Condition	No decline								
Number of auxiliary roosts	Number and condition	No decline								
Extent of potential foraging habitat	Hectares	No significant decline								
Linear features: length	Metres	No significant loss, within 2.5km of qualifying roosts.								
Light pollution	Lux	No significant increase in artificial light intensity adjacent to named roosts or along commuting routes within 2.5km of those roosts.								

1303 Lesser Horseshoe Bat *Rhinolophus hipposideros* – Ross Lake and Woods SAC

To maintain the favourable conservation condition of Lesser Horseshoe Bat which is defined by the following list of attributes and targets (*based upon Conservation Objectives: Kenmare River SAC 002158. Version 1*) :

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Population per roost	Number	Minimum number for the winter roost X; Minimum of X for summer roost.	🟥		🟥			🟥	🟥	
Winter roosts	Condition	No decline	🟥							
Summer roosts	Condition	No decline	🟥					🟥	🟥	
Number of auxiliary roosts	Number and condition	No decline	🟥					🟥	🟥	
Extent of potential foraging habitat	Hectares	No significant decline	🟥		🟥			🟥	🟥	
Linear features: length	Metres	No significant loss, within 2.5km of qualifying roosts.	🟥							
Light pollution	Lux	No significant increase in artificial light intensity adjacent to named roosts or along commuting routes within 2.5km of those roosts.						🟥	🟥	

1310 *Salicornia* and other annuals colonizing mud and sand

To maintain the favourable conservation condition of *Salicornia* and other annuals colonizing mud and sand which is defined by the following list of attributes and targets (based upon *Conservation Objectives: Lower River Shannon SAC 002165. Version 1.0*):

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Habitat area	Habitat area	Area stable or increasing, subject to natural processes, including erosion and succession.	🟥		🟥					
Habitat distribution	Occurrence	No decline, or change in habitat distribution, subject to natural processes.	🟥		🟥					
Physical structure: sediment supply	Presence/ absence of physical barriers	Maintain natural circulation of sediments and organic matter, without any physical obstructions	🟥		🟥					
Physical structure: creeks and pans	Occurrence	Maintain/restore creek and pan structure, subject to natural processes, including erosion and succession	🟥		🟥					
Physical structure: flooding regime	Hectares flooded; frequency	Maintain natural tidal regime	🟥		🟥					
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	🟥		🟥					
Vegetation structure: vegetation height	Centimetres	Maintain structural variation within sward	🟥		🟥					
Vegetation structure: vegetation cover	Percentage cover at a representative sample of monitoring stops	Maintain more than 90% of area outside creeks vegetated	🟥		🟥					
Vegetation composition: typical species and sub-communities	Percentage cover	Maintain the presence of species-poor communities with typical species listed in Saltmarsh Monitoring Project (McCorry and Ryle, 2009)	🟥		🟥		🟥			
Vegetation structure: negative indicator species-*Spartina anglica*	Hectares	No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%					🟥			

1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

To restore the favourable conservation condition of Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) which is defined by the following list of attributes and targets (taken from *Conservation Objectives: Galway Bay Complex SAC 000268. Version 1*):

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession.	🟥		🟥					
Habitat distribution	Occurrence	No decline or change in habitat distribution, subject to natural processes.	🟥		🟥					
Physical structure: sediment supply	Presence/ absence of physical barriers	Maintain natural circulation of sediments and organic matter, without any physical obstructions.	🟥		🟥					
Physical structure: creeks and pans	Occurrence	Maintain creek and pan structure, subject to natural processes, including erosion and succession.	🟥		🟥					
Physical structure: flooding regime	Hectares flooded; frequency	Maintain natural tidal regime.	🟥		🟥					
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.	🟥		🟥					
Vegetation structure: vegetation height	Centimetres	Maintain structural variation within sward.	🟥		🟥					
Vegetation structure: vegetation cover	Percentage cover at a representative sample of monitoring stops	Maintain more than 90% of the saltmarsh area vegetated.	🟥		🟥					
Vegetation composition: typical species and sub-communities	Percentage cover at a representative sample of monitoring stops	Maintain range of sub communities with typical species listed in Saltmarsh Monitoring Project (McCorry and Ryle, 2009).	🟥		🟥		🟥			
Vegetation structure: negative	Hectares	No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%.					🟥			

indicator species- *Spartina anglica*							🟥			

1393 Slender Green Feather-moss *Drepanocladus vernicosus*

To maintain or restore the favourable conservation condition of Slender Green Feather-moss in Lough Corrib SAC.

** Note that the absence of **Slender Green Feather-moss** has been confirmed from that portion of Lough Corrib SAC within the Route Selection study area associated with the N6 GGCTP project[3] but its distribution elsewhere in the SAC (save for the known site at Gortachalla) is unknown. Therefore in applying the precautionary principle, there is the potential for works associated with the construction of the greenway between Galway City and Oughterard to impact in this species within Lough Corrib SAC as the greenway will cross watercourses within, or that drain to, the SAC.*

The favourable conservation status of a species is achieved when:	**Potential Impact Pathways**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats.	🟥	🟥	🟥		🟥			
Natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future.	🟥	🟥	🟥		🟥			
There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.	🟥	🟥	🟥		🟥			

1410 Mediterranean salt meadows (*Juncetalia maritimi*)

To restore the favourable conservation condition of Mediterranean salt meadows (*Juncetalia maritimi*) which is defined by the following list of attributes and targets (taken from *Conservation Objectives: Galway Bay Complex SAC 000268. Version 1*):

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Habitat area	Hectares	Area increasing, subject to natural processes, including erosion and succession.	🟥		🟥					
Habitat distribution	Occurrence	No decline, or change in habitat distribution, subject to natural processes.	🟥		🟥					
Physical structure: sediment supply	Presence/ absence of physical barriers	Maintain natural circulation of sediments and organic matter, without any physical obstructions	🟥		🟥					
Physical structure: creeks and pans	Occurrence	Maintain creek and pan structure, subject to natural processes, including erosion and succession	🟥		🟥					

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[3] N6 Galway City Transport Project: Route Selection Report – A.4.2 Ecological Constraints Report (Arup, 2015)

Physical structure: flooding regime	Hectares flooded; frequency	Maintain natural tidal regime	🟥		🟥					
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	🟥		🟥					
Vegetation structure: vegetation height	Centimetres	Maintain structural variation within sward	🟥		🟥					
Vegetation structure: vegetation cover	Percentage cover at a representative sample of monitoring stops	Maintain more than 90% of area outside creeks vegetated	🟥		🟥					
Vegetation composition: typical species	Percentage cover	Maintain range of sub-communities with typical species listed in Saltmarsh Monitoring Project (McCorry and Ryle, 2009).	🟥		🟥					
Vegetation structure: negative indicator species- *Spartina anglica*	Hectares	No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1%					🟥			
1355 Otter *Lutra lutra* **To maintain or restore the favourable conservation condition of Otter *Lutra lutra* which is defined by the following list of attributes and targets (referenced area figures are taken from *Conservation Objectives: Galway Bay Complex SAC 000268. Version 1* and apply to that SAC only):**										
Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Distribution	Percentage positive survey sites	No significant decline	🟥		🟥			🟥	🟥	🟥
Extent of terrestrial habitat	Hectares	No significant decline. Area mapped and calculated as 262ha above high water mark (HWM); 14ha along river banks/ around ponds	🟥							
Extent of marine habitat	Hectares	No significant decline. Area mapped and calculated as 2040ha	🟥							
Extent of freshwater (river) habitat	Kilometres	No significant decline. Length mapped and calculated as 4km	🟥							

Extent of freshwater (lake/lagoon) habitat	Hectares	No significant decline. Area mapped and calculated as 21ha	🟥	🟥						
Couching sites and holts	Number	No significant decline	🟥					🟥		
Fish biomass available	Kilograms	No significant decline			🟥					
Barriers to connectivity	Number	No significant increase.							🟥	

1365 Harbour seal *Phoca vitulina*

To maintain the favourable conservation condition of Harbour Seal which is defined by the following list of attributes and targets (taken from *Conservation Objectives: Galway Bay Complex SAC 000268. Version 1*):

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use.						🟥	🟥	
Breeding behaviour	Breeding sites	Conserve breeding sites in a natural condition.								
Moulting behaviour	Moult haul-out sites	Conserve moult haul-out sites in a natural condition.								
Resting behaviour	Resting haul-out sites	Conserve resting haul-out sites in a natural condition.	🟥		🟥			🟥	🟥	
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the harbour seal population at the site.						🟥		

1833 Slender Naiad *Najas flexilis*

To maintain or restore the favourable conservation condition of Slender Naiad which is defined by the following list of attributes and targets (based upon *Conservation Objectives: Horn Head and Rinclevan SAC 000147. Version 1*):

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Population extent	Hectares; distribution	No change to the spatial extent of *Najas flexilis* within the lake, subject to natural processes.			🟥		🟥			
Population depth	Metres	No change to the depth range of *Najas flexilis* within the lake, subject to natural processes.					🟥			
Population viability	Plant traits	No decline in plant fitness, subject to natural processes.			🟥					
Population abundance	Square metres	No change to the cover abundance of *Najas flexilis*, subject to natural processes.			🟥		🟥			
Species distribution	Occurrence	No decline, subject to natural processes.			🟥		🟥			
Habitat extent	Hectares	No decline, subject to natural processes.			🟥		🟥			
Hydrological regime: water level fluctuations	Metres	Maintain appropriate natural hydrological regime necessary to support the habitat for the species.								
Lake substratum quality	Various	Maintain appropriate substratum type, extent and chemistry to support the population of the species.			🟥					
Water quality	Various	Maintain appropriate water quality to support the population of the species.			🟥					
Acidification status	pH units, mg/l	Maintain appropriate water and sediment pH, alkalinity and cation concentrations to support the population of *Najas flexilis*, subject to natural processes.			🟥					
Water colour	mg/L PtCo	Maintain appropriate water colour to support the population of *Najas flexilis*.			🟥					
Associated species	Species composition and abundance	Maintain appropriate associated species and vegetation communities to support the population of *Najas flexilis*.			🟥		🟥			
Fringing habitat: area and condition	Hectares	Maintain the area and condition of fringing habitats necessary to support the population of *Najas flexilis*.			🟥		🟥			

3110 Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)

To maintain or restore the favourable conservation condition of Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) which is defined by the following list of attributes and targets (based upon *Conservation Objectives: Inishbofin and Inishshark SAC 000278. Version 1*):

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Habitat area	Hectares	Area stable or increasing, subject to natural processes.		🟥						
Habitat distribution	Occurrence	No decline, subject to natural processes.		🟥						
Typical species	Occurrence	Typical species present, in good condition, and demonstrating typical abundances and distribution.		🟥			🟥			
Vegetation composition: characteristic zonation	Occurrence	All characteristic zones should be present, correctly distributed and in good condition.		🟥						
Vegetation distribution: maximum depth	Metres	Maintain maximum depth of vegetation, subject to natural processes.		🟥						
Hydrological regime: water level fluctuations	Metres	Maintain appropriate natural hydrological regime necessary to support the habitat.		🟥						
Lake substratum quality	Various	Maintain appropriate substratum type, extent and chemistry to support the vegetation.								
Water quality: transparency	Metres	Maintain appropriate Secchi transparency. There should be no decline in Secchi depth/transparency.								
Water quality: nutrients	µg/l P; mg/l N	Maintain the concentration of nutrients in the water column to sufficiently low levels to support the habitat and its typical species.		🟥						
Water quality: phytoplankton biomass	µg/l Chlorophyll a	Maintain appropriate water quality to support the habitat, including high chlorophyll a status.		🟥						
Water quality: phytoplankton composition	EPA phytoplankton composition metric	Maintain appropriate water quality to support the habitat, including high phytoplankton composition status.		🟥						

Water quality: attached algal biomass	Algal cover and EPA phytobenthos metric	Maintain trace/ absent attached algal biomass (<5% cover) and high phytobenthos status.								
Water quality: macrophyte status	EPA macrophyte metric (The Free Index)	Maintain high macrophyte status.					🟥			
Acidification status	pH units, mg/l	Maintain appropriate water and sediment pH, alkalinity and cation concentrations to support the habitat, subject to natural processes		🟥						
Water colour	mg/l PtCo	Maintain appropriate water colour to support the habitat.								
Dissolved organic carbon (DOC)	mg/l	Maintain appropriate organic carbon levels to support the habitat.								
Turbidity	nephelometric turbidity units/ mg/l SS/ other appropriate units	Maintain appropriate turbidity to support the habitat.								
Fringing habitat: area and condition	Hectares	Maintain the area and condition of fringing habitats necessary to support the natural structure and functioning of habitat 3110.	🟥	🟥			🟥			

3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*

To maintain the favourable conservation condition of Oligotrophic to mesotrophic waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea* which is defined by the following list of attributes and targets (based upon *Conservation Objectives: Inishbofin and Inishshark SAC 000278. Version 1*):

Favourable conservation status of a habitat is achieved when:	**Potential Impact Pathways**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Its natural range, and area it covers within that range, are stable or increasing.		🟥						
Specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future.		🟥						
Conservation status of its typical species is favourable.	🟥	🟥	🟥		🟥			

3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.

To maintain or restore the favourable conservation condition of Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. which is defined by the following list of attributes and targets (based upon *Conservation Objectives: Tranarossan and Melmore Lough SAC 000194. Version 1*):

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Habitat area	Hectares	Area stable or increasing, subject to natural processes.		🟥						
Habitat distribution	Occurrence	No decline, subject to natural processes.								
Typical species	Occurrence	Typical species present, in good condition, and demonstrating typical abundances and distribution.	🟥	🟥	🟥		🟥			
Vegetation composition: characteristic zonation	Occurrence	All characteristic zones should be present, correctly distributed and in good condition.		🟥	🟥		🟥			
Vegetation distribution: maximum depth	Metres	No change to maximum depth of vegetation, subject to natural processes.			🟥					
Hydrological regime: water level fluctuations	Metres	Maintain appropriate natural hydrological regime necessary to support the habitat.		🟥						
Lake substratum quality	Various	Maintain appropriate substratum type, extent and chemistry to support the vegetation.			🟥					
Water quality: transparency	Metres	Maintain appropriate Secchi transparency. There should be no decline in Secchi depth/transparency.		🟥	🟥					
Water quality: nutrients	µg/l P or mg/l N	The concentration of nutrients in the water column should be sufficiently low to prevent changes in species composition or habitat condition.								
Water quality: phytoplankton biomass	µg/l Chlorophyll a	Maintain appropriate water quality to support the habitat, including high chlorophyll a status.								
Water quality: phytoplankton composition	EPA phytoplankton composition metric	Maintain appropriate water quality to support the habitat, including high phytoplankton composition status.			🟥					

Water quality: attached algal biomass	Algal cover and EPA phytobenthos metric	Maintain trace/ absent attached algal biomass (<5% cover) and high phytobenthos status.								
Water quality: macrophyte status	EPA macrophyte metric (The Free Index)	Maintain high macrophyte status.			🟥					
Acidification status	pH units, mg/l	Maintain appropriate water and sediment pH, alkalinity and cation concentrations to support the habitat, subject to natural processes.		🟥	🟥					
Water colour	mg/l PtCo	Maintain appropriate water colour to support the habitat.			🟥					
Dissolved organic carbon (DOC)	mg/l	Maintain appropriate organic carbon levels to support the habitat.					🟥			
Turbidity	nephelometric turbidity units/ mg/l SS/ other appropriate unit	Maintain appropriate turbidity to support the habitat.			🟥					
Fringing habitat: area and condition	Hectares	Maintain the area and condition of fringing habitats necessary to support the natural structure and functioning of habitat 3140.	🟥	🟥	🟥		🟥			

3180 *Turloughs

To maintain the favourable conservation condition of Turloughs which is defined by the following list of attributes and targets (referenced area figures are taken from *Conservation Objectives: Galway Bay Complex SAC 000268. Version 1* and apply to that SAC only):

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Habitat area	Hectares	Area stable at c.59ha or increasing, subject to natural processes.	🟥	🟥						
Habitat distribution	Occurrence	No decline, subject to natural processes.	🟥	🟥						
Hydrological regime: flood duration, frequency, area, depth; permanently flooded area	Various	Appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat .		🟥						

Soil type: area	Hectares	Variety, area and extent of soil types necessary to support turlough vegetation and other biota.	🟥	⬜	⬜	⬜	⬜	⬜	⬜	⬜
Soil nutrient status: nitrogen and phosphorous	N and P concentration in soil	Nutrient status appropriate to soil types.	⬜	⬜	⬜	⬜	⬜	⬜	⬜	⬜
Physical structure: bare ground	Presence	Sufficient wet bare ground, as appropriate.	🟥	🟥	⬜	⬜	🟥	⬜	⬜	⬜
Chemical processes: calcium carbonate deposition and concentration	$CaCO_3$ deposition rate/soil concentration	Appropriate $CaCO_3$ deposition rates and concentration in soil.	⬜	⬜	⬜	⬜	⬜	⬜	⬜	⬜
Water quality: nutrients; colour; phytoplankton; epiphyton	Various	Appropriate water quality to support the natural structure and functioning of the habitat.	⬜	🟥	🟥	⬜	⬜	⬜	⬜	⬜
Active peat formation	Flood duration	Active peat formation, where appropriate.	⬜	⬜	⬜	⬜	⬜	⬜	⬜	⬜
Vegetation composition: area of vegetation communities	Hectares	Maintain area of sensitive and high conservation value vegetation communities/units at each turlough.	🟥	🟥	🟥	⬜	🟥	⬜	⬜	⬜
Vegetation composition: vegetation zonation	Distribution	Maintain vegetation zonation/mosaic characteristic of each turlough.	🟥	🟥	🟥	⬜	🟥	⬜	⬜	⬜
Vegetation structure: sward height	Centimetres	Sward heights appropriate to the vegetation unit, and a variety of sward heights across each turlough.	⬜	🟥	⬜	⬜	🟥	⬜	⬜	⬜
Typical species: terrestrial, wetland and aquatic plants, invertebrates and birds	Presence	Maintain typical species within and across all turloughs.	🟥	🟥	🟥	⬜	🟥	⬜	⬜	⬜
Fringing habitats: area	Hectares	Maintain marginal fringing habitats that support turlough vegetation, invertebrate, mammal and/or bird populations.	🟥	🟥	🟥	⬜	🟥	⬜	⬜	⬜

Vegetation structure: turlough woodland	Species diversity and woodland structure	Maintain appropriate turlough woodland diversity and structure.	🟥	🟥	🟥		🟥			

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

To restore the favourable conservation condition of Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion vegetation* which is defined by the following list of attributes and targets (based upon *Connemara Bog Complex SAC 002034. Version 1* and *Conservation Objectives: Lower River Shannon SAC 002165. Version 1.0*):

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Habitat area	Kilometres	Area stable or increasing, subject to natural processes	🟥		🟥		🟥			
Habitat distribution	Occurrence	No decline, subject to natural processes	🟥		🟥		🟥			
Hydrological regime: river flow	Metres per second	Maintain appropriate hydrological regimes			🟥					
Hydrological regime: tidal influence	Daily water level fluctuations - metres	Maintain natural tidal regime			🟥					
Hydrological regime: groundwater discharge	Metres per second	Maintain appropriate hydrological regimes			🟥					
Hydrological regime: freshwater seepages	Metres per second	Maintain appropriate freshwater seepage regimes		🟥	🟥					
Substratum composition: particle size range	Millimetres	The substratum should be dominated by the particle size ranges, appropriate to the habitat sub-type (frequently sands, gravels and cobbles)		🟥	🟥					
Water quality	Various	Maintain appropriate water quality to support the natural structure and functioning of the habitat		🟥	🟥					
Water quality: nutrients	Milligrams per litre	The concentration of nutrients in the water column should be sufficiently low to prevent changes in species composition or habitat condition								

Vegetation composition: typical species	Occurrence	Typical species of the relevant habitat sub-type should be present and in good condition	🟥		🟥		🟥			
Floodplain connectivity	Area	The area of active floodplain at and upstream of the habitat should be maintained	🟥		🟥					
Riparian habitat	Area	The area of riparian woodland at and upstream of the bryophyte-rich sub-type should be maintained	🟥		🟥		🟥			

4060 Alpine and boreal heaths

To maintain or restore the favourable conservation condition of Alpine and boreal heaths which is defined by the following list of attributes and targets (based upon *Conservation Objectives: Black Head-Poulsallagh Complex SAC 000020. Version 1*):

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Habitat area	Hectares	Area stable or increasing, subject to natural processes		🟥						
Habitat distribution	Occurrence	No decline, subject to natural processes		🟥						
Vegetation composition: typical species	Number at a representative number of monitoring stops	At least seven positive indicator species present		🟥						
Vegetation composition: negative indicator species	Percentage cover at a representative number of monitoring stops	Negative indicator species collectively not more than 10% cover		🟥						
Vegetation composition: non-native species	Percentage cover at a representative number of monitoring stops	Non-native species not more than 1% cover								
Vegetation composition: trees and shrubs	Percentage cover at a representative number of monitoring stops	Cover of trees and shrubs (except juniper (Juniperus communis)) not more than 25%		🟥						
Physical structure: disturbance	Percentage cover at a representative number of monitoring stops	Less than 10% disturbed bare ground (excluding rocks/stones)								

Indicators of local distinctiveness	Occurrence	Indicators of local distinctiveness are maintained		🟥						

5130 *Juniperus communis* formations on heaths or calcareous grasslands

To restore the favourable conservation condition of *Juniperus communis* formations on heaths or calcareous grasslands which is defined by the following list of attributes and targets (taken from *Conservation Objectives: Galway Bay Complex SAC 000268. Version 1*):

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Habitat area	Occurrence	Area stable or increasing, subject to natural processes.	🟥							
Habitat distribution	Hectares	No decline.	🟥							
Juniper population size	Number	At least 50 plants.	🟥							
Formation structure: cover and height	Percentage and metres	Well-developed structure with an open to closed cover of juniper up to or exceeding 0.5 m in height with associated species .	🟥				🟥			
Formation structure: community diversity and extent	Hectares	Appropriate diversity and extent of formation .	🟥				🟥			
Formation structure: cone-bearing plants	Percentage	At least 10% of plants bearing cones.	🟥							
Formation structure: seedling recruitment	Percentage	At least 10% of juniper plants within the formation are seedlings.	🟥							
Formation structure: dead plants	Percentage	Not more than 10% of plants dead .	🟥							
Vegetation composition:	Occurrence	A variety of typical native species with a minimum of 10 species present (excluding negative indicator species) .	🟥				🟥			

typical species			🟥				🟥			
Vegetation composition: negative indicator species	Occurrence	Negative indicator species, particularly non-native invasive species, absent or under control .					🟥			

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

Conservation objectives -

To maintain the favourable conservation condition of Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) which is defined by the following list of attributes and targets (taken from/based upon *Conservation Objectives: Galway Bay Complex SAC 000268. Version 1* and *Connemara Bog Complex SAC 002034. Version 1*):

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Habitat area	Hectares	Area stable or increasing, subject to natural processes.	🟥			🟥	🟥			
Habitat distribution	Occurrence	No decline, subject to natural processes .	🟥			🟥	🟥			
Vegetation composition: typical species	Number	At least 7 positive indicator species present, including 2 "high quality" species.	🟥			🟥	🟥			
Vegetation composition: negative indicator species	Percentage	Negative indicator species collectively not more than 20% cover, with cover by an individual species not more than 10%. Non-native invasive species, absent or under control .				🟥	🟥			
Vegetation composition: non-native species	Percentage at a representative number of monitoring stops	Cover of non-native species not more than 1%				🟥	🟥			
Vegetation structure: woody species and bracken (*Pteridium aquilinum*)	Percentage	Cover of bracken (*Pteridium aquilinum*) and woody species (except certain listed species such as juniper (*Juniperus communis*) in the case of Galway Bay Complex SAC) not more than 5% cover.				🟥	🟥			
Vegetation composition/ structure: broadleaf herb: grass ratio	Percentage at a representative number of monitoring stops	Broadleaf herb component of vegetation between 40 and 90%	🟥			🟥	🟥			

Vegetation structure: sward height	Percentage	30-70% of sward 5-40cm, high.	🟥			🟥	🟥			
Vegetation structure: litter	Percentage at a representative number of monitoring stops	Litter cover not more than 25%					🟥			
Physical structure: bare soil	Percentage at a representative number of monitoring stops	Not more than 10% bare soil								
Physical structure: disturbance	Square metres	Area showing signs of serious grazing or other disturbance less than 20m²								
Physical structure: bare ground	Percentage	Not more than 10% bare ground								

6410 *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)

To maintain the favourable conservation condition of Molinia meadows on calcareous, peaty or clayey-silt laden soils (*Molinion caeruleae*) which is defined by the following list of attributes and targets (based upon the *Connemara Bog Complex SAC 002034. Version 1* and *Conservation Objectives: Lower River Shannon SAC 002165. Version 1.0*):

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Hectare area	Hectares	Area stable or increasing, subject to natural processes.	🟥	🟥	🟥		🟥			
Habitat distribution	Occurrence	No decline, subject to natural processes.	🟥	🟥	🟥		🟥			
Vegetation composition: typical species	Number	At least 7 positive indicator species present, including 1 "high quality" species.	🟥	🟥	🟥		🟥			
Vegetation composition: negative indicator species	Percentage	Negative indicator species collectively not more than 20% cover, with cover by an individual species less than 10%. Non-native invasive species, absent or under control.	🟥	🟥			🟥			
Vegetation composition: non-native species	Percentage at a representative number of monitoring stops	Cover of non-native species not more than 1%	🟥	🟥			🟥			

Vegetation composition: moss species	Percentage at a representative number of monitoring stops	Hair mosses (Polytrichum spp.) not more than 25% cover	🟥	🟥	⬜	⬜	⬜	⬜	⬜	⬜
Vegetation composition: notable species	Number	No decline, subject to natural processes.	🟥	🟥	🟥	⬜	🟥	⬜	⬜	⬜
Vegetation composition: negative indicator moss species	Percentage	Bog mosses (*Sphagnum* spp.) not more than 10% cover; hair mosses (*Polytrichum* spp.) not more than 25% cover.	🟥	🟥	⬜	⬜	⬜	⬜	⬜	⬜
Vegetation structure: woody species and bracken (*Pteridium aquilinum*)	Percentage	Cover of woody species and bracken not more than 5% cover.	🟥	🟥	⬜	⬜	⬜	⬜	⬜	⬜
Vegetation structure: broadleaf herb: grass ratio	Percentage	Broadleaf herb component of vegetation between 40 and 90%.	🟥	🟥	🟥	⬜	🟥	⬜	⬜	⬜
Vegetation structure: sward height	Percentage	30-70% of sward between 10 and 80cm high.	🟥	⬜	🟥	⬜	🟥	⬜	⬜	⬜
Vegetation structure: litter	Percentage at a representative number of monitoring stops	Litter cover not more than 25%	⬜	⬜	⬜	⬜	⬜	⬜	⬜	⬜
Physical structure: bare ground	Percentage	Not more than 10% bare ground.	⬜	⬜	🟥	⬜	⬜	⬜	⬜	⬜
Physical structure: bare soil	Percentage at a representative number of monitoring stops	Not more than 10% bare soil	⬜	⬜	🟥	⬜	⬜	⬜	⬜	⬜

Physical structure: disturbance	Square metres	Area showing signs of serious grazing or other disturbance less than 20m²								

7110* Active raised bogs

To maintain or restore the favourable conservation condition of Active raised bogs (based upon *Conservation Objectives: All Saints Bog and Esker SAC 000566. Version 1*):

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Habitat area	Hectares	Maintain or restore area of active raised bog to 71.7ha, subject to natural processes	🟥	🟥	🟥		🟥			
Habitat distribution	Occurrence	Maintain or restore the distribution and variability of active raised bog across the SAC	🟥	🟥	🟥		🟥			
High bog area	Hectares	No decline in extent of high bog necessary to support the development and maintenance of active raised bog	🟥	🟥	🟥					
Hydrological regime: water levels	Centimetres	Maintain or restore appropriate water levels throughout the site		🟥	🟥					
Hydrological regime: flow patterns	Flow direction; slope	Restore, where possible, appropriate high bog topography, flow directions and slopes		🟥	🟥					
Transitional areas between high bog and adjacent mineral soils (including cutover areas)	Hectares; distribution	Restore adequate transitional areas to support / protect active raised bog and the services it provides	🟥	🟥	🟥					
Vegetation quality: central ecotope, active flush, soaks, bog woodland	Hectares	Restore 35.9ha of central ecotope/active flush/soaks/bog woodland as appropriate	🟥	🟥	🟥		🟥			

Vegetation quality: microtopographical features	Hectares	Restore adequate cover of high quality microtopographical features	🟥		🟥		🟥			
Vegetation quality: bog moss (Sphagnum) species	Percentage cover	Restore adequate cover of bog moss (Sphagnum) species to ensure peat-forming capacity	🟥	🟥	🟥		🟥			
Typical ARB species: flora	Occurrence	Restore, where appropriate, typical active raised bog flora	🟥	🟥	🟥		🟥			

7120 Degraded raised bogs still capable of natural regeneration

To maintain or restore the favourable conservation condition of Degraded raised bogs still capable of natural regeneration:

Favourable conservation status of a habitat is achieved when:	**Potential Impact Pathways**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Its natural range, and area it covers within that range, are stable or increasing.	🟥	🟥	🟥		🟥			
Specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future.	🟥	🟥	🟥					
Conservation status of its typical species is favourable.	🟥	🟥	🟥		🟥			

7150 Depressions on peat substrates of the *Rhynchosporion*

To maintain the favourable conservation condition of Depressions on peat substrates of the *Rhynchosporion* which is defined by the following list of attributes and targets (based upon *Connemara Bog Complex SAC 002034. Version 1*):

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Habitat area	Hectares	Area stable or increasing, subject to natural processes.	🟥	🟥	🟥		🟥			
Habitat distribution	Occurrence	No decline, subject to natural processes.	🟥	🟥	🟥		🟥			
Ecosystem function: soil nutrients	Soil pH and appropriate nutrient levels at a representative number of monitoring stops	Maintain soil nutrient status within natural range.								
Vegetation composition:	Number of species at a representative	Number of positive indicator species at each monitoring stop is at least five.		🟥	🟥		🟥			

positive indicator species	number of 2m x 2m monitoring stops			🟥	🟥		🟥			
Vegetation composition: *Rhynchospora* spp	Percentage cover at a representative number of 2m x 2m monitoring stops	Total cover of white beaked sedge (*Rhynchospora alba*) and brown beaked sedge (*R. fusca*) at least 10%.		🟥	🟥		🟥			
Vegetation composition: potential dominant species	Percentage cover at a representative number of 2m x 2m monitoring stops	Cover of each of the potential dominant species less than 35%.		🟥	🟥		🟥			
Vegetation composition: negative indicator species	Percentage cover at a representative number of 2m x 2m monitoring stops	Total cover of negative indicator species less than 1%.		🟥	🟥		🟥			
Vegetation composition: non-native species	Percentage cover at, and in local vicinity of, a representative number of 2m x 2m monitoring stops	Cover of non-native species less than 1%.		🟥	🟥		🟥			
Vegetation composition: native trees and scrub	Percentage cover in local vicinity of a representative number of monitoring stops	Cover of scattered native trees and shrubs less than 10%.		🟥			🟥			
Vegetation structure: *Sphagnum* condition	Condition of *Sphagnum* at a representative number of 2m x 2m monitoring stops	Less than 10% of the Sphagnum cover is crushed, broken and/or pulled up.								
Vegetation structure: signs of browsing	Percentage of shoots browsed at a representative	Last complete growing season's shoots of ericoids, crowberry (*Empetrum nigrum*) and bog-myrtle (*Myrica gale*) showing signs of browsing collectively less than 33%.								

	number of 2m x 2m monitoring stops									
Vegetation structure: burning	Occurrence in local vicinity of a representative number of monitoring stops	No signs of burning in sensitive areas, into the moss, liverwort or lichen layer or exposure of peat surface due to burning.								
Physical structure: disturbed bare ground	Percentage cover at, and in local vicinity of, a representative number of 2m x 2m monitoring stops	Cover of disturbed bare ground less than 10%.	🟥							
Physical structure: drainage	Occurrence in local vicinity of a representative number of monitoring stops	Area showing signs of drainage from heavy trampling, tracking or ditches less than 10%.		🟥	🟥					
Physical structure: erosion	Occurrence in local vicinity of a representative number of monitoring stops	Less than 5% of the greater bog mosaic comprises erosion gullies and eroded areas.			🟥					
Indicators of local distinctiveness	Occurrence and population size	No decline in distribution or population sizes of rare, threatened or scarce species associated with the habitat.	🟥	🟥	🟥		🟥			

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

To maintain the favourable conservation condition of Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* which is defined by the following list of attributes and targets (taken from/based upon *Conservation Objectives: Galway Bay Complex SAC 000268. Version 1*):

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Habitat area	Hectares	Area stable or increasing, subject to natural processes.	🟥	🟥	🟥		🟥			
Habitat distribution	Occurrence	No decline, subject to natural processes.	🟥	🟥	🟥		🟥			
Hydrological regime	Flow rates, metres	Appropriate natural hydrological regime necessary to support the natural structure and functioning of the habitat.		🟥	🟥					

Peat formation	Flood duration	Active peat formation, where appropriate.		🟥	🟥					
Water quality: nutrients	Water chemistry measures	Appropriate water quality to support the natural structure and functioning of the habitat.		🟥	🟥					
Vegetation composition: typical species	Presence	Maintain vegetation cover of typical species including brown mosses and vascular plants.	🟥	🟥	🟥		🟥			
Vegetation composition: trees and shrubs	Percentage	Cover of scattered native trees and shrubs not more than than 10%.	🟥				🟥			
Physical structure: disturbed bare ground	Percentage	Cover of disturbed bare ground not more than 10%. Where tufa is present, disturbed bare ground not more than 1%.	🟥							
Physical structure: drainage	Percentage	Areas showing signs of drainage as a result of drainage ditches or heavy trampling not more than 10%.		🟥	🟥					

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

To maintain the favourable conservation condition of Petrifying springs with tufa formation (*Cratoneurion*) which is defined by the following list of attributes and targets (based upon C*onservation Objectives: Black Head-Poulsallagh Complex SAC 000020. Version 1*):

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Habitat area	Square metres	Area stable or increasing, subject to natural processes.	🟥	🟥	🟥		🟥			
Habitat distribution	Occurrence	No decline.	🟥	🟥	🟥		🟥			
Hydrological regime: height of water table; water flow	Metres; metres per second	Maintain appropriate hydrological regimes.		🟥	🟥					
Water quality	Water chemistry measures	Maintain oligotrophic and calcareous conditions.		🟥	🟥					
Vegetation composition: typical species	Occurrence	Maintain typical species.	🟥	🟥	🟥		🟥			

7230 Alkaline fens

To maintain or restore the favourable conservation condition of Alkaline fens which is defined by the following list of attributes and targets (taken from/based upon *Conservation Objectives: Galway Bay Complex SAC 000268. Version 1*):

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Habitat area	Hectares	Area stable or increasing, subject to natural processes.	🟥	🟥	🟥		🟥			
Habitat distribution	Occurrence	No decline, subject to natural processes.	🟥	🟥	🟥		🟥			
Hydrological regime	Flow rates, metres	Appropriate natural hydrological regime necessary to support the natural structure and functioning of the habitat.		🟥	🟥					
Peat formation	Flood duration	Active peat formation, where appropriate.		🟥	🟥					
Water quality: nutrients	Water chemistry measures	Appropriate water quality to support the natural structure and functioning of the habitat.		🟥	🟥					
Vegetation composition: typical species	Presence	Maintain vegetation cover of typical species including brown mosses and vascular plants.	🟥	🟥	🟥		🟥			
Vegetation composition: trees and shrubs	Percentage	Cover of scattered native trees and shrubs less than 10%.	🟥	🟥			🟥			
Physical structure: disturbed bare ground	Percentage	Cover of disturbed bare ground less than 10%. Where tufa is present, disturbed bare ground less than 1%.	🟥							
Physical structure: drainage	Percentage	Areas showing signs of drainage as a result of drainage ditches or heavy trampling less than 10%.		🟥	🟥					

8240* Limestone pavements

To maintain or restore the favourable conservation condition of Limestone pavements which is defined by the following list of attributes and targets (based upon C*onservation Objectives: Black Head-Poulsallagh Complex SAC 000020. Version 1*):

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Habitat area	Hectares	Area stable, subject to natural processes.	🟥			🟥	🟥			
Habitat distribution	Occurrence	No decline.	🟥				🟥			
Vegetation composition: typical species	Number at a representative number of monitoring stops	At least seven positive indicator species present.	🟥			🟥	🟥			
Vegetation composition: bryophyte layer	Percentage at a representative number of monitoring stops	Bryophyte cover at least 50% on wooded pavement.	🟥			🟥	🟥			
Vegetation composition: negative indicator species	Percentage at a representative number of monitoring stops	Collective cover of negative indicator species on exposed pavement not more than 1%.	🟥				🟥			
Vegetation composition: non-native species	Percentage at a representative number of monitoring stops	Cover of non-native species not more than 1% on exposed pavement; on wooded pavement not more than 10% with no regeneration.	🟥				🟥			
Vegetation composition: scrub	Percentage at a representative number of monitoring stops	Scrub cover no more than 25% of exposed pavement.	🟥				🟥			
Vegetation composition: bracken cover	Percentage at a representative number of monitoring stops	Bracken (*Pteridium aquilinum*) cover no more than 10% on exposed pavement.	🟥							
Vegetation structure: woodland canopy	Percentage at a representative number of monitoring stops	Canopy cover on wooded pavement at least 30%.	🟥							

Vegetation structure: dead wood	Occurrence in a representative number of monitoring stops	Sufficient quantity of dead wood on wooded pavement to provide habitat for saproxylic organisms.								
Physical structure: disturbance	Occurrence in a representative number of monitoring stops	No evidence of grazing pressure on wooded pavement.								
Indicators of local distinctiveness	Occurrence	Indicators of local distinctiveness are maintained.	🟥			🟥	🟥			

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

To maintain or restore the favourable conservation condition of Old oak woodland with *Ilex* and *Blechnum* which is defined by the following list of attributes and targets (based upon *Connemara Bog Complex SAC 002034. Version 1*):

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Habitat area	Hectares	Area stable or increasing, subject to natural processes.	🟥				🟥			
Habitat distribution	Occurrence	No decline.	🟥				🟥			
Woodland size	Hectares	Area stable of increasing. Where topographically possible, "large" woods at least 25ha in size and “small” woods at least 3ha in size.	🟥							
Woodland structure: cover and height	Percentage and metres	Diverse structure with a relatively closed canopy containing mature trees; sub-canopy layer with semi- mature trees and shrubs; and well-developed herb layer.	🟥							
Woodland structure: community diversity and extent	Hectares	Maintain diversity and extent of community types.	🟥				🟥			
Woodland structure: natural regeneration	Seedling:sapling: pole ratio	Seedlings, saplings and pole age-classes occur in adequate proportions to ensure survival of woodland canopy.								
Woodland structure: dead wood	m^3 per hectare; number per hectare	At least $30m^3$/ha of fallen timber greater than 10cm diameter; 30 snags/ha; both categories should include stems greater than 40cm diameter.								
Woodland structure: veteran trees	Number per hectare	No decline	🟥							

Woodland structure: indicators of local distinctiveness	Occurrence	No decline	🟥				🟥			
Vegetation composition: native tree cover	Percentage	No decline. Native tree cover not less than 95%.	🟥							
Vegetation composition: typical species	Occurrence	A variety of typical native species present, depending on woodland type, including oak (*Quercus petraea*) and birch (*Betula pubescens*).	🟥				🟥			
Vegetation composition: negative indicator species	Occurrence	Negative indicator species, particularly non-native invasive species, absent or under control.					🟥			

91D0* Bog woodland

To maintain or restore the favourable conservation condition of the Annex I habitat for which the SAC has been selected (based upon *Conservation Objectives: All Saints Bog and Esker SAC 000566. Version 1*):

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Habitat area	Hectares	Area stable or increasing, subject to natural processes.	🟥	🟥			🟥			
Habitat distribution	Occurrence	No decline, subject to natural processes.	🟥	🟥			🟥			
Vegetation composition: positive indicator species	Number in a representative number of monitoring stops	Birch (*Betula pubescens*), bog moss (*Sphagnum* species) and at least five other species present	🟥	🟥			🟥			
Vegetation composition: negative indicator species	Percentage cover at a representative number of monitoring stops	Both native and non-native invasive species absent or under control. Total cover should be less than 10%	🟥	🟥			🟥			
Woodland structure: cover and height of birch	Percentage cover and metres at a representative number of monitoring stops	A minimum 30% cover of birch (*Betula pubescens*) with a median canopy height of 4m	🟥	🟥			🟥			
Woodland structure: dwarf shrub cover	Percentage cover at a representative	Dwarf shrub cover not more than 50%	🟥	🟥			🟥			

	number of monitoring stops		🟥	🟥	⬜	⬜	🟥	⬜	⬜	⬜
Woodland structure: ling cover	Percentage cover at a representative number of monitoring stops	Ling (*Calluna vulgaris*) cover not more than 40%	🟥	🟥	⬜	⬜	🟥	⬜	⬜	⬜
Woodland structure: bryophyte cover	Percentage cover at a representative number of monitoring stops	Bryophyte cover at least 50%, with bog moss (Sphagnum spp.) cover at least 25%	🟥	🟥	⬜	⬜	🟥	⬜	⬜	⬜
Woodland structure: tree size classes	Occurrence	Each size class present	🟥	🟥	⬜	⬜	⬜	⬜	⬜	⬜
Woodland structure: senescent and dead wood	Occurrence	Senescent or dead wood present	⬜	⬜	⬜	⬜	⬜	⬜	⬜	⬜

References

Arup (2015) N6 Galway City Transport Project: Route Selection Report.

Galway Harbour Company (2014) Galway Harbour Extension Environmental Impact Statement.

O'Connor, W. (2007) A Survey of Juvenile Lamprey Populations in the Corrib and Suir Catchments. *Irish Wildlife Manuals* No. 26. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Table C-3: Site specific conservation objectives of the Special Conservation Interests of European Sites (SPAs) within the zone of Influence (ZoI) of the GTS and analysis of likely significant effects via the identified impact pathways

Arctic Tern *Sterna paradisaea* [A194], Common Tern *Sterna hirundo* [A193], Sandwich Tern *Sterna sandvicensis* [A191]

To maintain the favourable conservation condition of Common Tern, Arctic Tern and Sandwich Tern which is defined by the following list of attributes and targets (taken from/based upon *Conservation Objectives: Inner Galway Bay SPA 004031. Version 1* and *Conservation Objectives: Rockabill SPA 004014. Version 1*):

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Breeding population abundance: apparently occupied nests (AONs)	Number	No significant decline								
Productivity rate: fledged young per breeding pair	Mean number	No significant decline			🟥					🟥
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline								
Prey biomass available	Kg	No significant decline			🟥					
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase								
Disturbance at breeding site	Level of impact	Human activities should occur at levels that do not adversely affect the breeding population								
Population trend	Percentage change	Long term population trend stable or increasing			🟥			🟥		🟥
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing and intensity of use of areas by all of the above named species, other than that occurring from natural patterns of variation			🟥			🟥		

Common scoter *Melanitta nigra* [A065]

To maintain the favourable conservation condition of Common scoter which is defined by the following list of attributes and targets (taken from/based upon *Conservation Objectives: Inner Galway Bay SPA 004031. Version 1* and Conservation *Objectives: Donegal Bay SPA 004151. Version 1.0*):

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Breeding population abundance: apparently occupied nests (AONs)	Number	No significant decline								
Productivity rate: fledged young per breeding pair	Mean number	No significant decline			🟥					
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline								
Prey biomass available	Kg	No significant decline			🟥					
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase								
Population trend	Percentage change	Long term population trend stable or increasing			🟥					🟥
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing and intensity of use of areas by all of the above named species, other than that occurring from natural patterns of variation			🟥					

Black-headed gull *Chroicocephalus ridibundus* [A179]

To maintain the favourable conservation condition of Black-headed gull which is defined by the following list of attributes and targets (taken from/based upon *Conservation Objectives: Inner Galway Bay SPA 004031. Version 1* and Conservation *Objectives: Donegal Bay SPA 004151. Version 1.0*):

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Breeding population abundance: apparently occupied nests (AONs)	Number	No significant decline								
Productivity rate: fledged young per breeding pair	Mean number	No significant decline			🟥					🟥

Distribution: breeding colonies	Number; location; area (hectares)	No significant decline								
Prey biomass available	Kg	No significant decline			🟥					
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase								
Population trend	Percentage change	Long term population trend stable or increasing	🟥		🟥			🟥		🟥
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing and intensity of use of areas by all of the above named species, other than that occurring from natural patterns of variation	🟥		🟥			🟥		

Common gull *Larus canus* [A182]

To maintain the favourable conservation condition of Common gull which is defined by the following list of attributes and targets (taken from/based upon *Conservation Objectives: Inner Galway Bay SPA 004031. Version 1* and Conservation *Objectives: Donegal Bay SPA 004151. Version 1.0*):

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Breeding population abundance: apparently occupied nests (AONs)	Number	No significant decline								
Productivity rate: fledged young per breeding pair	Mean number	No significant decline			🟥					🟥
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline								
Prey biomass available	Kg	No significant decline			🟥					
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase								
Population trend	Percentage change	Long term population trend stable or increasing	🟥		🟥			🟥		🟥
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing and intensity of use of areas by all of the above named species, other than that occurring from natural patterns of variation	🟥		🟥			🟥		

Cormorant *Phalacrocorax carbo* [A017]

To maintain the favourable conservation condition of Cormorant which is defined by the following list of attributes and targets (taken from *Conservation Objectives: Inner Galway Bay SPA 004031. Version 1*):

**Note - Breeding population is located at Deer Island, 8km off the coastline in Galway City; see Inner Galway Bay Special Protection Area (Site Code 4031). Conservation Objectives Supporting Document VERSION 1 (NPWS, 2013)*

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Breeding population abundance: apparently occupied nests (AONs)	Number	This attribute applies to breeding cormorant. No significant decline								
Productivity rate	Mean number	This attribute applies to breeding cormorant. No significant decline			🟥					🟥
Distribution: breeding colonies	Number; location; area (Hectares)	This attribute applies to breeding cormorant. No significant decline								
Prey biomass available	Kg	This attribute applies to breeding cormorant. No significant decline			🟥					
Barriers to connectivity	Number; location; shape; area (hectares)	This attribute applies to breeding cormorant. No significant increase								
Disturbance at breeding site	Level of impact	This attribute applies to breeding cormorant. Human activities should occur at levels that do not adversely affect the breeding population								
Population trend	Percentage change	This attribute applies to non-breeding cormorant. Long term population trend stable or increasing	🟥		🟥			🟥		🟥
Distribution	Range, timing and intensity of use of areas	This attribute applies to non-breeding cormorant. No significant decrease in the range, timing and intensity of use of areas by all of the above named species, other than that occurring from natural patterns of variation	🟥		🟥			🟥		

Hen Harrier *Circus cyaneus* [A082]

To maintain the favourable conservation condition of Hen Harrier which is defined by the following list of attributes and targets (taken from *Conservation Objectives: Wexford Harbour and Slobs SPA 004076. Version 1.0*):

Attribute	**Measure**	**Target**	**Potential Impact Pathways**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Roost attendance: individual hen harriers	Number	No significant decline								
Suitable foraging habitat	Hectares	No significant decline			🟥		🟥			
Roost site condition	Area (hectares); structure	The roost site should be maintained in a suitable condition								
Disturbance at the roost site	Level of impact	Human activities should occur at levels that do not adversely affect the Hen Harrier winter roost population								

Bar-tailed Godwit *Limosa lapponica* [A157], Black-tailed godwit *Limosa limosa* [A156], Coot *Fulica atra* [A125], Curlew *Numenius arquata* [A160], Dunlin *Calidris alpina* [A149], Gadwall *Anas strepera* [A051], Golden Plover *Pluvialis apricaria* [A140], Great Northern Diver *Gavia immer* [A003], Grey Heron *Ardea cinerea* [A028], Greenland White-fronted Goose *Anser albifrons flavirostris* [A395], Lapwing *Vanellus vanellus* [A142], Light-bellied Brent Goose *Branta bernicla hrota* [A046], Pochard *Aythya ferina* [A059], Red-breasted Merganser *Mergus serrator* [A069], Redshank *Tringa, totanus* [A162], Ringed Plover *Charadrius hiaticula* [A137], Shoveler *Anas clypeata* [A056], Teal *Anas crecca* [A052], Tufted duck *Aythya fuligula* [A061], Turnstone *Arenaria interpres* [A169], Whooper swan *Cygnus cygnus* [A038], Wigeon *Anas penelope* [A050]

To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for the SPA

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Population trend	Numbers / Percentage change	Long term population trend stable or increasing	🟥	🟥	🟥	⬜	⬜	🟥	⬜	🟥
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing and intensity of use of areas by all of the above named species, other than that occurring from natural patterns of variation	🟥	🟥	🟥	⬜	⬜	🟥	⬜	⬜

Wetlands [A999]

Maintain the favourable conservation condition of wetland habitats within the SPA.

Attribute	Measure	Target	Potential Impact Pathways							
			1	2	3	4	5	6	7	8
Habitat area	Hectares	The permanent area occupied by the wetland habitat should be stable and not significantly less than the area specified in the site conservation objectives, other than that occurring from natural patterns of variation	🟥	🟥	🟥	⬜	🟥	⬜	⬜	⬜

Appendix D

County and City Development Plan Level Environmental Protection Policies

D1

This appendix lists the references for overarching Plan level environmental protection policies from the Galway County Development Plan 2015-2021 and the Galway City Draft Development Plan 2017-2023 referred to in this report. It also sets out how these relate to protecting European Sites in conjunction with the GTS specific mitigation measures with reference to the potential impact pathways identified in the NIS (Table D-1). The full text of these Plan level environmental protection policies is included for reference in Table D-2.

Table D-1: Environmental protection policies from the Galway City Council Draft Development Plan 2017-2023 and the Galway County Development Plan 2015-2021 referred to in the NIS and how these relate to protecting European Sites from impacts due to the potential GTS impact pathways

Potential Impact Pathway	Environmental protection policies from the Galway City Council Draft Development Plan 2017-2023	Environmental protection policies from the Galway County Development Plan 2015-2021
Habitat Loss	GCiDP 01 (Natural Heritage, Recreation and Amenity Aim) GCiDP 02 (Natural Heritage, Recreation and Amenity Strategy) GCiDP 03 (Policy 4.1 Green Network) GCiDP 04 (European Designated sites) GCiDP 05 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 06 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways) GCiDP 07 (Policy 4.5.1 Community Spaces: Greenways and Public Rights of Way) GCiDP 08 (Environment and Infrastructure Aim) GCiDP 9 (Policy 9.3 Flood Risk Assessment) GCiDP 10 (Specific Development Standards) GCiDP 19 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 21 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways) GCiDP 22 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways)	GCoDP 01 (Development Strategy Objectives - Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment) GCoDP 02 (Development Strategy Objectives - Objective DS 9 Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment) GCoDP 03 (Development Strategy Objectives - Objective DS 10 Impacts of Development on Protected Sites) GCoDP 04 (Roads and Transport Policy - Policy TI 1 Transportation Strategy and Compliance with Legislation) GCoDP 06 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 07 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 18 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 2 Biodiversity and Ecological Networks) GCoDP 19 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 6 Protection of Bats and Bats Habitats)
Habitat degradation – hydrogeology	GCiDP 01 (Natural Heritage, Recreation and Amenity Aim) GCiDP 02 (Natural Heritage, Recreation and Amenity Strategy) GCiDP 03 (Policy 4.1 Green Network) GCiDP 04 (European Designated sites) GCiDP 05 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 06 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways) GCiDP 08 (Environment and Infrastructure Aim) GCiDP 10 (Specific Development Standards) GCiDP 11 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways) GCiDP 12 (Policy 9.6 Water Quality) GCiDP 13 (Policy 9.7 Water Services) GCiDP 14 (Specific Development Standards) GCiDP 20 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 21 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways)	GCoDP 01 (Development Strategy Objectives - Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment) GCoDP 02 (Development Strategy Objectives - Objective DS 9 Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment) GCoDP 03 (Development Strategy Objectives - Objective DS 10 Impacts of Development on Protected Sites) GCoDP 04 (Roads and Transport Policy - Policy TI 1 Transportation Strategy and Compliance with Legislation) GCoDP 06 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 07 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 08 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 09 (Water Policies and Objectives - Objective WS 1 Protection of Ground Waters) GCoDP 10 (Water Policies and Objectives - Objective WS 11 Regionally & Locally Important Aquifers)

		GCoDP 15 (Natural Heritage & Biodiversity Policies & Objectives - Policy NHB 4) GCoDP 16 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 3 Water Resources) GCoDP 18 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 2 Biodiversity and Ecological Networks) GCoDP 19 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 6 Protection of Bats and Bats Habitats)
Habitat degradation – tunnelling/excavation	GCiDP 01 (Natural Heritage, Recreation and Amenity Aim) GCiDP 02 (Natural Heritage, Recreation and Amenity Strategy) GCiDP 03 (Policy 4.1 Green Network) GCiDP 04 (European Designated sites) GCiDP 05 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 08 (Environment and Infrastructure Aim) GCiDP 10 (Specific Development Standards) GCiDP 20 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 21 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways)	GCoDP 01 (Development Strategy Objectives - Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment) GCoDP 02 (Development Strategy Objectives - Objective DS 9 Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment) GCoDP 03 (Development Strategy Objectives - Objective DS 10 Impacts of Development on Protected Sites) GCoDP 04 (Roads and Transport Policy - Policy TI 1 Transportation Strategy and Compliance with Legislation) GCoDP 06 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 07 (Natural Heritage & Biodiversity Policies & Objectives
Habitat degradation – water quality impacts during construction	GCiDP 01 (Natural Heritage, Recreation and Amenity Aim) GCiDP 02 (Natural Heritage, Recreation and Amenity Strategy) GCiDP 03 (Policy 4.1 Green Network) GCiDP 04 (European Designated sites) GCiDP 05 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 06 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways) GCiDP 08 (Environment and Infrastructure Aim) GCiDP 10 (Specific Development Standards) GCiDP 11 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways) GCiDP 12 (Policy 9.6 Water Quality) GCiDP 13 (Policy 9.7 Water Services) GCiDP 14 (Specific Development Standards) GCiDP 15 (Environment and Infrastructure Strategy) GCiDP 16 (Policy 9.3 Flood Risk Assessment) GCiDP 17 (Policy 9.8 Sustainable Urban Drainage Systems (SUDS)) GCiDP 20 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance)	GCoDP 01 (Development Strategy Objectives - Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment) GCoDP 02 (Development Strategy Objectives - Objective DS 9 Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment) GCoDP 03 (Development Strategy Objectives - Objective DS 10 Impacts of Development on Protected Sites) GCoDP 04 (Roads and Transport Policy - Policy TI 1 Transportation Strategy and Compliance with Legislation) GCoDP 06 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 07 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 12 (Water Policies and Objectives - Objective WS 2 EU Policies and Directives) GCoDP 15 (Natural Heritage & Biodiversity Policies & Objectives - Policy NHB 4) GCoDP 16 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 3 Water Resources)

	GCiDP 21 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways) GCiDP 22 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways)	GCoDP 18 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 2 Biodiversity and Ecological Networks) GCoDP 19 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 6 Protection of Bats and Bats Habitats)
Habitat degradation – water quality impacts during operation	GCiDP 01 (Natural Heritage, Recreation and Amenity Aim) GCiDP 02 (Natural Heritage, Recreation and Amenity Strategy) GCiDP 03 (Policy 4.1 Green Network) GCiDP 04 (European Designated sites) GCiDP 05 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 06 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways) GCiDP 08 (Environment and Infrastructure Aim) GCiDP 10 (Specific Development Standards) GCiDP 11 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways) GCiDP 12 (Policy 9.6 Water Quality) GCiDP 13 (Policy 9.7 Water Services) GCiDP 14 (Specific Development Standards) GCiDP 15 (Environment and Infrastructure Strategy) GCiDP 16 (Policy 9.3 Flood Risk Assessment) GCiDP 17 (Policy 9.8 Sustainable Urban Drainage Systems (SUDS)) GCiDP 20 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 21 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways) GCiDP 22 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways)	GCoDP 01 (Development Strategy Objectives - Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment) GCoDP 02 (Development Strategy Objectives - Objective DS 9 Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment) GCoDP 03 (Development Strategy Objectives - Objective DS 10 Impacts of Development on Protected Sites) GCoDP 04 (Roads and Transport Policy - Policy TI 1 Transportation Strategy and Compliance with Legislation) GCoDP 06 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 07 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 12 (Water Policies and Objectives - Objective WS 2 EU Policies and Directives) GCoDP 13 (Wastewater Policies and Objectives - Objective WW 1 EU Policies and Directives) GCoDP 14 (Wastewater Policies and Objectives - Objective WW 6 Adherence to Environmental Standards) GCoDP 15 (Natural Heritage & Biodiversity Policies & Objectives - Policy NHB 4) GCoDP 16 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 3 Water Resources) GCoDP 18 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 2 Biodiversity and Ecological Networks) GCoDP 19 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 6 Protection of Bats and Bats Habitats)
Habitat degradation – shading	GCiDP 01 (Natural Heritage, Recreation and Amenity Aim) GCiDP 02 (Natural Heritage, Recreation and Amenity Strategy) GCiDP 03 (Policy 4.1 Green Network) GCiDP 04 (European Designated sites) GCiDP 05 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 06 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways) GCiDP 08 (Environment and Infrastructure Aim)	GCoDP 01 (Development Strategy Objectives - Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment) GCoDP 02 (Development Strategy Objectives - Objective DS 9 Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment) GCoDP 03 (Development Strategy Objectives - Objective DS 10 Impacts of Development on Protected Sites)

	GCiDP 10 (Specific Development Standards) GCiDP 20 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance)	GCoDP 04 (Roads and Transport Policy - Policy TI 1 Transportation Strategy and Compliance with Legislation) GCoDP 06 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 07 (Natural Heritage & Biodiversity Policies & Objectives
Habitat degradation – air quality	GCiDP 01 (Natural Heritage, Recreation and Amenity Aim) GCiDP 02 (Natural Heritage, Recreation and Amenity Strategy) GCiDP 03 (Policy 4.1 Green Network) GCiDP 04 (European Designated sites) GCiDP 05 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 08 (Environment and Infrastructure Aim) GCiDP 10 (Specific Development Standards) GCiDP 18 (Policy 9.10 Air Quality and Noise) GCiDP 20 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance)	GCoDP 01 (Development Strategy Objectives - Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment) GCoDP 02 (Development Strategy Objectives - Objective DS 9 Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment) GCoDP 03 (Development Strategy Objectives - Objective DS 10 Impacts of Development on Protected Sites) GCoDP 04 (Roads and Transport Policy - Policy TI 1 Transportation Strategy and Compliance with Legislation) GCoDP 06 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 07 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 18 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 2 Biodiversity and Ecological Networks)
Habitat degradation – non-native invasive species	GCiDP 01 (Natural Heritage, Recreation and Amenity Aim) GCiDP 02 (Natural Heritage, Recreation and Amenity Strategy) GCiDP 03 (Policy 4.1 Green Network) GCiDP 04 (European Designated sites) GCiDP 05 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 06 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways) GCiDP 08 (Environment and Infrastructure Aim) GCiDP 10 (Specific Development Standards) GCiDP 19 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 20 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 21 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways)	GCoDP 01 (Development Strategy Objectives - Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment) GCoDP 02 (Development Strategy Objectives - Objective DS 9 Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment) GCoDP 03 (Development Strategy Objectives - Objective DS 10 Impacts of Development on Protected Sites) GCoDP 04 (Roads and Transport Policy - Policy TI 1 Transportation Strategy and Compliance with Legislation) GCoDP 06 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 07 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 17 (Natural Heritage & Biodiversity Policies & Objectives - Policy NHB 7 Invasive Species) GCoDP 18 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 2 Biodiversity and Ecological Networks)
Disturbance/displacement	GCiDP 01 (Natural Heritage, Recreation and Amenity Aim) GCiDP 02 (Natural Heritage, Recreation and Amenity Strategy) GCiDP 03 (Policy 4.1 Green Network) GCiDP 04 (European Designated sites)	GCoDP 01 (Development Strategy Objectives - Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment)

	GCiDP 05 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 06 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways) GCiDP 07 (Policy 4.5.1 Community Spaces: Greenways and Public Rights of Way) GCiDP 08 (Environment and Infrastructure Aim) GCiDP 10 (Specific Development Standards) GCiDP 20 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 21 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways) GCiDP 22 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways)	GCoDP 02 (Development Strategy Objectives - Objective DS 9 Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment) GCoDP 03 (Development Strategy Objectives - Objective DS 10 Impacts of Development on Protected Sites) GCoDP 04 (Roads and Transport Policy - Policy TI 1 Transportation Strategy and Compliance with Legislation) GCoDP 06 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 07 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 18 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 2 Biodiversity and Ecological Networks) GCoDP 19 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 6 Protection of Bats and Bats Habitats)
Barrier effect	GCiDP 01 (Natural Heritage, Recreation and Amenity Aim) GCiDP 02 (Natural Heritage, Recreation and Amenity Strategy) GCiDP 03 (Policy 4.1 Green Network) GCiDP 04 (European Designated sites) GCiDP 05 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 06 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways) GCiDP 08 (Environment and Infrastructure Aim) GCiDP 10 (Specific Development Standards) GCiDP 20 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 21 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways) GCiDP 22 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways)	GCoDP 01 (Development Strategy Objectives - Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment) GCoDP 02 (Development Strategy Objectives - Objective DS 9 Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment) GCoDP 03 (Development Strategy Objectives - Objective DS 10 Impacts of Development on Protected Sites) GCoDP 04 (Roads and Transport Policy - Policy TI 1 Transportation Strategy and Compliance with Legislation) GCoDP 06 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 07 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 18 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 2 Biodiversity and Ecological Networks) GCoDP 19 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 6 Protection of Bats and Bats Habitats)
Mortality Risk	GCiDP 01 (Natural Heritage, Recreation and Amenity Aim) GCiDP 02 (Natural Heritage, Recreation and Amenity Strategy) GCiDP 03 (Policy 4.1 Green Network) GCiDP 04 (European Designated sites) GCiDP 05 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 06 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways) GCiDP 08 (Environment and Infrastructure Aim) GCiDP 10 (Specific Development Standards)	GCoDP 01 (Development Strategy Objectives - Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment) GCoDP 02 (Development Strategy Objectives - Objective DS 9 Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment) GCoDP 03 (Development Strategy Objectives - Objective DS 10 Impacts of Development on Protected Sites) GCoDP 04 (Roads and Transport Policy - Policy TI 1 Transportation Strategy and Compliance with Legislation)

	GCiDP 20 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance) GCiDP 21 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways) GCiDP 22 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways)	GCoDP 06 (Natural Heritage & Biodiversity Policies & Objectives GCoDP 07 (Natural Heritage & Biodiversity Policies & Objectives

Table D-2: Environmental protection policies from the Galway City Council Draft Development Plan 2017-2023 and the Galway County Development Plan 2015-2021 referred to above in Table D-1

Galway City Council Draft Development Plan 2017-2023
GCiDP 01 (Natural Heritage, Recreation and Amenity Aim) "*To provide for a green network in the city that allows for the sustainable use, management and protection of natural heritage, recreation amenity areas, parks and open spaces in an integrated manner. The green network will ensure the protection of nature and provide for the enhancement and expansion of passive and active recreational opportunities. It will be accessible to all and by sustainable modes of transport, where feasible. Ensure better integration of environmental and natural resource considerations in the Development Plan through the SEA process and provide the highest level of protection for European Sites, taking account of Article 6 of the Habitats Directive.*"
GCiDP 02 (Natural Heritage, Recreation and Amenity Strategy) "*Promote a green network for the city that allows for sustainable use, management and protection of natural heritage, protected ecological sites, flora and fauna, recreation and amenity areas and parks in an integrated manner where it can be demonstrated that there will be no adverse impacts on the integrity of European Sites and /or where the competent authority has ascertained that the use of the site is in accordance with Article 6 of the Habitat Directive.*" "*Conserve, protect and enhance the designated and non-designated sites and natural habitats, while enabling the sustainable development of the city.*"
GCiDP 03 (Policy 4.1 Green Network) "*Support sustainable use and management of areas of ecological importance, parks and recreation amenity areas and facilities through an integrated green network policy approach in line with Galway City Recreation and Amenity Needs Study, where it can be demonstrated that there will be no adverse impacts on the integrity of European Sites.*"
GCiDP 04 (European Designated sites) "*Plan and projects should consider DEHLG Guidance for Planning Authorities on Appropriate Assessment of Plans and Projects in Ireland (2009) and potential impacts identified in the HDA of the City Development Plan relating to habitat loss and fragmentation, water quality, disturbance and in combination effects.*" "*The policies and objectives of the City Development Plan have been drafted taking cognisance of Article 6 of the Habitats Directive. All plans including lower tier plans and projects identified as having potential to adversely impact on European Sites are required to adhere to the requirements of the Habitats Directive, to ensure no adverse impact on the integrity of European Sites.*"

GCiDP 05 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance)

"*Protect European sites that form part of the Natura 2000 network (including Special Protection Areas and Special Areas of Conservation) in accordance with the requirements in the EU Habitats Directive (92/43/EEC), EU Birds Directive (2009/147/EC) and associated national legislation. Ensure that plans or projects within the Plan area will only be authorised and /or supported after the competent authority has ascertained based on scientific evidence, screening for appropriate assessment and /or a Habitats Directive Assessment that:*

1. *The plan or project will not give rise to an adverse direct, indirect or secondary effect on the integrity of any European site (either individually or in combination with other plans or projects); or*
2. *The plan or project will have an adverse effect on the integrity of any European site (that does not host a priority natural habitat type/and or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or*
3. *The plan or project will have an adverse effect on the integrity of any European site (that hosts a natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons for overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000.*"

"*Protect, conserve and support the development of an ecological network throughout the city which will improve the ecological coherence of the Natura 2000 network in accordance with Article 10 of the Habitats Directive.*"

"*Protect Local Biodiversity Areas, wildlife corridors and stepping stones identified in the Galway City Habitat Inventory 2005 and Galway Biodiversity Action Plan 2014-2024 in supporting the biodiversity of the city and in the Council's role/responsibilities, works and operations, where appropriate.*"

"*Encourage, in liaison with the NPWS, the sustainable management of features which are important for the ecological coherence of network of European Sites and essential, by their linear or continuous nature or as stepping stones for the migration, dispersal and genetic exchange of wild species.*"

"*Ensure that plans and projects with the potential to have a significant impact on European Sites (cSAC's or SPA) whether directly, indirectly or in combination with other plans or projects are subject to Appropriate Assessment under Article 6 of the Habitats Directive (92/43 EEC) and associated legislation and guidelines to inform decision making.*"

"*Protect the ecological integrity of Statutory Nature Reserves, refuges for fauna and Annex 1 Habitats.*"

GCiDP 06 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways)

"*Protect and maintain the integrity of the coastal environment and waterways by avoiding significant impacts and meeting the requirements of statutory bodies, national and European legislation and standards.*"

"*Conserve and protect natural conservation areas within the coastal area and along waterways and ensure that the range and quality of associated habitats and the range and populations of species are maintained.*"

"*Have regard to European and national best practice guidance when assessing development in or near coastal areas which is likely to have significant effects on the integrity, defined by the structure and function, of any designated European Sites, protected coastal and marine fauna and flora.*"

"*Protect and maintain, where feasible, undeveloped riparian zones and natural floodplains along the River Corrib and its tributaries.*"

GCiDP 07 (Policy 4.5.1 Community Spaces: Greenways and Public Rights of Way)

"*Provide controlled access and linkages into all parks/public open spaces, areas of natural heritage, including along waterways, where it can be demonstrated that there will be no adverse impacts on the integrity of European Sites. Ensure that paths and structures are constructed from suitable materials.*"

GCiDP 08 (Environment and Infrastructure Aim)

"*To secure a high quality, clean and healthy environment, while facilitating the sustainable development of the city, through supporting the continued improvement and expansion of infrastructure services, including for water, drainage, communication, energy and waste management facilities. To ensure that environmental protection is an integral part of the development process within the city, by avoiding potential pollution at source and reducing environmental risks to the city and it's community. Address climate change and reduce greenhouse gas emissions by facilitating and promoting energy efficiency, energy conservation and renewable energy sources.*"

GCiDP 09 (Policy 9.3 Flood Risk Assessment)

"*Protect and maintain, where feasible, undeveloped riparian zones and natural floodplains along the River Corrib and its tributaries.*"

GCiDP 10 (Specific Development Standards)

11.28 Extract Industries/Quarries – "*The operation of quarries can give rise to land use and environmental issues which require to be mitigated and controlled in the planning process. The protection of residential dwellings, residential amenities, natural amenities, the prevention of pollution, noise/vibration, traffic and the safeguarding of groundwater will be given serious consideration. The Council will have regard to the DEHLG's Quarries and Ancillary Activities, Guidelines for Planning Authorities, 2004 when assessing all quarry related proposals, in order to achieve more sustainable aggregates development and to avoid and minimise adverse impacts on the environment. Particular constraint will be exercised for sites in the vicinity of/in areas of residential settlements, areas of archaeological importance, recorded monuments, European areas of ecological importance and other environmentally sensitive (designated) areas, unless it can clearly be demonstrated that such quarries would not have significant adverse impacts on residential dwellings, amenities or the environment. All developments should have regard to and comply with the Environmental Protection Agency's (EPA) publication Environmental Management in the Extractive Industry (non-scheduled minerals), 2006.*"

11.31 Natura Impact Assessment – "*Under Article 6 of the Habitats Directive there is a requirement to establish whether, in relation to plans and projects, appropriate assessment (AA) is required. If, following screening, it is considered that AA is required then the proponent of the plan or project must prepare a Natura Impact Statement/Natura Impact Report. A plan or project will only be authorised after the competent authority has ascertained, based on scientific evidence, Screening for Appropriate Assessment, and a Stage 2 Appropriate Assessment where necessary, that:*

(a) The plan or project will not give rise to significant adverse direct, indirect or secondary effects on the integrity of any Natura 2000 site (either individually or in combination with other plans or projects); or

(b) *The plan or project will have significant adverse effects on the integrity of any Natura 2000 (that does not host a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest – including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or*

(c) *The plan or project will have a significant adverse effect on the integrity of any Natura 2000 site (that hosts a natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons for overriding public interest- restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000.*"

GCiDP 11 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways)

“*Support the implementation of the recommendations of the Western River Basin District – River Basin Management Plan Water Matters (2009) and future plan in relation to the protection of water quality of surface waters, groundwater and coastal waters.*”

“*Ensure development and uses adhere to the principles of sustainable development and restrict any development or use, which negatively impact on water quality.*”

GCiDP 12 (Policy 9.6 Water Quality)

“Support the actions of the Western River Basin District Management Plan 2009-2015 and future River Basin Management Plan in order to promote and achieve a restoration of good status, reduce chemical pollution and prevent deterioration of surface, coastal and groundwater quality, where appropriate.”

“*Protect the city’s groundwater resource in accordance with the Groundwater Directive 2006/118/EC and the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010) or any updated legislation and ensure that any development, which threatens the quality of the city’s groundwater is restricted.*”

“*Minimise and control discharges to inland surface water bodies, groundwater and coastal waters to prevent water pollution.*”

GCiDP 13 (Policy 9.7 Water Services)

“Provide a sustainable and effective wastewater drainage collection and treatment system capable of meeting the needs of domestic, commercial, and industrial users in the city in partnership with Irish Water.”

“*Ensure that all new developments have and are provided with satisfactory drainage systems in the interests of public health and to avoid the pollution of the ground and surface waters.*”

GCiDP 14 (Specific Development Standards)

11.22 Water Quality – “*Proposed developments, which include the storage and/or run-off of potential polluting substances, such as oil and chemicals shall be accompanied with details and specifications, which indicate how risk of pollution will be minimised by using best available practices. This shall also apply to the construction stage.*”

GCiDP 15 (Environment and Infrastructure Strategy)

“*Protect and manage water resources effectively and improve coastal and fresh water quality.*”

GCiDP 16 (Policy 9.3 Flood Risk Assessment)

“*Protect and promote sustainable management and uses of water bodies and watercourses from inappropriate development, including rivers, streams, associated undeveloped riparian strips, wetlands and natural floodplains.*”

“*Ensure the use of SUDS, sustainable urban drainage systems, wherever practical, in the design of development to reduce the rate and quantity of surface water run-off.*”

GCiDP 17 (Policy 9.8 Sustainable Urban Drainage Systems (SUDS))

“*Ensure the use of Sustainable Urban Drainage Systems (SUDS) and sustainable surface water drainage management, wherever practical in the design of development to enable surface water run-off to be managed as near to its source as possible and achieve wider benefits such as sustainable development, water quality, biodiversity and local amenity.*”

“*Proposals for Sustainable Urban Drainage Systems (SUDS) should include provisions for the long term management, operation and maintenance of these systems.*”

GCiDP 18 (Policy 9.10 Air Quality and Noise)

Maintain air quality to a satisfactory standard by regulating and monitoring atmospheric emissions in accordance with EU policy directives on air quality and Ambient Air Quality and Cleaner Air for Europe (CAFÉ) Directive (2008/50/EC), by promoting and supporting initiatives to reduce air pollution and by increasing the use of sustainable transport modes and developing urban woodland, encouraging tree planting, conserving and creating green open space.

GCiDP 19 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance)

"*Support and implement measures to control and manage alien/invasive species, where appropriate.*"

GCiDP 20 (Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance)

"*Protect and conserve rare and threatened flora and fauna and their key habitats, (wherever they occur) listed on Annex I and Annex IV of the EU Habitats Directive (92/43EEC) and listed for protection under the Wildlife Acts 1976-2000.*"

GCiDP 21 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways)

"*Ensure that development does not have a significant adverse impact, incapable of satisfactory mitigation, on protected species.*"

GCiDP 22 (Policy 4.3 Blue Spaces: Coast, Canals and Waterways)

"*Ensure the protection of the River Corrib as a Salmonid River, where appropriate.*"

Galway County Council Development Plan 2015-2021

GCoDP 01 (Development Strategy Objectives - Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment)

"*Protect European Sites that form part of the Natura 2000 network (Including Special Protection Areas and Special Areas of Conservation) in accordance with the requirements in the EU Habitats Directive (92/43/EEC), EU Birds Directive (2009/147/EC), the Planning and Development (Amendment) Act 2010, the European Communities (Birds and Natural Habitats) Regulations 2011(SI No.477 of 2011) (and any subsequent amendments or updated legislation) and having due regard to the guidance in the Appropriate Assessment Guidelines 2010 (and any updated or subsequent guidance). A plan or project (e.g. proposed development) within the Plan Area will only be authorised after the competent authority (Galway County Council) has ascertained, based on scientific evidence, Screening for Appropriate Assessment, and/or a Habitats Directive Assessment where necessary, that:*

(a) The Plan or project will not give rise to significant adverse direct, indirect or secondary effects on the integrity of any European Site (either individually or in combination with other plans or projects); or

(b) The Plan or project will have significant adverse effects on the integrity of any European Site (that does not host a priority natural habitat type/and or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or

(c) *The Plan or project will have a significant adverse effect on the integrity of any European Site (that hosts a natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons for overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000.*"

GCoDP 02 (Development Strategy Objectives - Objective DS 9 Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment)
"*Ensure that proposed projects and any associated improvement works or associated infrastructure relating to renewable energy projects; water supply and abstraction; wastewater and discharges; flood alleviation and prevention; roads, power lines and telecommunications; and amenity and recreation provision are subject to Appropriate Assessment where relevant.*"

GCoDP 03 (Development Strategy Objectives - Objective DS 10 Impacts of Development on Protected Sites)
"*Have regard to any impacts of development on or near existing and proposed Natural Heritage Areas, Special Protection Areas and Special Areas of Conservation, Nature Reserves, Ramsar Sites, Wildfowl Sanctuaries, Salmonoid Waters, Refuges for Flora and Fauna, Conamara National Park, shellfish waters, freshwater pearl mussel catchments and any other designated sites including future designations.*"

GCoDP 04 (Roads and Transport Policy - Policy TI 1 Transportation Strategy and Compliance with Legislation)
"*It is the overarching policy of Galway County Council to comply with all relevant Irish and European planning and environmental legislation in implementing its Transportation Strategy.*"

GCoDP 05 (Water & Wastewater Infrastructure &, Waste Management & Extractive Industry

Objective EQ 4 Compliance with Article 6(3) of the EU Habitats Directive - "*Ensure that projects associated with the mineral extractive industry carry out screening for Appropriate Assessment in accordance with Article 6(3) of the Habitats Directive, where required.*"

GCoDP 06 (Natural Heritage & Biodiversity Policies & Objectives

Policy NHB 1 Natural Heritage and Biodiversity - "*It is the policy of Galway County Council to support the protection, conservation and enhancement of natural heritage and biodiversity, including the protection of the integrity of European Sites, that form part of the Natura 2000 network, the protection of Natural Heritage Areas and proposed Natural Heritage Areas and the promotion of the development of a green/ecological network within the Plan Area, in order to support ecological functioning and connectivity, create opportunities in suitable locations for active and passive recreation and to structure and provide visual relief from the built environment.*"

GCoDP 07 (Natural Heritage & Biodiversity Policies & Objectives

Objective NHB 1 Protected Habitats and Species - "*Support the protection of habitats and species listed in the Annexes to and/or covered by the EU Habitats Directive (92/43/EEC) (as amended) and Birds Directive (2009/147/EC), and regularly occurring-migratory birds and their habitats, and species protected under the Wildlife Acts 1976-2000 and the Flora Protection Order.*"

GCoDP 08 (Natural Heritage & Biodiversity Policies & Objectives

Objective NHB12 Soil/Ground Water Protection - "*Developments shall ensure that adequate soil protection measures are undertaken, where appropriate, including investigations into the nature and extent of any soil/groundwater contamination.*"

GCoDP 09 (Water Policies and Objectives - Objective WS 1 Protection of Ground Waters)
"*Support the protection of groundwater resources and dependent wildlife/habitats in accordance with the Groundwater Directive 2006/118/EC, the European Communities Environmental Objectives (groundwater) Regulations, 2010 (S.I. No. 9 of 2010) or any updated legislation and the Groundwater Protection Scheme and source protection plans for water supplies.*"

GCoDP 10 (Water Policies and Objectives - Objective WS 11 Regionally & Locally Important Aquifers)
"*Protect the regionally and locally important aquifers within the County from risk of pollution and ensure the satisfactory implementation of the groundwater protection schemes and groundwater source protection zones, where data has been made available by the Geological Survey of Ireland.*"

GCoDP 11 (Water Policies and Objectives - Policy WS 4 Water Quality) “*Promote public awareness of water quality issues and the measures required to protect both surface water and groundwater bodies.*”
GCoDP 12 (Water Policies and Objectives - Objective WS 2 EU Policies and Directives) “*Protect, conserve and enhance existing and potential water resources of the County, in accordance with the EU Water Framework Directive, the River Basin Management Plans, the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI No. 272 of 2009), and implement the European Communities (Drinking Water) Regulations (No. 2) 2007 and ensure that water supplies comply with the parameters in these regulations.*”
GCoDP 13 (Wastewater Policies and Objectives - Objective WW 1 EU Policies and Directives) “*Ensure that all wastewater generated is collected, treated and discharged after treatment in a safe and sustainable manner, having regard to the standards and requirements set out in EU and national legislation and guidance and subject to compliance with the provisions and objectives of the EU Water Framework Directive, relevant River Basin Management Plans, Urban Waste Water Directive and the EU Habitats Directive.*”
GCoDP 14 (Wastewater Policies and Objectives - Objective WW 6 Adherence to Environmental Standards) “*Promote the provision of safe and secure wastewater infrastructure to ensure that the public is protected and that permitted development, is within the environmental carrying capacity and does not negatively impact on habitat quality or species diversity.*”
GCoDP 15 (Natural Heritage & Biodiversity Policies & Objectives - Policy NHB 4) “*Protect, conserve and enhance the water resources of the county, including, rivers, streams, lakes, wetlands, springs, turloughs, surface water and groundwater quality, as well as surface waters, aquatic and wetland habitats and freshwater and water dependant species and seek to protect and conserve the quality, character and features of inland waterways by controlling developments close to navigable and non-navigable waterways.*”
GCoDP 16 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 3 Water Resources) “*Protect the water resources in the Plan Area, including rivers, streams, lakes, wetlands, springs, turloughs, surface water and groundwater quality, as well as surface waters, aquatic and wetland habitats and freshwater and water dependant species in accordance with the requirements and guidance in the EU Water Framework Directive 2000 (2000/60/EC), the European Union (Water Policy) Regulations 2003 (as amended), the Western River Basin District Management Plan 2009-2015, Shannon International River Basin Management Plan 2009-2015 and other relevant EU Directives, including associated national legislation and policy guidance (including any superseding versions of same).*”
GCoDP 17 (Natural Heritage & Biodiversity Policies & Objectives - Policy NHB 7 Invasive Species) *“It is a policy of the Council to support measures for the prevention and eradication of invasive species. This will include the dissemination of information to raise public awareness, consultation with relevant stakeholders, the promotion of the use of native species in amenity planting and landscaping and the recording of invasive/native species as the need arises and resources permit.*”
GCoDP 18 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 2 Biodiversity and Ecological Networks) “*Support the protection and enhancement of biodiversity and ecological connectivity within the Plan Area, including woodlands, trees, hedgerows, semi-natural grasslands, rivers, streams, natural springs, wetlands, stonewalls, geological and geo-morphological systems, other landscape features and associated wildlife where these form part of the ecological network and/or may be considered as ecological corridors or stepping stones in the context of Article 10 of the Habitats Directive.*”
GCoDP 19 (Natural Heritage & Biodiversity Policies & Objectives - Objective NHB 6 Protection of Bats and Bats Habitats)

“*Seek to protect bats and their roosts, their feeding areas, flight paths and commuting routes. Ensure that development proposals in areas which are potentially important for bats, including areas of woodland, linear features such as hedgerows, stone walls, watercourses and associated riparian vegetation which may provide migratory/foraging uses shall be subject to suitable assessment for potential impacts on bats. This will include an assessment of the cumulative loss of habitat or the impact on bat populations and activity in the area and may include a specific bat survey. Any assessment shall be carried out by a suitably qualified professional and where development is likely to result in significant adverse effects on bat populations or activity in the area, development will be prohibited or require mitigation and/or compensatory measures, as appropriate.*”

Appendix E

Potential In-combination Effects Assessment of the Galway Transport Strategy (GTS) and plans and projects located within the Zone of Influence of GTS

E1

This appendix presents the analysis and findings of the in-combination effects assessment, which examines the potential for adverse effects to arise as a consequence of the implementation of the GTS and any other plans and projects that are located within the Zone of Influence (ZoI) of the GTS.

Table E-1 presents a Source-Pathway-Receptor Matrix of plans and projects located within the ZoI of the GTS against each of the identified potential impact pathways of the GTS and each European Sites that could be impacted.

Table E-1: Source-Pathway-Receptor Matrix for other Plans and Projects.

	Potential Impact Pathways										
Plans and Projects	**Habitat Loss** Direct loss of habitat (terrestrial or freshwater) in European Site – habitat fragmentation is directly associated with this impact pathway	**Habitat degradation – hydrogeology** Tunnelling and/or deep excavations affecting the existing hydrogeological regime	**Habitat degradation - tunnelling/ excavation** Tunnelling and/or deep excavations affecting the structural integrity of surface level habitats	**Habitat degradation – water quality impacts during construction** Construction works affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – water quality impacts during operation** Project operation affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – shading** Shading effects of bridge structures (sunlight, direct precipitation) on habitats	**Habitat degradation – air quality** A reduction in air quality affecting fauna species and/or habitats (vegetation composition and structure)	**Habitat degradation – non-native invasive species** Introducing or spreading non-native invasive species affecting habitats (vegetation composition and structure)	**Disturbance/ displacement** Disturbance to fauna resulting in displacement from important habitat areas (e.g. breeding/resting places or foraging areas)	**Barrier effect** New structures creating a barrier to fauna species movement (e.g. within foraging areas or along commuting routes)	**Mortality risk** Mortality/road traffic collision risk to fauna species
Plans											
National Plans											
Climate Action and Low-Carbon Development – National Policy Position Ireland	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC Cregganna Marsh SPA Rahasane Turlough SAC Rahasane Turlough SPA Castletaylor Complex SAC Kiltiernan Turlough SAC Lough Fingall Complex SAC		Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC			Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Galway Bay Complex SAC Ross Lake and Woods SAC	

	Potential Impact Pathways										
Plans and Projects	**<u>Habitat Loss</u>** Direct loss of habitat (terrestrial or freshwater) in European Site – habitat fragmentation is directly associated with this impact pathway	**<u>Habitat degradation – hydrogeology</u>** Tunnelling and/or deep excavations affecting the existing hydrogeological regime	**<u>Habitat degradation - tunnelling/ excavation</u>** Tunnelling and/or deep excavations affecting the structural integrity of surface level habitats	**<u>Habitat degradation – water quality impacts during construction</u>** Construction works affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**<u>Habitat degradation – water quality impacts during operation</u>** Project operation affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**<u>Habitat degradation – shading</u>** Shading effects of bridge structures (sunlight, direct precipitation) on habitats	**<u>Habitat degradation – air quality</u>** A reduction in air quality affecting fauna species and/or habitats (vegetation composition and structure)	**<u>Habitat degradation – non-native invasive species</u>** Introducing or spreading non-native invasive species affecting habitats (vegetation composition and structure)	**<u>Disturbance/ displacement</u>** Disturbance to fauna resulting in displacement from important habitat areas (e.g. breeding/resting places or foraging areas)	**<u>Barrier effect</u>** New structures creating a barrier to fauna species movement (e.g. within foraging areas or along commuting routes)	**<u>Mortality risk</u>** Mortality/road traffic collision risk to fauna species
Foodwise 2025	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC Cregganna Marsh SPA Rahasane Turlough SAC Rahasane Turlough SPA Castletaylor Complex SAC Kiltiernan Turlough SAC Lough Fingall Complex SAC			Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA		Lough Corrib SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC		
Inland Fisheries Ireland Corporate Plan 2011-2015	***<u>No potential negative in-combination effects will arise</u>*** *from the implementation of Inland Fisheries Ireland Corporate Plan 2011-2015 and the GTS. This Plan includes the following two fisheries goals that will ensure a positive impact on Qualifying Interest fish species of Lough Corrib SAC Atlantic salmon, Brook lamprey and Sea Lamprey: "to improve the protection and conservation of the resource" and "to develop and improve wild fish populations".*										
Ireland's Rural Development	Lough Corrib SAC Galway Bay Complex SAC	Lough Corrib SAC Lough Corrib SPA		Lough Corrib SAC Lough Corrib SPA	Lough Corrib SAC Lough Corrib SPA		Lough Corrib SAC	Lough Corrib SAC Lough Corrib SPA	Lough Corrib SAC Lough Corrib SPA	Lough Corrib SAC Galway Bay Complex SAC	

	Potential Impact Pathways										
Plans and Projects	**Habitat Loss** Direct loss of habitat (terrestrial or freshwater) in European Site – habitat fragmentation is directly associated with this impact pathway	**Habitat degradation – hydrogeology** Tunnelling and/or deep excavations affecting the existing hydrogeological regime	**Habitat degradation - tunnelling/ excavation** Tunnelling and/or deep excavations affecting the structural integrity of surface level habitats	**Habitat degradation – water quality impacts during construction** Construction works affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – water quality impacts during operation** Project operation affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – shading** Shading effects of bridge structures (sunlight, direct precipitation) on habitats	**Habitat degradation – air quality** A reduction in air quality affecting fauna species and/or habitats (vegetation composition and structure)	**Habitat degradation – non-native invasive species** Introducing or spreading non-native invasive species affecting habitats (vegetation composition and structure)	**Disturbance/ displacement** Disturbance to fauna resulting in displacement from important habitat areas (e.g. breeding/resting places or foraging areas)	**Barrier effect** New structures creating a barrier to fauna species movement (e.g. within foraging areas or along commuting routes)	**Mortality risk** Mortality/road traffic collision risk to fauna species
Programme 2014-2020	Inner Galway Bay SPA	Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC Cregganna Marsh SPA Rahasane Turlough SAC Rahasane Turlough SPA Castletaylor Complex SAC Kiltiernan Turlough SAC Lough Fingall Complex SAC		Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Galway Bay Complex SAC Inner Galway Bay SPA			Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Ross Lake and Woods SAC	
National Spatial Strategy for Ireland 2002 – 2020	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC Cregganna Marsh SPA		Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA		Lough Corrib SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Galway Bay Complex SAC Ross Lake and Woods SAC	

	Potential Impact Pathways										
Plans and Projects	**Habitat Loss** Direct loss of habitat (terrestrial or freshwater) in European Site – habitat fragmentation is directly associated with this impact pathway	**Habitat degradation – hydrogeology** Tunnelling and/or deep excavations affecting the existing hydrogeological regime	**Habitat degradation - tunnelling/ excavation** Tunnelling and/or deep excavations affecting the structural integrity of surface level habitats	**Habitat degradation – water quality impacts during construction** Construction works affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – water quality impacts during operation** Project operation affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – shading** Shading effects of bridge structures (sunlight, direct precipitation) on habitats	**Habitat degradation – air quality** A reduction in air quality affecting fauna species and/or habitats (vegetation composition and structure)	**Habitat degradation – non-native invasive species** Introducing or spreading non-native invasive species affecting habitats (vegetation composition and structure)	**Disturbance/ displacement** Disturbance to fauna resulting in displacement from important habitat areas (e.g. breeding/resting places or foraging areas)	**Barrier effect** New structures creating a barrier to fauna species movement (e.g. within foraging areas or along commuting routes)	**Mortality risk** Mortality/road traffic collision risk to fauna species
		Rahasane Turlough SAC Rahasane Turlough SPA Castletaylor Complex SAC Kiltiernan Turlough SAC Lough Fingall Complex SAC									
Pollution Reduction Programmes for Groundwaters	***No potential negative in-combination effects will arise*** *from the implementation of Pollution Reduction Programmes for Groundwaters and the GTS. These Programmes will have a positive impact on groundwater quality in Ireland as they will ensure adherence to measures set out in the EU Groundwater Directive (2006/118/EC) (e.g. assessing groundwater chemical status; procedures for identifying significant and sustained upward trends in groundwater pollution; and, measures to prevent or limit inputs of pollutants to groundwater) and the Good Agricultural Practice for Protection of Waters Regulations 2006 (e.g. set back distances for application of organic fertiliser and soiled water on land in the vicinity of water abstraction points, such as wells, springs and surfaces, to prevent water pollution arising from fertilisers and certain activities) (Shannon International River Basin District, 2008).*										
Smarter Travel A Sustainable Transport Future 2009-2020	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC Cregganna Marsh SPA Rahasane Turlough SAC		Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA			Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Galway Bay Complex SAC Ross Lake and Woods SAC	

	Potential Impact Pathways										
Plans and Projects	**Habitat Loss** Direct loss of habitat (terrestrial or freshwater) in European Site – habitat fragmentation is directly associated with this impact pathway	**Habitat degradation – hydrogeology** Tunnelling and/or deep excavations affecting the existing hydrogeological regime	**Habitat degradation - tunnelling/ excavation** Tunnelling and/or deep excavations affecting the structural integrity of surface level habitats	**Habitat degradation – water quality impacts during construction** Construction works affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – water quality impacts during operation** Project operation affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – shading** Shading effects of bridge structures (sunlight, direct precipitation) on habitats	**Habitat degradation – air quality** A reduction in air quality affecting fauna species and/or habitats (vegetation composition and structure)	**Habitat degradation – non-native invasive species** Introducing or spreading non-native invasive species affecting habitats (vegetation composition and structure)	**Disturbance/ displacement** Disturbance to fauna resulting in displacement from important habitat areas (e.g. breeding/resting places or foraging areas)	**Barrier effect** New structures creating a barrier to fauna species movement (e.g. within foraging areas or along commuting routes)	**Mortality risk** Mortality/road traffic collision risk to fauna species
		Rahasane Turlough SPA Castletaylor Complex SAC Kiltiernan Turlough SAC Lough Fingall Complex SAC									
Surface Water Pollution Reduction Programme	***No potential negative in-combination effects will arise*** *from the implementation of Pollution Reduction Programmes for Surface Waters and the GTS. These Programmes will have a positive impact on surface water quality in Ireland as they will take into account environmental quality standards (Shannon International River Basin District, 2008).*										
Wild Atlantic Way Operational Programme 2015-2019	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA				Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA			Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA		
Regional Plans											
Regional Planning Guidelines for the West Region 2010-2022	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA		Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA		Lough Corrib SAC	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and	

	Potential Impact Pathways										
Plans and Projects	**Habitat Loss** Direct loss of habitat (terrestrial or freshwater) in European Site – habitat fragmentation is directly associated with this impact pathway	**Habitat degradation – hydrogeology** Tunnelling and/or deep excavations affecting the existing hydrogeological regime	**Habitat degradation - tunnelling/ excavation** Tunnelling and/or deep excavations affecting the structural integrity of surface level habitats	**Habitat degradation – water quality impacts during construction** Construction works affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – water quality impacts during operation** Project operation affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – shading** Shading effects of bridge structures (sunlight, direct precipitation) on habitats	**Habitat degradation – air quality** A reduction in air quality affecting fauna species and/or habitats (vegetation composition and structure)	**Habitat degradation – non-native invasive species** Introducing or spreading non-native invasive species affecting habitats (vegetation composition and structure)	**Disturbance/ displacement** Disturbance to fauna resulting in displacement from important habitat areas (e.g. breeding/resting places or foraging areas)	**Barrier effect** New structures creating a barrier to fauna species movement (e.g. within foraging areas or along commuting routes)	**Mortality risk** Mortality/road traffic collision risk to fauna species
		Ross Lake and Woods SAC Cregganna Marsh SPA Rahasane Turlough SAC Rahasane Turlough SPA Castletaylor Complex SAC Kiltiernan Turlough SAC Lough Fingall Complex SAC			Ross Lake and Woods SAC						
West Catchment Flood Risk Assessment and Management (CFRAMS) Study	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC Cregganna Marsh SPA Rahasane Turlough SAC Rahasane Turlough SPA		Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA				Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and	

	Potential Impact Pathways										
Plans and Projects	**Habitat Loss** Direct loss of habitat (terrestrial or freshwater) in European Site – habitat fragmentation is directly associated with this impact pathway	**Habitat degradation – hydrogeology** Tunnelling and/or deep excavations affecting the existing hydrogeological regime	**Habitat degradation - tunnelling/ excavation** Tunnelling and/or deep excavations affecting the structural integrity of surface level habitats	**Habitat degradation – water quality impacts during construction** Construction works affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – water quality impacts during operation** Project operation affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – shading** Shading effects of bridge structures (sunlight, direct precipitation) on habitats	**Habitat degradation – air quality** A reduction in air quality affecting fauna species and/or habitats (vegetation composition and structure)	**Habitat degradation – non-native invasive species** Introducing or spreading non-native invasive species affecting habitats (vegetation composition and structure)	**Disturbance/ displacement** Disturbance to fauna resulting in displacement from important habitat areas (e.g. breeding/resting places or foraging areas)	**Barrier effect** New structures creating a barrier to fauna species movement (e.g. within foraging areas or along commuting routes)	**Mortality risk** Mortality/road traffic collision risk to fauna species
		Castletaylor Complex SAC Kiltiernan Turlough SAC Lough Fingall Complex SAC									
River Basin Management Plan for the Western River Basin District in Ireland (2009-2015)	*__No potential negative in-combination effects will arise__ from the implementation of the Western River Basin Management and the GTS. This plan will have a positive impact on surface and ground water quality in the Western River Basin District as its main aims are "to protect all waters within the district and, where necessary, improve waters and achieve sustainable water use."*										
Shannon International River Basin Management Plan (2009-2015)	*__No potential negative in-combination effects will arise__ from the implementation of the Shannon International River Basin Management and the GTS. This plan will have a positive impact on surface and ground water quality in the Western River Basin District as its main aims are "to protect all waters within the district and, where necessary, improve waters and achieve sustainable water use."*										
Local Plans											
Athenry Local Area Plan 2012-2018		Lough Corrib SAC		Galway Bay Complex SAC Inner Galway Bay SPA	Galway Bay Complex SAC Inner Galway Bay SPA						
Bearna Local Area Plan 2007-2017				Galway Bay Complex SAC	Galway Bay Complex SAC			Galway Bay Complex SAC	Galway Bay Complex SAC		

	Potential Impact Pathways										
Plans and Projects	**Habitat Loss** Direct loss of habitat (terrestrial or freshwater) in European Site – habitat fragmentation is directly associated with this impact pathway	**Habitat degradation – hydrogeology** Tunnelling and/or deep excavations affecting the existing hydrogeological regime	**Habitat degradation - tunnelling/ excavation** Tunnelling and/or deep excavations affecting the structural integrity of surface level habitats	**Habitat degradation – water quality impacts during construction** Construction works affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – water quality impacts during operation** Project operation affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – shading** Shading effects of bridge structures (sunlight, direct precipitation) on habitats	**Habitat degradation – air quality** A reduction in air quality affecting fauna species and/or habitats (vegetation composition and structure)	**Habitat degradation – non-native invasive species** Introducing or spreading non-native invasive species affecting habitats (vegetation composition and structure)	**Disturbance/ displacement** Disturbance to fauna resulting in displacement from important habitat areas (e.g. breeding/resting places or foraging areas)	**Barrier effect** New structures creating a barrier to fauna species movement (e.g. within foraging areas or along commuting routes)	**Mortality risk** Mortality/road traffic collision risk to fauna species
				Inner Galway Bay SPA	Inner Galway Bay SPA			Inner Galway Bay SPA	Inner Galway Bay SPA		
Claremorris Local Area Plan 2013-2019		Lough Corrib SAC		Lough Corrib SAC	Lough Corrib SAC						
Draft Clare County Development Plan 2017-2023		Galway Bay Complex SAC Inner Galway Bay SPA		Galway Bay Complex SAC Inner Galway Bay SPA	Galway Bay Complex SAC Inner Galway Bay SPA			Galway Bay Complex SAC Inner Galway Bay SPA	Galway Bay Complex SAC Inner Galway Bay SPA		
Gaeltacht Local Area Plan 2008-2018	Lough Corrib SAC Galway Bay Complex Inner Galway Bay SPA	Lough Corrib SAC		Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC		Lough Corrib SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex Inner Galway Bay SPA Ross Lake and Woods SAC		
Galway City Council Draft Development Plan 2017-2023	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA		Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC		Lough Corrib	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	

	Potential Impact Pathways										
Plans and Projects	**Habitat Loss** Direct loss of habitat (terrestrial or freshwater) in European Site – habitat fragmentation is directly associated with this impact pathway	**Habitat degradation – hydrogeology** Tunnelling and/or deep excavations affecting the existing hydrogeological regime	**Habitat degradation - tunnelling/ excavation** Tunnelling and/or deep excavations affecting the structural integrity of surface level habitats	**Habitat degradation – water quality impacts during construction** Construction works affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – water quality impacts during operation** Project operation affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – shading** Shading effects of bridge structures (sunlight, direct precipitation) on habitats	**Habitat degradation – air quality** A reduction in air quality affecting fauna species and/or habitats (vegetation composition and structure)	**Habitat degradation – non-native invasive species** Introducing or spreading non-native invasive species affecting habitats (vegetation composition and structure)	**Disturbance/ displacement** Disturbance to fauna resulting in displacement from important habitat areas (e.g. breeding/resting places or foraging areas)	**Barrier effect** New structures creating a barrier to fauna species movement (e.g. within foraging areas or along commuting routes)	**Mortality risk** Mortality/road traffic collision risk to fauna species
Galway City Local Economic and Community Plan	Lough Corrib Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Inner Galway Bay SPA Galway Bay Complex SAC Inner Galway Bay SPA		Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA		Lough Corrib	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA	
Galway County Development Plan 2015-2021	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA		Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC		Lough Corrib	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	
Gort Local Area Plan 2013-2019				Galway Bay Complex SAC Inner Galway Bay SPA	Galway Bay Complex SAC Inner Galway Bay SPA						
Headford Local Area Plan 2015-2021		Lough Corrib SAC		Lough Corrib SAC	Lough Corrib SAC						
Loughrea Local Area Plan 2012-2018				Galway Bay Complex SAC	Galway Bay Complex SAC						

	Potential Impact Pathways										
Plans and Projects	**Habitat Loss** Direct loss of habitat (terrestrial or freshwater) in European Site – habitat fragmentation is directly associated with this impact pathway	**Habitat degradation – hydrogeology** Tunnelling and/or deep excavations affecting the existing hydrogeological regime	**Habitat degradation - tunnelling/ excavation** Tunnelling and/or deep excavations affecting the structural integrity of surface level habitats	**Habitat degradation – water quality impacts during construction** Construction works affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – water quality impacts during operation** Project operation affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – shading** Shading effects of bridge structures (sunlight, direct precipitation) on habitats	**Habitat degradation – air quality** A reduction in air quality affecting fauna species and/or habitats (vegetation composition and structure)	**Habitat degradation – non-native invasive species** Introducing or spreading non-native invasive species affecting habitats (vegetation composition and structure)	**Disturbance/ displacement** Disturbance to fauna resulting in displacement from important habitat areas (e.g. breeding/resting places or foraging areas)	**Barrier effect** New structures creating a barrier to fauna species movement (e.g. within foraging areas or along commuting routes)	**Mortality risk** Mortality/road traffic collision risk to fauna species
				Inner Galway Bay SPA	Inner Galway Bay SPA						
Maigh Cuilinn Local Area Plan 2013-2019				Lough Corrib SAC	Lough Corrib SAC Lough Corrib SPA		Lough Corrib SAC	Lough Corrib SAC	Lough Corrib SAC Lough Corrib SPA Ross Lake and Woods SAC	Lough Corrib SAC Lough Corrib SPA Ross Lake and Woods SAC	
Mayo County Development Plan 2014-2020[1]		Lough Corrib SAC Lough Corrib SPA		Lough Corrib SAC	Lough Corrib SAC Lough Corrib SPA			Lough Corrib SAC			
Oranmore Local Area Plan 2012-2018	Galway Bay Complex SAC Inner Galway Bay SPA			Galway Bay Complex SAC Inner Galway Bay SPA	Galway Bay Complex SAC Inner Galway Bay SPA			Galway Bay Complex SAC Inner Galway Bay SPA	Galway Bay Complex SAC Inner Galway Bay SPA	Galway Bay Complex SAC	
Tuam Local Area Plan 2011-2017		Lough Corrib SAC		Lough Corrib SAC	Lough Corrib SAC		Lough Corrib SAC	Lough Corrib SAC	Lough Corrib SAC Lough Corrib SPA		
Projects											
Greenways											
Galway Dublin Greenway	Galway Bay Complex SAC	Cregganna Marsh SPA		Galway Bay Complex SAC				Galway Bay Complex SAC			

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[1] The Local Area Plans for the towns of Ballinrobe, Ballyhaunis and Claremorris have been integrated into the *Mayo County Development Plan 2014-2020*. As these towns are located within the River Corrib catchment, their associated plans have the potential to act in-combination with the GTS.

	Potential Impact Pathways										
Plans and Projects	**Habitat Loss** Direct loss of habitat (terrestrial or freshwater) in European Site – habitat fragmentation is directly associated with this impact pathway	**Habitat degradation – hydrogeology** Tunnelling and/or deep excavations affecting the existing hydrogeological regime	**Habitat degradation - tunnelling/ excavation** Tunnelling and/or deep excavations affecting the structural integrity of surface level habitats	**Habitat degradation – water quality impacts during construction** Construction works affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – water quality impacts during operation** Project operation affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – shading** Shading effects of bridge structures (sunlight, direct precipitation) on habitats	**Habitat degradation – air quality** A reduction in air quality affecting fauna species and/or habitats (vegetation composition and structure)	**Habitat degradation – non-native invasive species** Introducing or spreading non-native invasive species affecting habitats (vegetation composition and structure)	**Disturbance/ displacement** Disturbance to fauna resulting in displacement from important habitat areas (e.g. breeding/resting places or foraging areas)	**Barrier effect** New structures creating a barrier to fauna species movement (e.g. within foraging areas or along commuting routes)	**Mortality risk** Mortality/road traffic collision risk to fauna species
(Oranmore to Ballinasloe Cycleway)	Inner Galway Bay SPA	Rahasane Turlough SAC Rahasane Turlough SPA Castletaylor Complex SAC Kiltiernan Turlough SAC Lough Fingall Complex SAC		Inner Galway Bay SPA				Inner Galway Bay SPA			
Connemara Greenway (Clifden to Oughterard Cycleway)	Lough Corrib Ross Lake and Woods SAC			Lough Corrib SAC Lough Corrib SPA Ross Lake and Woods SAC				Lough Corrib SAC Lough Corrib SPA Ross Lake and Woods SAC	Lough Corrib SAC Lough Corrib SPA Ross Lake and Woods SAC		
Galway to Spiddal Greenway (Bearna to Spiddal Cycleway)				Galway Bay Complex SAC Inner Galway Bay SPA				Galway Bay Complex SAC Inner Galway Bay SPA	Galway Bay Complex SAC Inner Galway Bay SPA		
Roads											
M6 Motorway Service Area (Rathmorrissy Interchange)		Galway Bay Complex SAC Inner Galway Bay Complex SPA									

	Potential Impact Pathways										
Plans and Projects	**Habitat Loss** Direct loss of habitat (terrestrial or freshwater) in European Site – habitat fragmentation is directly associated with this impact pathway	**Habitat degradation – hydrogeology** Tunnelling and/or deep excavations affecting the existing hydrogeological regime	**Habitat degradation - tunnelling/ excavation** Tunnelling and/or deep excavations affecting the structural integrity of surface level habitats	**Habitat degradation – water quality impacts during construction** Construction works affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – water quality impacts during operation** Project operation affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – shading** Shading effects of bridge structures (sunlight, direct precipitation) on habitats	**Habitat degradation – air quality** A reduction in air quality affecting fauna species and/or habitats (vegetation composition and structure)	**Habitat degradation – non-native invasive species** Introducing or spreading non-native invasive species affecting habitats (vegetation composition and structure)	**Disturbance/ displacement** Disturbance to fauna resulting in displacement from important habitat areas (e.g. breeding/resting places or foraging areas)	**Barrier effect** New structures creating a barrier to fauna species movement (e.g. within foraging areas or along commuting routes)	**Mortality risk** Mortality/road traffic collision risk to fauna species
N18 Oranmore to Gort		Galway Bay Complex SAC Inner Galway Bay SPA Cregganna Marsh SPA Rahasane Turlough SAC Rahasane Turlough SPA Castletaylor Complex SAC Kiltiernan Turlough SAC Lough Fingall Complex SAC		Galway Bay Complex SAC Inner Galway Bay SPA	Galway Bay Complex SAC Inner Galway Bay SPA						
M17 Galway to Tuam	Lough Corrib SAC	Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA		Lough Corrib SAC	Lough Corrib SAC		Lough Corrib SAC	Lough Corrib SAC	Lough Corrib SAC	Lough Corrib SAC	Lough Corrib SAC

	Potential Impact Pathways										
Plans and Projects	**Habitat Loss** Direct loss of habitat (terrestrial or freshwater) in European Site – habitat fragmentation is directly associated with this impact pathway	**Habitat degradation – hydrogeology** Tunnelling and/or deep excavations affecting the existing hydrogeological regime	**Habitat degradation - tunnelling/ excavation** Tunnelling and/or deep excavations affecting the structural integrity of surface level habitats	**Habitat degradation – water quality impacts during construction** Construction works affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – water quality impacts during operation** Project operation affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – shading** Shading effects of bridge structures (sunlight, direct precipitation) on habitats	**Habitat degradation – air quality** A reduction in air quality affecting fauna species and/or habitats (vegetation composition and structure)	**Habitat degradation – non-native invasive species** Introducing or spreading non-native invasive species affecting habitats (vegetation composition and structure)	**Disturbance/ displacement** Disturbance to fauna resulting in displacement from important habitat areas (e.g. breeding/resting places or foraging areas)	**Barrier effect** New structures creating a barrier to fauna species movement (e.g. within foraging areas or along commuting routes)	**Mortality risk** Mortality/road traffic collision risk to fauna species
N17 Tuam Bypass		Lough Corrib SAC		Lough Corrib SAC	Lough Corrib SAC Lough Corrib SPA		Lough Corrib SAC	Lough Corrib SAC	Lough Corrib SAC Lough Corrib SPA		
N59 Clifden to Maam Cross **Proposed Road Development**				Lough Corrib SAC	Lough Corrib SAC Lough Corrib SPA						
N59 Maam Cross to Oughterard **Proposed Road Development**	Lough Corrib SAC	Lough Corrib SAC Lough Corrib SPA		Lough Corrib SAC	Lough Corrib SAC Lough Corrib SPA	Lough Corrib	Lough Corrib	Lough Corrib SAC Lough Corrib SPA	Lough Corrib SAC Lough Corrib SPA	Lough Corrib SAC	Lough Corrib SAC
N59 Maigh Cuilinn (Moycullen) Bypass Road Project	Lough Corrib SAC	Lough Corrib SAC Lough Corrib SPA		Lough Corrib SAC Lough Corrib SPA	Lough Corrib SAC Lough Corrib SPA						
R336 Bearna to Scríb via Ros an Mhíl Road Scheme		Galway Bay Complex SAC Inner Galway Bay SPA									
Coastal Protection											

	Potential Impact Pathways										
Plans and Projects	**Habitat Loss** Direct loss of habitat (terrestrial or freshwater) in European Site – habitat fragmentation is directly associated with this impact pathway	**Habitat degradation – hydrogeology** Tunnelling and/or deep excavations affecting the existing hydrogeological regime	**Habitat degradation - tunnelling/ excavation** Tunnelling and/or deep excavations affecting the structural integrity of surface level habitats	**Habitat degradation – water quality impacts during construction** Construction works affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – water quality impacts during operation** Project operation affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – shading** Shading effects of bridge structures (sunlight, direct precipitation) on habitats	**Habitat degradation – air quality** A reduction in air quality affecting fauna species and/or habitats (vegetation composition and structure)	**Habitat degradation – non-native invasive species** Introducing or spreading non-native invasive species affecting habitats (vegetation composition and structure)	**Disturbance/ displacement** Disturbance to fauna resulting in displacement from important habitat areas (e.g. breeding/resting places or foraging areas)	**Barrier effect** New structures creating a barrier to fauna species movement (e.g. within foraging areas or along commuting routes)	**Mortality risk** Mortality/road traffic collision risk to fauna species
Sáilín to Silverstrand Coastal Protection Scheme	Galway Bay Complex SAC Inner Galway Bay SPA	Galway Bay Complex SAC Inner Galway Bay SPA		Galway Bay Complex SAC Inner Galway Bay SPA	Galway Bay Complex SAC Inner Galway Bay SPA			Galway Bay Complex SAC Inner Galway Bay SPA	Galway Bay Complex SAC Inner Galway Bay SPA	Galway Bay Complex SAC Inner Galway Bay SPA	
Salthill Coastal Protection Works (Blackrock to Galway Golf Club)	Galway Bay Complex SAC Inner Galway Bay SPA	Galway Bay Complex SAC Inner Galway Bay SPA		Galway Bay Complex SAC Inner Galway Bay SPA	Galway Bay Complex SAC Inner Galway Bay SPA			Galway Bay Complex SAC Inner Galway Bay SPA	Galway Bay Complex SAC Inner Galway Bay SPA	Galway Bay Complex SAC Inner Galway Bay SPA	
Other Infrastructure Projects											
Proposed Galway Harbour Port Extension	Galway Bay SAC Inner Galway Bay SPA			Galway Bay SAC Inner Galway Bay SPA	Galway Bay SAC Inner Galway Bay SPA			Galway Bay SAC Inner Galway Bay SPA	Lough Corrib SPA Galway Bay SAC Inner Galway Bay SPA		
Water supply schemes		Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Cregganna Marsh SPA Rahasane Turlough SAC		Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC						

	Potential Impact Pathways										
Plans and Projects	**Habitat Loss** Direct loss of habitat (terrestrial or freshwater) in European Site – habitat fragmentation is directly associated with this impact pathway	**Habitat degradation – hydrogeology** Tunnelling and/or deep excavations affecting the existing hydrogeological regime	**Habitat degradation - tunnelling/ excavation** Tunnelling and/or deep excavations affecting the structural integrity of surface level habitats	**Habitat degradation – water quality impacts during construction** Construction works affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – water quality impacts during operation** Project operation affecting surface, ground and/or coastal water quality, or affecting the hydrological/tidal regime supporting wetland/coastal/estuarine habitats	**Habitat degradation – shading** Shading effects of bridge structures (sunlight, direct precipitation) on habitats	**Habitat degradation – air quality** A reduction in air quality affecting fauna species and/or habitats (vegetation composition and structure)	**Habitat degradation – non-native invasive species** Introducing or spreading non-native invasive species affecting habitats (vegetation composition and structure)	**Disturbance/ displacement** Disturbance to fauna resulting in displacement from important habitat areas (e.g. breeding/resting places or foraging areas)	**Barrier effect** New structures creating a barrier to fauna species movement (e.g. within foraging areas or along commuting routes)	**Mortality risk** Mortality/road traffic collision risk to fauna species
		Rahasane Turlough SPA Castletaylor Complex SAC Kiltiernan Turlough SAC Lough Fingall Complex SAC									
Wastewater Treatment Works (Public and Private)		Lough Corrib SAC Lough Corrib SPA Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC Cregganna Marsh SPA Rahasane Turlough SAC Rahasane Turlough SPA Castletaylor Complex SAC Kiltiernan Turlough SAC Lough Fingall Complex SAC		Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC	Lough Corrib SAC Galway Bay Complex SAC Inner Galway Bay SPA Ross Lake and Woods SAC						

E2

Table E-2 presents an analysis of the potential for adverse in-combination effects on European Site integrity to arise from the implementation of the GTS and any other plans and projects as per each of the identified potential impact pathways.

Table E-2: Analysis of potential for adverse in-combination effects on European Site integrity arising from the implementation of the GTS and any other plans and projects as per each identified potential impact pathway.

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
National Plans		
Climate Action and Low-Carbon Development – National Policy Position Ireland **National Spatial Strategy for Ireland 2002 – 2020** **Smarter Travel A Sustainable Transport Future 2009-2020**	No Appropriate Assessment Screening Statement or Natura Impact Report has been completed for *Climate Action and Low Carbon Development – National Policy Position Ireland*, *National Spatial Strategy for Ireland 2002-2020* or *Smarter Travel A Sustainable Transport Future 2009-2020*. It is considered that **these three plans will not have any adverse effects on SAC Qualifying Interest habitats or species, or SPA Special Conservation Interest bird species** via any of the identified impact pathways set out below and outlined in **Table E1** above. This is due to the fact that any development that may arise from these plans which has the potential to affect the same European Sites as GTS will have to adhere to the following policies and objectives of the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* (as detailed in each plan).	Following on from this strategic level assessment, it has been determined that there is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the three national plans: *Climate Action and Low-Carbon Development-National Policy Position Ireland*; *National Spatial Strategy for Ireland 2002-2020*; and, *Smarter Travel A Sustainable Transport Future 2009-2020*. This is due to the following reasons: • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* will ensure no adverse effects will occur from any development that may arise in relation to the *Climate Action and Low-Carbon Development-National Policy Position Ireland*. This will include the requirement for any development taking place within the county to undergo Screening for Appropriate Assessment and/or Appropriate Assessment where necessary and in doing so to demonstrate that the project will not give rise to any adverse direct, indirect or secondary effects on the integrity of any European Site • No adverse effects on European Site integrity will arise from the GTS, due to the following
	Potential Impact Pathways – Habitat Loss; Habitat Degradation – Hydrogeology; Habitat Degradation - Water Quality (Construction/Operation); Habitat Degradation – Air Quality[2]; Habitat Degradation - Non-native Invasive Species; Disturbance/Displacement; and, Barrier Effect	
	Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment; **Objective DS 9** Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment; **Objective DS** 10 Impacts of Development on Protected Sites; **Objective EQ 4** Compliance with Article 6(3) of the EU Habitats Directive; **Policy NHB 1** Natural Heritage and Biodiversity; **Objective NHB 1** Protected Habitats and Species**;** and, **Objective AFF 5** Compliance with the EU Habitats Directive (Galway County Council, 2014a) **Natural Heritage, Recreation and Amenity Aim**; **Natural Heritage, Recreation and Amenity Strategy**; **Policy 4.1** Green Network; **European Designated sites**; **Policy 4.2** Protected Spaces: Sites of European, **National and Local Ecological Importance**; **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.5.1** Community Spaces: Greenways and Public Rights of Way; **Environment and Infrastructure Aim**; **Environment and Infrastructure Strategy**; **Policy 9.3** Flood Risk Assessment; **Policy 9.5** Sustainable Building Design and Construction; **Policy 9.14** Energy and Associated Infrastructure; **Zoning objective for RA**; **Specific Developments Objectives for RA Zones**; **Specific Development Standard 11.28** Extract Industries/Quarries; **Specific Development Standard 11.31** Natura Impact Assessment (Galway City Council, 2016)	

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[2] This potential impact pathway only applies to the *National Spatial Strategy for Ireland 2002-2020* and *Smarter Travel A Sustainable Transport Future 2009-2020* plans.

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathway –Habitat Degradation – Hydrogeology	mitigation measures outlined in Section 3.2 of this report for: **Habitat Loss** (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Air Quality** (i.e. Box 7 GTS – Habitat Degradation – Air Quality); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement); and, **Barrier Effect** (i.e. Box 10 GTS – Barrier Effect)
	Objective NHB12 Soil/Ground Water Protection; **Objective WS 1** Protection of Ground Waters; **Objective WS 11** Regionally & Locally Important Aquifers; and, **Policy WS 4** Water Quality (Galway County Council, 2014a) **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22** Water Quality (Galway City Council, 2016)	
	Potential Impact Pathway – Habitat Degradation – Water Quality (Construction/Operation)	
	Policy WS 4 Water Quality; **Objective WS 2** EU Policies and Directives; **Objective WW 1** EU Policies and Directives; **Objective WW 6** Adherence to Environmental Standards; **Policy NHB 4**; and, **Objective NHB 3** Water Resources (Galway County Council, 2014a) **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.6.2** Open Spaces: Agricultural Lands; Environment and Infrastructure Strategy; **Policy 9.3** Flood Risk Assessment; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.8** Sustainable Urban Drainage Systems (SUDS); **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22 Water Quality** (Galway City Council, 2016)	
	Potential Impact Pathway – Habitat Degradation - Non-native Invasive Species	
	Policy NHB 7 Invasive Species (Galway County Council, 2014a) **Policy 4.2** Protected Spaces: Sites of European, National and Local Ecological Importance (Galway City Council, 2016)	
	Potential Impact Pathway – Disturbance/Displacement	
	Objective NHB 2 Biodiversity and Ecological Networks; and, **Objective NHB 6** Protection of Bats and Bats Habitats. (Galway County Council, 2014a) **Policy 4.2** Protected Spaces: Sites of European, National and Local Ecological Importance; and, **Policy 4.3** Blue Spaces: Coast, Canals and Waterways (Galway City Council, 2016)	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
Foodwise 2025	According to the Natura Impact Statement (Philip Farrelly & Co, 2015), there were 11 proposed actions that had potential to impact on the beef, seafood, tillage and forestry sectors but application of statutory management requirements, GLAS and licencing and permitting procedures in specific sectors were viewed to fully address these potential impacts. Based on this assessment, it is considered that the ***Foodwise 2025* will not have any adverse effects on SAC Qualifying Interest habitats or species, or SPA Special Conservation Interest bird species** in Co. Galway via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the fact that any development that may arise in relation to Foodwise 2025 which has the potential to affect the same European Sites as GTS will have to adhere to the following policies and objectives of the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* (as detailed in plan): ***Potential Impact Pathways – Habitat Loss, Habitat Degradation – Hydrogeology, Habitat Degradation – Water Quality (Operation), Non-native Invasive Species, Disturbance/Displacement*** **Objectives DS 6** Natura 2000 Network and Habitats Directive Assessment; **Objective DS 9** Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment; **Objective DS** 10 Impacts of Development on Protected Sites; **Objective EQ 4** Compliance with Article 6(3) of the EU Habitats Directive; **Policy NHB 1** Natural Heritage and Biodiversity; **Objective NHB 1** Protected Habitats and Species**;** and, **Objective AFF 5** Compliance with the EU Habitats Directive (Galway County Council, 2014a) **Natural Heritage, Recreation and Amenity Aim**; **Natural Heritage, Recreation and Amenity Strategy**; **Policy 4.1** Green Network; **European Designated sites**; **Policy 4.2** Protected Spaces: Sites of European, **National and Local Ecological Importance**; **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.5.1** Community Spaces: Greenways and Public Rights of Way; **Environment and Infrastructure Aim**; **Environment and Infrastructure Strategy**; **Policy 9.3** Flood Risk Assessment; **Policy 9.5** Sustainable Building Design and Construction; **Policy 9.14** Energy and Associated Infrastructure; **Zoning objective for RA**; **Specific Developments Objectives for RA Zones**; **Specific Development Standard 11.28** Extract Industries/Quarries; **Specific Development Standard 11.31** Natura Impact Assessment (Galway City Council, 2016) ***Potential Impact Pathway –Habitat Degradation – Hydrogeology*** **Objective NHB12** Soil/Ground Water Protection; **Objective WS 1** Protection of Ground Waters; **Objective WS 11** Regionally & Locally Important Aquifers; and, **Policy WS 4** Water Quality (Galway County Council, 2014a) **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22** Water Quality (Galway City Council, 2016)	Following on from this strategic level assessment, it has been determined that there is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the *Foodwise 2025*. This is due to the following reasons: • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* will ensure no adverse effects will occur from any development alone that may arise in relation to the *Foodwise 2025*. This will include the requirement for any development taking place within the county to undergo Screening for Appropriate Assessment and/or Appropriate Assessment where necessary and in doing so to demonstrate that the project will not give rise to any adverse direct, indirect or secondary effects on the integrity of any European Site; and, • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Loss** (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	Potential Impact Pathway – Habitat Degradation – Water Quality (Operation)	Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); and, **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement).
	Policy WS 4 Water Quality; **Objective WS 2** EU Policies and Directives; **Objective WW 1** EU Policies and Directives; **Objective WW 6** Adherence to Environmental Standards; **Policy NHB 4**; and, **Objective NHB 3** Water Resources (Galway County Council, 2014a) **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.6.2** Open Spaces: Agricultural Lands; Environment and Infrastructure Strategy; **Policy 9.3** Flood Risk Assessment; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.8** Sustainable Urban Drainage Systems (SUDS); **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22 Water Quality** (Galway City Council, 2016)	
	Potential Impact Pathway – Habitat Degradation - Non-native Invasive Species	
	Policy NHB 7 Invasive Species (Galway County Council, 2014a) **Policy 4.2** Protected Spaces: Sites of European, National and Local Ecological Importance (Galway City Council, 2016)	
	Potential Impact Pathway – Disturbance/Displacement	
	Objective NHB 2 Biodiversity and Ecological Networks; and, **Objective NHB 6** Protection of Bats and Bats Habitats (Galway County Council, 2014a) **Policy 4.2** Protected Spaces: Sites of European, National and Local Ecological Importance; and, **Policy 4.3** Blue Spaces: Coast, Canals and Waterways (Galway City Council, 2016)	
Ireland's Rural Development Programme 2014-2020	According to the conclusions of its Natura Impact Report (Blackthorn Ecology 2014), ***Ireland's Rural Development Programme 2014-2020*** **will not have any adverse effects on SAC Qualifying Interest habitats or species or SPA SCI bird species** via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the following mitigation measures:	Following on from this strategic level assessment, it has been determined that there is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and *Ireland's Rural Development Programme 2014-2020*. This is due to the following reasons:

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	Potential Impact Pathways - Habitat Loss; Habitat Degradation – Hydrogeology; Habitat Degradation – Water Quality (Construction/Operation); Non-native Invasive Species; Disturbance/Displacement; and, Barrier Effect	• No adverse effects on European Site integrity will arise from Ireland's Rural Development Programme 2014-2020 alone, due to the mitigation measures outlined in the NIR • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* will ensure no adverse effects will occur from any development alone that may arise in relation to the *Ireland's Rural Development Programme 2014-2020*. This will include the requirement for any development taking place within the county to undergo Screening for Appropriate Assessment and/or Appropriate Assessment where necessary and in doing so to demonstrate that the project will not give rise to any adverse direct, indirect or secondary effects on the integrity of any European Site • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Loss** (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS –
	• "*Appropriate assessment of individual projects… to ensure that significant impacts do not arise for these developments.*" • "*Appropriate assessment of reclamation projects*" • "*Continuing Professional Development for agricultural advisors in forestry schemes*" • "*Consultations with key stakeholders during GLAS measure development*" and, • "*Monitoring… to ensure that any negative impacts from the scheme will be detected and remedied before they result in significant impacts on Natura 2000 sites*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
		Habitat Degradation – Water Quality (Construction) – New Road Developments); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement); and, **Barrier Effect** (i.e. Box 10 GTS – Barrier Effect)
Wild Atlantic Way Operational Programme 2015-2019	According to the conclusions of its Natura Impact Report (CASS Ltd., 2015b), the ***Wild Atlantic Way Operational Programme 2015-2019*** **alone will not have any adverse effects on SAC Qualifying Interest habitats or species or SPA SCI bird species** via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the mitigation measures (described below) that local authorities and other organisations will have to comply with in order to obtain funding, and the implementation of the *Strategy for Environmental Surveying and Monitoring for the Wild Atlantic Way Operational Programme* (CAAS Ltd., 2015c). This monitoring strategy will provide more data on the condition of habitats, which can in turn be utilised during the preparation of site-specific conservation objectives and development of integrated management plans for all relevant European Sites.	There is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the *Wild Atlantic Way Operational Programme 2015-2019*. This is due to the following reasons: • No adverse effects on European Site integrity will arise from the Wild Atlantic Way Operational Programme alone, due to the mitigation measures listed in the NIR; • The NIR states “*the implementation of the Operational Programme may result in developments within the study area and that works have not been explicitly defined, habitat loss within those sites occurring within the nine coastal counties cannot, at this stage, be ruled out.”* Although there is some uncertainty with regards to the potential for habitat loss to occur, adherence to the overarching policies and objectives outlined in the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* will ensure no adverse effects will arise from the implementation of the *Wild Atlantic Way Operational Programme 2015-2019* • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of
	Potential impact Pathways – Habitat Loss; Habitat Degradation – Water Quality (Operation); Habitat Degradation - Non-native Invasive Species; and, Disturbance/Displacement	
	• **Regulatory framework for environmental protection and management** – “*Local authorities and others shall cumulatively contribute towards - in combination with other users and bodies - the achievement of the objectives of the regulatory framework for environmental protection and management. Local authorities and others will demonstrate, as appropriate, that plans, programmes and projects comply with EU Directives - including the Habitats Directive (92/43/EEC, as amended), the Birds Directive (2009/147/EC), the Environmental Impact Assessment Directive (85/337/EEC, as amended) and the Strategic Environmental Assessment Directive (2001/42/EC) - and relevant transposing Regulations.*” • **Information to be considered by local authorities and others at lower levels of decision making and environmental assessment** – “*Lower levels of decision making and environmental assessment by local authorities and others, as relevant, should consider the sensitivities identified in Section 4 of the SEA Environmental Report, including the following:* *(a) Candidate Special Areas of Conservation and Special Protection Areas;* *(b) Features of the landscape that provide linkages/connectivity to designated sites (e.g. watercourses, areas of semi-natural habitat such as linear woodlands etc.)*	

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	(c) *Salmonid Waters;* (d) *Shellfish Waters;* (e) *Freshwater Pearl Mussel catchments;* (f) *Nature Reserves;* (g) *Natural Heritage Areas and proposed Natural Heritage Areas;* (h) *Areas likely to contain a habitat listed in annex 1 of the Habitats Directive;* (i) *Entries to the Record of Monuments and Places and Zones of Archaeological Potential;* (j) *Entries to the Record of Protected Structures;* (k) *Un-designated sites of importance to wintering or breeding bird species of conservation concern;* (l) *Architectural Conservation Areas; and* (m) *Relevant landscape designations.*" - **Protection of Biodiversity including Natura 2000 Network** – "*Local authorities and others shall contribute, as appropriate, towards the protection of designated ecological sites including candidate Special Areas of Conservation (cSACs) and Special Protection Areas (SPAs); UNESCO World Heritage and UNESCO Biosphere sites; Ramsar Sites; Salmonid Waters; Shellfish Waters; Freshwater Pearl Mussel catchments; Flora Protection Order sites; Wildlife Sites (including Nature Reserves); Certain entries to the Water Framework Directive Register of Protected Areas; Natural Heritage Areas (NHAs) and proposed Natural Heritage Areas (pNHAs); Wildfowl Sanctuaries (see S.I. 192 of 1979); and Tree Preservation Orders (TPOs). Local authorities and others shall demonstrate compliance with relevant EU Environmental Directives and applicable National Legislation, Policies, Plans and Guidelines, including the following and any updated/superseding documents):* (a) *EU Directives, including the Habitats Directive (92/43/EEC, as amended), the Birds Directive (2009/147/EC), the Environmental Liability Directive (2004/35/EC), the Environmental Impact Assessment Directive (85/337/EEC, as amended), the Water Framework Directive (2000/60/EC) and the Strategic Environmental Assessment Directive (2001/42/EC).* (b) *National legislation, including the Wildlife Act 1976, the European Communities (Environmental Impact Assessment) Regulations 1989 (SI No. 349 of 1989) (as amended), the Wildlife (Amendment) Act 2000, the European Union (Water Policy) Regulations 2003 (as amended), the Planning and Development Act 2000 (as amended), the European Communities (Birds and Natural Habitats) Regulations 2011 (SI No. 477 of 2011), the European Communities (Environmental Liability) Regulations 2008 and the Flora Protection Order 1999.* (c) *National policy guidelines (including any clarifying Circulars or superseding versions of same), including the Landscape and Landscape Assessment Draft Guidelines 2000, the Environmental Impact Assessment Sub-Threshold Development Guidelines 2003, Strategic Environmental Assessment Guidelines 2004 and the Appropriate Assessment Guidance 2010.* (d) *Catchment and water resource management Plans, including River Basin District Management Plans 2009-2015 (including any superseding versions of same).* (e) *Biodiversity Plans and guidelines, including Actions for Biodiversity 2011-2016: Ireland's 2nd National Biodiversity Plan (including any superseding version of same).*	this report for: **Habitat Loss** (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); and, **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement)

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	(f) Ireland's Environment 2014 (EPA, 2014, including any superseding versions of same), and to make provision where appropriate to address the report's goals and challenges." • **Appropriate Assessment** – "*All projects and plans arising from this programme will be screened for the need to undertake Appropriate Assessment under Article 6 of the Habitats Directive. A plan or project will only be authorised after the competent authority has ascertained, based on scientific evidence, Screening for Appropriate Assessment, and a Stage 2 Appropriate Assessment where necessary, that:* *(a) The Plan or project will not give rise to significant adverse direct, indirect or secondary effects on the integrity of any European Site (either individually or in combination with other plans or projects); or* *(b) The Plan or project will have significant adverse effects on the integrity of any European Site (that does not host a priority natural habitat type/and or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or* *(c) The Plan or project will have a significant adverse effect on the integrity of any European Site (that hosts a natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons for overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000.*" • **Protection of Natura 2000 Sites** – "*No projects giving rise to significant cumulative, direct, indirect or secondary impacts on Natura 2000 sites arising from their size or scale, land take, proximity, resource requirements, emissions (disposal to land, water or air), transportation requirements, duration of construction, operation, decommissioning or from any other effects shall be permitted on the basis of this programme (either individually or in combination with other plans or projects).*" • **NPWS & Integrated Management Plans - "***Regarding, integrated management plans, Article 6(1) of the Habitats Directive requires that Member States establish the necessary conservation measures for Special Area of Conservation involving, if need be, appropriate management plans specifically designed for the sites or integrated into other development plans. The NPWS's current priority is to identify site specific conservation objectives; management plans may be considered after this is done. Where Integrated Management Plans are being prepared for all Natura sites (or parts thereof), Fáilte Ireland and local authorities shall engage with the National Parks and Wildlife Service in order to ensure that plans are fully integrated with the Operational Programme and other plans and programmes, with the intention that such plans are practical, achievable and sustainable and have regard to all relevant ecological, cultural, social and economic considerations and with special regard to local communities.*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathway - Habitat Degradation – Water Quality (Construction)	
	• **Construction and Environmental Management Plan** – "*Construction Environment Management Plans (CEMPs) shall be prepared in advance of the construction of larger projects and implemented throughout. Such plans shall incorporate relevant mitigation measures... CEMPs typically provide details of intended construction practice for the proposed development, including:* *(a) Location of the sites and materials compound(s) including area(s) identified for the storage of construction refuse,* *(b) Location of areas for construction site offices and staff facilities,* *(c) Details of site security fencing and hoardings,* *(d) Details of on-site car parking facilities for site workers during the course of construction,* *(e) Details of the timing and routing of construction traffic to and from the construction site and associated directional signage,* *(f) Measures to obviate queuing of construction traffic on the adjoining road network,* *(g) Measures to prevent the spillage or deposit of clay, rubble or other debris,* *(h) Alternative arrangements to be put in place for pedestrians and vehicles in the case of the closure of any public right of way during the course of site development works,* *(i) Details of appropriate mitigation measures for noise, dust and vibration, and monitoring of such levels,* *(j) Containment of all construction-related fuel and oil within specially constructed bunds to ensure that fuel spillages are fully contained; such bunds shall be roofed to exclude rainwater,* *(k) Disposal of construction/demolition waste and details of how it is proposed to manage excavated soil,* *(l) A water and sediment management plan, providing for means to ensure that surface water runoff is controlled such that no silt or other pollutants enter local water courses or drains,* *(m) Details of a water quality monitoring and sampling plan.* *(n) If peat is encountered - a peat storage, handling and reinstatement management plan.* *(o) Measures adopted during construction to prevent the spread of invasive species (such as Japanese Knotweed).* *(p) Appointment of an ecological clerk of works at site investigation, preparation and construction phases.*" • **Protection of Riparian Zone and Waterbodies and Watercourses** – "*Local authorities and others shall demonstrate that waterbodies and watercourses are protected from inappropriate development, including rivers, streams, associated undeveloped riparian strips, wetlands and natural floodplains. This will include protection buffers in riverine, wetland and coastal areas, as appropriate.*" • **Water Framework Directive and associated legislation** – "*Local authorities and others shall contribute towards, as appropriate, the protection of existing and potential water resources, and their use by humans and wildlife, including rivers, streams, wetlands, groundwater, coastal waters and associated habitats and species in accordance with the requirements and guidance in the EU Water Framework Directive 2000 (2000/60/EC), the European Union (Water Policy) Regulations 2003 (as amended), the European Communities Environmental Objectives (Surface*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Waters) Regulations 2009 (SI No. 272 of 2009), the Groundwater Directive 2006/118/EC and the European Communities Environmental Objectives (groundwater) Regulations, 2010 (S.I. No. 9 of 2010) and other relevant EU Directives, including associated national legislation and policy guidance (including any superseding versions of same). Local authorities and others shall support the application and implementation of a catchment planning and management approach to development and conservation, including the implementation of Sustainable Drainage System techniques for new development.” • **River Basin Management Plan** – *“Local authorities and others shall support the implementation of the relevant recommendations and measures as outlined in the various River Basin Management Plans 2009 – 2015, and associated Programmes of Measures, or any such plans that may supersede same during the lifetime of the Operational Programme, as well as relevant recommendations contained in the Water Quality in Ireland 2007 – 2009 (EPA, 2011, and any updated/superseding document). Local authorities and others shall demonstrate that proposals for development would not have an unacceptable impact on the water environment, including surface waters, groundwater quality and quantity, river corridors and associated woodlands and coastal waters. Also local authorities and others shall have cognisance of, where relevant, the EU’s Common Implementation Strategy Guidance Document No. 20 which provides guidance on exemptions to the environmental objectives of the Water Framework Directive.”* • **Surface Water Drainage and Sustainable Drainage Systems (SuDs)** – “*Local authorities and others shall ensure that new development is adequately serviced with surface water drainage infrastructure and promote the use of Sustainable Drainage Systems as appropriate.*”	
	Potential Impact Pathway – Habitat Degradation - Non-native Invasive Species	
	• **Non-native invasive species** – “*Local authorities and others shall support, as appropriate, the National Parks and Wildlife Service’s efforts to seek to control the spread of non-native invasive species on land and water.*”	
Regional Plans		
Regional Planning Guidelines for the West	According to the conclusions of its Natura Impact Report, the ***Regional Planning Guidelines for the West Region 2010-2022*** **alone will not have any adverse effects on SAC Qualifying Interest habitats or species or SPA SCI bird species** via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the following mitigation measures:	Following on from this strategic level assessment, it is determined that there is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
Region 2010 – 2022	***Potential impact Pathways – Habitat Loss; Habitat Degradation – Hydrogeology; Habitat Degradation – Water Quality (Construction/Operation); Habitat Degradation – Air Quality; Habitat Degradation - Non-native Invasive Species; Disturbance/Displacement; and, Barrier Effect*** • "*Development shall not be permitted or specific policy adopted unless the Habitats Directive Assessment process has been carried out (where relevant) and it concludes that there is no threat to a Natura 2000 site habitat or that which might be mitigated to maintain the integrity and conservation objectives of the site.*" • "*Local Authority Habitats Directive Assessment should also:* *(a) Ensure that identified threats are examined holistically and in combination with other threats listed in this appendix or otherwise as set out by the National Parks and Wildlife Service (NPWS).* *(b) Where mitigation measures are possible, the amount of land occupied by a development and indirect impacts should be minimal taking account of habitat size, location, season, spatial patterns of habitats and species, etc.* (c) *No effluent discharge that would be liable to have a negative impact on a habitat shall be permitted unless and until it has been concluded either that no negative impact would arise or that any such impacts can be satisfactorily mitigated.*" • "*Major residential developments have the potential to fragment or erode habitat. Emissions generated from traffic, noise, light etc. all have potential disruptive impacts. Proposed residential development located in or in close proximity to a Natura 2000 site shall be accompanied by a Habitats Directive Assessment which will examine if the development will have a negative impact (including in-combination effects) on a Natura 2000 site or that where such an impact is likely it can be mitigated satisfactorily.*" • "*In addition to the impact from wastewater, industrial and enterprise developments and tourism developments may have other negative implications for Natura 2000 sites. These implications may be related to the physical destruction of a habitat, air pollution from traffic, noise and other general activities and light pollution. No industrial or enterprise policies or objectives shall be adopted or development permitted unless it can be demonstrated through the carrying out of the Habitats Directive Assessment process that the development will not impact negatively on a Natura 2000 site or that where such an impact is likely it can be mitigated satisfactorily.*" • "*Policies for the development of mineral extraction sites must be contingent on, and be stated to be contingent on it being demonstrated that the development will not impact negatively on a Natura 2000 site. Where a development cannot be shown not to have a negative impact even with mitigation measures being adopted, then the development cannot be permitted except in the very rare circumstances of IROPI Regional Planning Guidelines for the West Region 2010 -2022 153 arising. Even where Natura 2000 sites are not impacted on, any mineral extraction development will be contingent on effluent arising from it being such that it will not impact on any wastewater treatment system whether private or public, that will prevent that system discharging a final effluent that meets the discharge regulation requirements and which would meet the objectives of the River Basin Management Plans.*"	and the *Regional Planning Guidelines for the West Region 2010-2022*. This is due to the following reasons: • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* will ensure no adverse effects will occur from any development alone that may arise in relation to the *Regional Planning Guidelines for the West Region 2010-2022*. This will include the requirement for any development taking place within the county to undergo Screening for Appropriate Assessment and/or Appropriate Assessment where necessary and in doing so to demonstrate that the project will not give rise to any adverse direct, indirect or secondary effects on the integrity of any European Site • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Loss** (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) –

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	• ”*In considering all transport and other infrastructure proposals, regard must be had to the requirements of the Habitats Directive including the carrying out of an assessment of the implications for any Natura 2000 site that might be at risk from the proposed development."* • "*Where a specific road proposal is being considered that is liable to impact negatively on a Natura 2000 site, such a proposal must be assessed in accordance with the requirements of HDA process. If such assessment demonstrates that such a development cannot take place without impacting negatively on any Natura 2000 site, then the development cannot proceed unless the rare circumstance of IROPI.*" • "*Where a specific rail proposal is being considered that is liable to impact negatively on a Natura 2000 site, such a proposal must be assessed in accordance with the requirements of the HDA process. If such assessment demonstrates that such a development cannot take place without impacting negatively on any Natura 2000 site, then the development cannot proceed unless the rare circumstance of IROPI.*" • "*Areas that contain or are designated as Natura 2000 or other ecological sites may also coincide with areas suitable for wind energy development. DoEHLG Wind Energy Development Guidelines (2006) should be followed when identifying areas suitable for wind energy. When exploring areas of suitability, Natura 2000 sites and other ecological sites should be placed in the 'not normally permissible' category. The HDA process must be undertaken at plan level and where mitigation is satisfactory, an individual development may be permitted in an 'open for consideration' category, which has undergone the HDA process and which has concluded that the proposed development would not have a negative impact on such a site or that mitigation measures which would eliminate such impacts can be identified and applied.*" • "*Recreational development may require the provision of waste-water facilities that discharge to river systems. Many of these systems contain Natura 2000 sites that would be vulnerable to inadequately treated wastewater discharges. Therefore, policies for the development of recreational facilities in such areas must be contingent on, and be stated to be contingent on, the provision of waste-water treatment systems with a capacity to produce waste water discharges of a standard that will not impact negatively on downstream (ex-situ) Natura 2000 sites.*" • "*Even where Natura 2000 sites are not impacted on, any recreational development will be contingent on effluent arising from it being such that it will not impact on any waste-water treatment system whether private or public, that will prevent that system discharging a final effluent that meets discharge requirements and which would meet the requirements of the River Basin Management Plans.*" • "*In addition to the impact from waste-water, recreational developments may have other negative implications for Natura 2000 sites. These implications may be related to the physical destruction of a habitat, the impact of air emissions, the impact of Regional Planning Guidelines for the West Region 2010 -2022 156 traffic, noise and other general activities and light pollution. No policy regarding commercial development shall be adopted or development permitted in or in proximity to a Natura 2000 site unless it can be demonstrated through the carrying out of HDA process that the policy or development will not impact negatively on a Natura 2000 site or that where such an impact is likely it can be mitigated satisfactorily.*" • "*In considering the impact of any proposed policy or project that is liable to give rise to impacts on a Natura 2000 site, the Planning Authority shall consider the likely cumulative effect of such impacts that are liable to arise from*	Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Air Quality** (i.e. Box 7 GTS – Habitat Degradation – Air Quality); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement); and, **Barrier Effect** (i.e. Box 10 GTS – Barrier Effect)

Plan or Project	Potential for Adverse Effects on European Site Integrity Alone?	Potential for Adverse Effects on European Site Integrity In-combination?
	any source and shall not adopt any policy or permit any development that would result in the deterioration of the site's habitat status either by itself or cumulatively with other developments or activities."	
	Potential impact Pathways – Habitat Degradation – Hydrogeology	
	• "*Tourism and rural enterprise developments may be proposed in areas without a piped waste-water collection and treatment system and this has implications for the quality of groundwater in the region. Development which requires the provision of a private treatment system should be considered in the context of the following:* *(a) The quality of the groundwater into which the effluent will discharge and the need to preserve or improve that quality.* *(b) The quality of the effluent proposed to be discharged from the waste-water treatment process.* *(c) The quantity of the effluent proposed to be discharged.* *(d) The capacity of the ground to enhance the quality of the final effluent and ability of treated effluent to percolate to, or reach groundwater.* *(e) Proposals for the management and maintenance of the treatment system.* *(f) The capacity of the Local Authority to monitor the quality of the discharge.* *(g) Direct, indirect and cumulative effects on Natura 2000 sites and their conservation objectives.* • *"Potential flood risk to any part of the wastewater treatment system Permission should not be granted unless the Planning Authority is satisfied that the quality of the groundwater will not be impaired and policies to this effect should be included in Development Plans.*" • "*Permission should not be granted unless the Planning Authority is satisfied that the quality of the groundwater will not be impaired and policies to this effect should be included in Development Plans.*" • "*Recreational developments may be proposed in areas without a piped waste-water collection and treatment system and this has implications for the quality of groundwater in the region. Any development that requires the provision of a private treatment system should be considered in the context of the following –* *(a) The quality of the groundwater into which the effluent will discharge and the need to preserve or improve that quality.* *(b) The quality of the effluent proposed to be discharged from the waste-water treatment process.* *(c) The quantity of the effluent proposed to be discharged* *(d) The capacity of the ground to enhance the quality of the final effluent and ability of treated effluent to percolate to, or reach groundwater.* *(e) Proposals for the management and maintenance of the treatment system.* *(f) The capacity of the ground to enhance the quality of the final effluent.* *(g) Proposals for the management and maintenance of the treatment system.* *(h) The capacity of the Local Authority to monitor the quality of the discharge.* *(i) Direct, indirect and cumulative effects on Natura 2000 sites and their conservation objectives.*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	(j) Potential flood risk to any part of the wastewater treatment system *Permission should not be granted unless the Planning Authority is satisfied that the quality of the groundwater will not be impaired and policies to this effect should be included in Development Plans.*"	
	Potential impact Pathways – Habitat Degradation – Water Quality (Construction/Operation)	
	- "*Major population growth and housing development will require the provision of wastewater facilities. The major centres identified for growth (i.e. Galway, Castlebar, Ballina, Tuam and Roscommon) have or will require waste-water treatment systems expansion that discharge to river systems. Many of these systems contain are Natura 2000 sites and contain habitats and species which would be vulnerable to inadequately treated wastewater discharges. The development of housing in such areas must be contingent on, and be stated to be contingent on, the provision of waste-water treatment systems with a capacity to produce waste water discharges of a standard that will not impact negatively on downstream Natura 2000 sites.*" - "*Where Natura 2000 sites are not impacted on, any development of enterprise, industry and tourism development will be contingent on the effluent arising from it being such that it will not impact on any waste-water treatment system whether private or public, that will prevent that system discharging a final effluent that meets the requirements of discharge regulation in order to achieve the objectives of the River Basin Management Plans nor should any development of this nature impact negatively on the natural environment unless demonstrated that appropriate mitigation measures can address the impacts.*" - "*Major commercial development may require the provision of waste-water facilities. The major centres identified for commercial growth have or will require waste-water treatment systems that discharge to river systems. Many of these systems contain Natura 2000 Sites that would be vulnerable to inadequately treated waste-water discharges. Therefore, policies for the development of commercial activities in such areas must be contingent on, and be stated to be contingent on, the provision of waste-water treatment systems with a capacity to produce waste water discharges of a standard that will not impact negatively on downstream Natura 2000 Sites. Where a development cannot be shown not to have a negative impact even with mitigation measures being adopted, then the development cannot be permitted except in the very rare instances of IROPI.*" - "*In addition to the impact from waste-water, commercial developments may have other negative implications on Natura 2000 sites. These implications may be related to the physical destruction of a habitat, the impact of air emissions, the impact of traffic, noise and other general activities and light pollution. No commercial policy shall be adopted or development permitted in or in proximity to a Natura 2000 site unless it can be demonstrated through the carrying out of the HDA process that the development will not impact negatively on a Natura 2000 site or that where such an impact is likely it can be mitigated satisfactorily.*" - "*Where Natura 2000 sites are not impacted on, any commercial development will be contingent on effluent arising from it being such that it will not impact on any waste-water treatment system whether private or public, that will*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	prevent that system discharging a final effluent that meets the requirements of the appropriate River Basin District Management Plan.” • “*Distributed population growth in areas without a piped waste-water collection and treatment system has implications for the quality of groundwater in the area. The RBD analyses have identified areas within the region where the quality of the ground-water is not adequate. Any development that requires the provision of a private treatment system should be considered in the context of the following –* *(a) The quality of the groundwater into which the effluent will discharge and the need to preserve or improve that quality.* *(b) The quality of the effluent proposed to be discharged from the waster-water treatment process.* *(c) The quantity of the effluent proposed to be discharged.* *(d) The capacity of the ground to enhance the quality of the final effluent and ability of treated effluent to percolate to, or reach groundwater.* *(e) Proposals for the management and maintenance of the treatment system.* *(f) The capacity of the Local Authority to monitor the quality of the discharge.* *(g) Direct, indirect and cumulative effects on Natura 2000 sites and their conservation objectives.* (h) *Potential flood risk to any part of the wastewater treatment system.*” • “*Where the river system to which the final effluent from waste-water treatment plants installed to service smaller towns and villages discharges, contain Natura 2000 sites that would be vulnerable to inadequately treated waste-water discharges the installation of a waste water treatment system and the amount and nature of effluent it proposes to treat must be contingent on, and be stated to be contingent on, the production of wastewater discharges of a standard that will not impact negatively on downstream Natura 2000 sites. Even where Natura 2000 sites are not impacted on, the installation of any wastewater treatment system will be contingent on the effluent arising from it being such that it will give rise to a final effluent that meets the discharge requirements and would not compromise the objectives of the River Basin Management Plans.*” • “*Many areas that contain or are designated as Natura 2000 sites are also liable to be included in areas designated as being of landscape importance. In considering the policies to apply in such areas regard shall be had to the designation of the area as a Natura 2000 site. As noted above, in implementing these guidelines, full regard must be had to the requirements of the Habitats Directive including the carrying out Regional Planning Guidelines for the West Region 2010 -2022 155 of an assessment of the implications for any Natura 2000 site that might be at risk from any proposed development. While all Natura 2000 sites are of key importance, a number have particular importance as they contain species that are of particular relevance as indicators of environmental quality. A key species in this regard is the Fresh Water Pearl Mussel and all Planning Authorities must take particular care that activities permitted within their areas do not pose a threat to species such as this, whether they lie within or without the Authority's functional area. Where such an impact is identified the development must be mitigated or, where that is not possible must not be implemented unless the procedure relating to developments of IROPI has been completed.*”	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	• *"The European Union Water Framework Directive imposes significant requirements for the protection of water bodies. Local authorities will be required to continue to co-ordinate activities to achieve objectives through the River Basin Management Plans for the Shannon and Western River Basin Districts."* • *"In considering the impact of any proposed policy or project that is liable to give rise to a waste-water treatment demand, the Planning Authority shall consider the likely cumulative impact of such demands that are liable to arise from any source and shall not adopt any policy or permit any development that would result in the capacity of the area's waste water treatment system to be exceeded by the cumulative demands of successive developments."*	
West Catchment Flood Risk Assessment and Management Study	No Appropriate Assessment Screening Statement or Natura Impact Report has been completed for the *West Catchment Flood Risk Assessment and Management Study*. It is considered that the ***West Catchment Flood Risk Assessment and Management Study* will not have any adverse effects on SAC Qualifying Interest habitats or species, or SPA Special Conservation Interest bird species** via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the fact that any development that may arise in relation to the West Catchment Flood Risk Assessment and Management Study which has the potential to affect the same European Sites as GTS will have to adhere to the following policies and objectives of the *Galway County Development Plan 2015-2021* and *Galway City Council Draft Development Plan 2017-2023* (as detailed in plan): ***Potential Impact Pathways – Habitat Loss; Habitat Degradation – Hydrogeology; Habitat Degradation – Water Quality (Construction); Habitat Degradation – Non-native Invasive Species; Disturbance/Displacement; and, Barrier Effect*** **Objectives DS 6** Natura 2000 Network and Habitats Directive Assessment; **Objective DS 9** Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment; **Objective DS** 10 Impacts of Development on Protected Sites; **Objective EQ 4** Compliance with Article 6(3) of the EU Habitats Directive; **Policy NHB 1** Natural Heritage and Biodiversity; **Objective NHB 1** Protected Habitats and Species**;** and, **Objective AFF 5** Compliance with the EU Habitats Directive (Galway County Council, 2014a) **Natural Heritage, Recreation and Amenity Aim**; **Natural Heritage, Recreation and Amenity Strategy**; **Policy 4.1** Green Network; **European Designated sites**; **Policy 4.2** Protected Spaces: Sites of European, **National and Local Ecological Importance**; **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.5.1** Community Spaces: Greenways and Public Rights of Way; **Environment and Infrastructure Aim**; **Environment and Infrastructure Strategy**; **Policy 9.3** Flood Risk Assessment; **Policy 9.5** Sustainable Building Design and Construction; **Policy 9.14** Energy and Associated Infrastructure; **Zoning objective for RA**; **Specific Developments Objectives for RA Zones**; **Specific Development Standard 11.28** Extract Industries/Quarries; **Specific Development Standard 11.31** Natura Impact Assessment (Galway City Council, 2016)	Following on from this strategic level assessment, it is determined that there is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the *West Catchment Flood Risk Assessment and Management Study*. This is due to the following reasons: • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* will ensure no adverse effects will occur from any development alone that may arise in relation to the *West Catchment Flood Risk Assessment and Management Study*. This will include the requirement for any development taking place within the county to undergo Screening for Appropriate Assessment and/or Appropriate Assessment where necessary and in doing so to demonstrate that the project will not give rise to any adverse direct, indirect or secondary effects on the integrity of any European Site • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Loss** (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathway – Habitat Degradation – Hydrogeology	Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement); and, **Barrier Effect** (i.e. Box 10 GTS – Barrier Effect)
	Objective NHB12 Soil/Ground Water Protection; **Objective WS 1** Protection of Ground Waters; **Objective WS 11** Regionally & Locally Important Aquifers; and, **Policy WS 4** Water Quality (Galway County Council, 2014a) **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22** Water Quality (Galway City Council, 2016)	
	Potential Impact Pathway – Habitat Degradation – Water Quality (Construction)	
	Policy WS 4 Water Quality; **Objective WS 2** EU Policies and Directives; **Objective WW 1** EU Policies and Directives; **Objective WW 6** Adherence to Environmental Standards; **Policy NHB 4**; and, **Objective NHB 3** Water Resources (Galway County Council, 2014a) **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.6.2** Open Spaces: Agricultural Lands; Environment and Infrastructure Strategy; **Policy 9.3** Flood Risk Assessment; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.8** Sustainable Urban Drainage Systems (SUDS); **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22 Water Quality** (Galway City Council, 2016)	
	Potential Impact Pathway –Habitat Degradation - Non-native Invasive Species	
	Policy NHB 7 Invasive Species (Galway County Council, 2014a) **Policy 4.2** Protected Spaces: Sites of European, National and Local Ecological Importance (Galway City Council, 2016)	
	Potential Impact Pathway – Disturbance/Displacement; and, Barrier Effect	
	Objective NHB 2 Biodiversity and Ecological Networks; and, **Objective NHB 6** Protection of Bats and Bats Habitat (Galway County Council, 2014a)	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance; and, **Policy 4.3** Blue Spaces: Coast, Canals and Waterways (Galway City Council, 2016)	
Local Plans		
Galway County Development Plan 2015-2021[3][4]	According to the conclusions of its Natura Impact Report (CAAS Ltd., 2015a), the **Galway County Development Plan 2015-2021 will not have any adverse effects on the SAC Qualifying Interest habitats or species, or SPA Special Conservation Interest bird species** via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the implementation of the following objectives and policies (as detailed in the plan): ***Potential Impact Pathways – Habitat Loss; Habitat Degradation – Hydrogeology; Habitat Degradation – Water Quality (Construction & Operation); Habitat Degradation – Air Quality; Habitat Degradation – Non-native Invasive Species; Disturbance/Displacement; and Barrier Effect*** **Development Strategy Objectives** • **Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment** – "*Protect European Sites that form part of the Natura 2000 network (Including Special Protection Areas and Special Areas of Conservation) in accordance with the requirements in the EU Habitats Directive (92/43/EEC), EU Birds Directive (2009/147/EC), the Planning and Development (Amendment) Act 2010, the European Communities (Birds and Natural Habitats) Regulations 2011(SI No.477 of 2011) (and any subsequent amendments or updated legislation) and having due regard to the guidance in the Appropriate Assessment Guidelines 2010 (and any updated or subsequent guidance). A plan or project (e.g. proposed development) within the Plan Area will only be authorised after the competent authority (Galway County Council) has ascertained, based on scientific evidence, Screening for Appropriate Assessment, and/or a Habitats Directive Assessment where necessary, that:* *(a) The Plan or project will not give rise to significant adverse direct, indirect or secondary effects on the integrity of any European Site (either individually or in combination with other plans or projects); or* *(b) The Plan or project will have significant adverse effects on the integrity of any European Site (that does not host a priority natural habitat type/and or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set*	There is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the Galway County Development Plan 2015-2021. This is due to the following reasons: • No adverse effects on European Site integrity will arise from the *Galway County Development Plan* alone, due to the policies and objectives listed in the NIR; and, • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Loss** (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) –

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[3] The *Galway County Development Plan 2015-2021* is the overarching plan for the Co. Galway and as such any other plans located within Co. Galway must comply with the policies and objectives outlined in the County Plan.

[4] Developments that may arise from the following expired Local Area Plans are covered by the *Galway County Development Plan 2015-2021*: *Claregalway Local Area Plan 2005-2011*, *Clarinbridge Local Area Plan 2007-2013*, *Kinvara Local Area Plan 2005-2011* and *Oughterard Local Area Plan 2006-2012*.

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or (c) *The Plan or project will have a significant adverse effect on the integrity of any European Site (that hosts a natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons for overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000.*" - **Objective DS 9 Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment** – "*Ensure that proposed projects and any associated improvement works or associated infrastructure relating to renewable energy projects; water supply and abstraction; wastewater and discharges; flood alleviation and prevention; roads, power lines and telecommunications; and amenity and recreation provision are subject to Appropriate Assessment where relevant.*" - **Objective DS 10 Impacts of Development on Protected Sites** – "*Have regard to any impacts of development on or near existing and proposed Natural Heritage Areas, Special Protection Areas and Special Areas of Conservation, Nature Reserves, Ramsar Sites, Wildfowl Sanctuaries, Salmonid Waters, Refuges for Flora and Fauna, Connemara National Park, shellfish waters, freshwater pearl mussel catchments and any other designated sites including future designations.*" **Roads and Transport Policy** - **Policy TI 1 Transportation Strategy and Compliance with Legislation** - "*It is the overarching policy of Galway County Council to comply with all relevant Irish and European planning and environmental legislation in implementing its Transportation Strategy.*" **Water & Wastewater Infrastructure &, Waste Management & Extractive Industry** - **Objective EQ 4 Compliance with Article 6(3) of the EU Habitats Directive** - "*Ensure that projects associated with the mineral extractive industry carry out screening for Appropriate Assessment in accordance with Article 6(3) of the Habitats Directive, where required.*" **Natural Heritage & Biodiversity Policies & Objectives** - **Policy NHB 1 Natural Heritage and Biodiversity** - "*It is the policy of Galway County Council to support the protection, conservation and enhancement of natural heritage and biodiversity, including the protection of the integrity of European Sites, that form part of the Natura 2000 network, the protection of Natural Heritage Areas and proposed Natural Heritage Areas and the promotion of the development of a green/ecological network within the Plan Area, in order to support ecological functioning and connectivity, create opportunities in suitable locations for active and passive recreation and to structure and provide visual relief from the built environment.*"	Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Air Quality** (i.e. Box 7 GTS – Habitat Degradation – Air Quality); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement); and, **Barrier Effect** (i.e. Box 10 GTS – Barrier Effect)

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	- **Objective NHB 1 Protected Habitats and Species** - "*Support the protection of habitats and species listed in the Annexes to and/or covered by the EU Habitats Directive (92/43/EEC) (as amended) and Birds Directive (2009/147/EC), and regularly occurring-migratory birds and their habitats, and species protected under the Wildlife Acts 1976-2000 and the Flora Protection Order.*" **Agriculture, Fishing, Marine Resources and Forestry Policies and Objectives** - **Objective AFF 5 Compliance with the EU Habitats Directive** - "*New agricultural projects that may potentially affect Natura 2000 Sites, individually or in combination with other plans and projects shall be subject to Appropriate Assessment to ensure that there are no likely significant effects on the integrity of any Natura 2000 Sites in the County.*"	
	Potential Impact Pathway - Habitat Degradation – Hydrogeology	
	Natural Heritage & Biodiversity Policies & Objectives - **Objective NHB12 Soil/Ground Water Protection** - "*Developments shall ensure that adequate soil protection measures are undertaken, where appropriate, including investigations into the nature and extent of any soil/groundwater contamination.*" **Water Policies and Objectives** - **Objective WS 1 Protection of Ground Waters** - "*Support the protection of groundwater resources and dependent wildlife/habitats in accordance with the Groundwater Directive 2006/118/EC, the European Communities Environmental Objectives (groundwater) Regulations, 2010 (S.I. No. 9 of 2010) or any updated legislation and the Groundwater Protection Scheme and source protection plans for water supplies.*" - **Objective WS 11 Regionally & Locally Important Aquifers** - "*Protect the regionally and locally important aquifers within the County from risk of pollution and ensure the satisfactory implementation of the groundwater protection schemes and groundwater source protection zones, where data has been made available by the Geological Survey of Ireland.*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathways – Habitat Degradation – Water Quality (Construction & Operation)	
	Water Policies and Objectives • **Policy WS 4 Water Quality** - "*Promote public awareness of water quality issues and the measures required to protect both surface water and groundwater bodies.*" • **Objective WS 2 EU Policies and Directives** - "*Protect, conserve and enhance existing and potential water resources of the County, in accordance with the EU Water Framework Directive, the River Basin Management Plans, the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI No. 272 of 2009), and implement the European Communities (Drinking Water) Regulations (No. 2) 2007 and ensure that water supplies comply with the parameters in these regulations.*" **Wastewater Policies and Objectives** • **Objective WW 1 EU Policies and Directives** - "*Ensure that all wastewater generated is collected, treated and discharged after treatment in a safe and sustainable manner, having regard to the standards and requirements set out in EU and national legislation and guidance and subject to compliance with the provisions and objectives of the EU Water Framework Directive, relevant River Basin Management Plans, Urban Waste Water Directive and the EU Habitats Directive.*" • **Objective WW 6 Adherence to Environmental Standards** - "*Promote the provision of safe and secure wastewater infrastructure to ensure that the public is protected and that permitted development, is within the environmental carrying capacity and does not negatively impact on habitat quality or species diversity.*" **Natural Heritage & Biodiversity Policies & Objectives** • **Policy NHB 4** – "*Water Resources Protect, conserve and enhance the water resources of the county, including, rivers, streams, lakes, wetlands, springs, turloughs, surface water and groundwater quality, as well as surface waters, aquatic and wetland habitats and freshwater and water dependant species and seek to protect and conserve the quality, character and features of inland waterways by controlling developments close to navigable and non-navigable waterways.*" • **Objective NHB 3 Water Resources** - "*Protect the water resources in the Plan Area, including rivers, streams, lakes, wetlands, springs, turloughs, surface water and groundwater quality, as well as surface waters, aquatic and wetland habitats and freshwater and water dependant species in accordance with the requirements and guidance in the EU Water Framework Directive 2000 (2000/60/EC), the European Union (Water Policy) Regulations 2003 (as amended), the Western River Basin District Management Plan 2009-2015, Shannon International River Basin Management Plan 2009-2015 and other relevant EU Directives, including associated national legislation and policy guidance (including any superseding versions of same).*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathways –Habitat Degradation – Non-native Invasive Species	
	Natural Heritage & Biodiversity Policies & Objectives - **Policy NHB 7 Invasive Species** - "*It is a policy of the Council to support measures for the prevention and eradication of invasive species. This will include the dissemination of information to raise public awareness, consultation with relevant stakeholders, the promotion of the use of native species in amenity planting and landscaping and the recording of invasive/native species as the need arises and resources permit.*"	
	Potential Impact Pathways – Disturbance/Displacement	
	Natural Heritage & Biodiversity Policies & Objectives - **Objective NHB 2 Biodiversity and Ecological Networks** - "*Support the protection and enhancement of biodiversity and ecological connectivity within the Plan Area, including woodlands, trees, hedgerows, semi-natural grasslands, rivers, streams, natural springs, wetlands, stonewalls, geological and geo-morphological systems, other landscape features and associated wildlife where these form part of the ecological network and/or may be considered as ecological corridors or stepping stones in the context of Article 10 of the Habitats Directive.*" - **Objective NHB 6 Protection of Bats and Bats Habitats** - "*Seek to protect bats and their roosts, their feeding areas, flight paths and commuting routes. Ensure that development proposals in areas which are potentially important for bats, including areas of woodland, linear features such as hedgerows, stone walls, watercourses and associated riparian vegetation which may provide migratory/foraging uses shall be subject to suitable assessment for potential impacts on bats. This will include an assessment of the cumulative loss of habitat or the impact on bat populations and activity in the area and may include a specific bat survey. Any assessment shall be carried out by a suitably qualified professional and where development is likely to result in significant adverse effects on bat populations or activity in the area, development will be prohibited or require mitigation and/or compensatory measures, as appropriate.*"	
Galway City Council Draft Development Plan 2017-2023	A Natura Impact Report has been prepared for the *Galway City Council Draft Development Plan 2017-2023*. Based on the in-combination effects assessment for the GTS, there will be **no adverse effects on SAC Qualifying Interest habitats or species, or SPA Special Conservation Interest bird species** via the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the implementation of the following policies, objectives and specific development standards (as detailed in the plan):	There is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the *Galway City Council Draft Development Plan 2017-2023*. This is due to the following reasons:

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	Potential Impact Pathways – Habitat Loss, Habitat Degradation – Hydrogeology, Habitat Degradation – Water Quality (Construction & Operation), Habitat Degradation – Air Quality, Habitat Degradation – Non-native Invasive Species, Disturbance/Displacement, Barrier Effect	• No adverse effects on European Site integrity will arise from the *Draft Galway City Development Plan 2017-2023* alone, due to the policies, objectives and specific development standards • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* will further more ensure no adverse effects will arise from the implementation of the *Draft Galway City Development Plan 2017-2023* • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Loss** (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Air Quality** (i.e. Box 7 GTS – Habitat Degradation – Air Quality); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species);
	<u>Natural Heritage, Recreation and Amenity Aim</u> • “*To provide for a green network in the city that allows for the sustainable use, management and protection of natural heritage, recreation amenity areas, parks and open spaces in an integrated manner. The green network will ensure the protection of nature and provide for the enhancement and expansion of passive and active recreational opportunities. It will be accessible to all and by sustainable modes of transport, where feasible. Ensure better integration of environmental and natural resource considerations in the Development Plan through the SEA process and provide the highest level of protection for European Sites, taking account of Article 6 of the Habitats Directive.*” **<u>Natural Heritage, Recreation and Amenity Strategy</u>** • “*Promote a green network for the city that allows for sustainable use, management and protection of natural heritage, protected ecological sites, flora and fauna, recreation and amenity areas and parks in an integrated manner where it can be demonstrated that there will be no adverse impacts on the integrity of European Sites and /or where the competent authority has ascertained that the use of the site is in accordance with Article 6 of the Habitat Directive.*” • “*Conserve, protect and enhance the designated and non-designated sites and natural habitats, while enabling the sustainable development of the city.*” **<u>Policy 4.1 Green Network</u>** • “*Support sustainable use and management of areas of ecological importance, parks and recreation amenity areas and facilities through an integrated green network policy approach in line with Galway City Recreation and Amenity Needs Study, where it can be demonstrated that there will be no adverse impacts on the integrity of European Sites.*” • “*Co-operate with the NPWS, landowners and stakeholders in the preparation and implementation of management plans for designated sites.*” • “*Ensure that all passive and active recreational proposals are considered in the context of potential impact on the environment, sites of ecological and biodiversity importance and general amenity.*” **<u>European Designated sites</u>** • “*Plan and projects should consider DEHLG Guidance for Planning Authorities on Appropriate Assessment of Plans and Projects in Ireland (2009) and potential impacts identified in the HDA of the City Development Plan relating to habitat loss and fragmentation, water quality, disturbance and in combination effects.*” • “*The policies and objectives of the City Development Plan have been drafted taking cognisance of Article 6 of the Habitats Directive. All plans including lower tier plans and projects identified as having potential to adversely*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	impact on European Sites are required to adhere to the requirements of the Habitats Directive, to ensure no adverse impact on the integrity of European Sites." **Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance** • "*Protect European Site that form part of the Natura 2000 network (including Special Protection Areas and Special Areas of Conservation) in accordance with the requirements in the EU Habitats Directive (92/43/EEC), EU Birds Directive (2009/147/EC) and associated national legislation. Ensure that plans or projects within the Plan area will only be authorised and /or supported after the competent authority has ascertained based on scientific evidence, screening for appropriate assessment and /or a Habitats Directive Assessment that:* *(a) The plan or project will not give rise to an adverse direct, indirect or secondary effect on the integrity of any European Site (either individually or in combination with other plans or projects); or* *(b) The plan or project will have an adverse effect on the integrity of any European Site (that does not host a priority natural habitat type/and or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or* (c) *3. The plan or project will have an adverse effect on the integrity of any European Site (that hosts a natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons for overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000.*" • "*Protect, conserve and support the development of an ecological network throughout the city which will improve the ecological coherence of the Natura 2000 network in accordance with Article 10 of the Habitats Directive.*" • "*Protect Local Biodiversity Areas, wildlife corridors and stepping stones identified in the Galway City Habitat Inventory 2005 and Galway Biodiversity Action Plan 2014-2024 in supporting the biodiversity of the city and in the Council's role/responsibilities, works and operations, where appropriate.*" • "*Encourage, in liaison with the NPWS, the sustainable management of features which are important for the ecological coherence of network of European Sites and essential, by their linear or continuous nature or as stepping stones for the migration, dispersal and genetic exchange of wild species.*" • "*Ensure that plans and projects with the potential to have a significant impact on European Sites (cSAC's or SPA) whether directly, indirectly or in combination with other plans or projects are subject to Appropriate Assessment under Article 6 of the Habitats Directive (92/43 EEC) and associated legislation and guidelines to inform decision making.*" • "*Protect the ecological integrity of Statutory Nature Reserves, refuges for fauna and Annex 1 Habitats.*"	**Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement); and, **Barrier Effect** (i.e. Box 10 GTS – Barrier Effect)

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Policy 4.3 Blue Spaces: Coast, Canals and Waterways • "*Protect and maintain the integrity of the coastal environment and waterways by avoiding significant impacts and meeting the requirements of statutory bodies, national and European legislation and standards.*" • "*Conserve and protect natural conservation areas within the coastal area and along waterways and ensure that the range and quality of associated habitats and the range and populations of species are maintained.*" • "*Have regard to European and national best practice guidance when assessing development in or near coastal areas which is likely to have significant effects on the integrity, defined by the structure and function, of any designated European Sites, protected coastal and marine fauna and flora.*" • "*Protect and maintain, where feasible, undeveloped riparian zones and natural floodplains along the River Corrib and its tributaries.*" **Policy 4.5.1 Community Spaces: Greenways and Public Rights of Way** • "*Provide controlled access and linkages into all parks/public open spaces, areas of natural heritage, including along waterways, where it can be demonstrated that there will be no adverse impacts on the integrity of European Sites. Ensure that paths and structures are constructed from suitable materials.*" **Environment and Infrastructure Aim** • "*To secure a high quality, clean and healthy environment, while facilitating the sustainable development of the city, through supporting the continued improvement and expansion of infrastructure services, including for water, drainage, communication, energy and waste management facilities. To ensure that environmental protection is an integral part of the development process within the city, by avoiding potential pollution at source and reducing environmental risks to the city and its community. Address climate change and reduce greenhouse gas emissions by facilitating and promoting energy efficiency, energy conservation and renewable energy sources.*" **Environment and Infrastructure Strategy** • "*Support the provision of efficient and sustainable water services, energy and telecommunication infrastructure in the city.*" **Policy 9.3 Flood Risk Assessment** • "*Ensure any proposal aimed at alleviating flooding will be subject to Appropriate Assessment in accordance with Article 6 of the EU Habitats Directive, where appropriate.*" • "*Continue to protect the coastal area and foreshore and avoid inappropriate development in areas at risk of coastal erosion and/or would cause and escalate coastal erosion in adjoining areas.*" • "*Protect and maintain, where feasible, undeveloped riparian zones and natural floodplains along the River Corrib and its tributaries.*"	

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	Policy 9.5 Sustainable Building Design and Construction • "*Ensure that the development of renewable energy and its associated infrastructure avoids negative impacts on European Sites and adhere to the requirements of Article 6 of the Habitats Directive (92/43EEC).*" **Policy 9.14 Energy and Associated Infrastructure** • "*Ensure that the infrastructural renewal and development of energy networks avoid negative impacts on European Sites and adhere to the requirements of Article 6 of the Habitats Directive (92/43 EEC). Support where appropriate the provision of energy networks, provided it can be demonstrated that:* *(a) The development is required in order to facilitate the provision or retention of significant economic or social infrastructure;* *(b) The route proposed has been identified with due consideration for social, economic, environmental and cultural impacts through relevant environmental assessment;* *(c) The design is such that will achieve least environmental impact consistent;* *(d) Where impacts are identified mitigation features have been included;* (e) *Where it can be shown the proposed development is consistent with international best practice with regard to materials and technologies that will ensure a safe, secure, reliable, economic and efficient high quality network.*" **Land Use Zoning Policies and Objectives** • **Zoning objective for RA** - "*To provide for and protect recreational uses, open space, amenity uses and natural heritage.* • **Specific Developments Objectives for RA Zones** – "*RA lands between the River Corrib and the Dyke Road and south of Quincentenary Bridge Road in Council ownership. The Council will consider the development of these lands to accommodate municipal and club water based facilities. Development of these lands shall include criteria for a high standard of design and shall not proceed if significant or indeterminate impact on the SAC were likely.*" **Specific Development Standards** • **11.28 Extract Industries/Quarries** – "*The operation of quarries can give rise to land use and environmental issues which require to be mitigated and controlled in the planning process. The protection of residential dwellings, residential amenities, natural amenities, the prevention of pollution, noise/vibration, traffic and the safeguarding of groundwater will be given serious consideration. The Council will have regard to the DEHLG's Quarries and Ancillary Activities, Guidelines for Planning Authorities, 2004 when assessing all quarry related proposals, in order to achieve more sustainable aggregates development and to avoid and minimise adverse impacts on the environment. Particular constraint will be exercised for sites in the vicinity of/in areas of residential settlements, areas of archaeological importance, recorded monuments, European areas of ecological importance and other environmentally sensitive (designated) areas, unless it can clearly be demonstrated that such quarries would not have significant adverse impacts on residential dwellings, amenities or the environment. All developments should*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	have regard to and comply with the Environmental Protection Agency's (EPA) publication Environmental Management in the Extractive Industry (non-scheduled minerals), 2006." • **11.31 Natura Impact Assessment** – "*Under Article 6 of the Habitats Directive there is a requirement to establish whether, in relation to plans and projects, appropriate assessment (AA) is required. If, following screening, it is considered that AA is required then the proponent of the plan or project must prepare a Natura Impact Statement/Natura Impact Report. A plan or project will only be authorised after the competent authority has ascertained, based on scientific evidence, Screening for Appropriate Assessment, and a Stage 2 Appropriate Assessment where necessary, that:* *(a) The plan or project will not give rise to significant adverse direct, indirect or secondary effects on the integrity of any Natura 2000 site (either individually or in combination with other plans or projects); or* *(b) The plan or project will have significant adverse effects on the integrity of any Natura 2000 (that does not host a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest – including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or* *(c) The plan or project will have a significant adverse effect on the integrity of any Natura 2000 site (that hosts a natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons for overriding public interest- restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000."*	
	Potential Impact Pathway – Habitat Degradation - Hydrogeology	
	Policy 4.3 Blue Spaces: Coast, Canals and Waterways • "*Support the implementation of the recommendations of the Western River Basin District – River Basin Management Plan Water Matters (2009) and future plan in relation to the protection of water quality of surface waters, groundwater and coastal waters.*" • "*Ensure development and uses adhere to the principles of sustainable development and restrict any development or use, which negatively impact on water quality.*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Policy 9.6 Water Quality • "*Support the actions of the Western River Basin District Management Plan 2009-2015 and future River Basin Management Plan in order to promote and achieve a restoration of good status, reduce chemical pollution and prevent deterioration of surface, coastal and groundwater quality, where appropriate.*" • "*Protect the city's groundwater resource in accordance with the Groundwater Directive 2006/118/EC and the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010) or any updated legislation and ensure that any development, which threatens the quality of the city's groundwater is restricted.*" • "*Minimise and control discharges to inland surface water bodies, groundwater and coastal waters to prevent water pollution.*" **Policy 9.7 Water Services** • "*Ensure that all new developments have and are provided with satisfactory drainage systems in the interests of public health and to avoid the pollution of the ground and surface waters.*" **Policy 9.12 Waste Management** • "*Ensure that development on contaminated lands include appropriate remediation measures.*" **Specific Development Standards** • **11.22 Water Quality** – "*Proposed developments, which include the storage and/or run-off of potential polluting substances, such as oil and chemicals shall be accompanied with details and specifications, which indicate how risk of pollution will be minimised by using best available practices. This shall also apply to the construction stage.*"	
	Potential Impact Pathway – Habitat Degradation – Water Quality (Construction/Operation)	
	Policy 4.3 Blue Spaces: Coast, Canals and Waterways • "*Support the implementation of the recommendations of the Western River Basin District – River Basin Management Plan Water Matters (2009) and future plan in relation to the protection of water quality of surface waters, groundwater and coastal waters.*" • "*Ensure development and uses adhere to the principles of sustainable development and restrict any development or use, which negatively impact on water quality.*" **Policy 4.6.2 Open Spaces: Agricultural Lands** • "*Ensure agricultural development complies with the measures set out in the Western River Basin Management Plan (2009) and future plan.*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Environment and Infrastructure Strategy • "*Protect and manage water resources effectively and improve coastal and fresh water quality.*" **Policy 9.3 Flood Risk Assessment** • "*Protect and promote sustainable management and uses of water bodies and watercourses from inappropriate development, including rivers, streams, associated undeveloped riparian strips, wetlands and natural floodplains.*" • "*Ensure the use of SUDS, sustainable urban drainage systems, wherever practical, in the design of development to reduce the rate and quantity of surface water run-off.*" **Policy 9.6 Water Quality** • "*Support the actions of the Western River Basin District Management Plan 2009-2015 and future River Basin Management Plan in order to promote and achieve a restoration of good status, reduce chemical pollution and prevent deterioration of surface, coastal and groundwater quality, where appropriate.*" • "*Minimise and control discharges to inland surface water bodies, groundwater and coastal waters to prevent water pollution.*" **Policy 9.7 Water Services** • "*Work in close liaison with Irish Water in the operation of water and waste water facilities in the city and the upgrade and expansion of the network.*" • "*Provide a sustainable and effective wastewater drainage collection and treatment system capable of meeting the needs of domestic, commercial, and industrial users in the city in partnership with Irish Water.*" • "*Ensure that all new developments have and are provided with satisfactory drainage systems in the interests of public health and to avoid the pollution of the ground and surface waters.*" **Policy 9.8 Sustainable Urban Drainage Systems (SUDS)** • "*Ensure the use of Sustainable Urban Drainage Systems (SUDS) and sustainable surface water drainage management, wherever practical in the design of development to enable surface water run-off to be managed as near to its source as possible and achieve wider benefits such as sustainable development, water quality, biodiversity and local amenity.*" • "*Proposals for Sustainable Urban Drainage Systems (SUDS) should include provisions for the long term management, operation and maintenance of these systems.*" **Policy 9.12 Waste Management** • "*Ensure that development on contaminated lands include appropriate remediation measures.*" **Specific Development Standards**	

Plan or Project	Potential for Adverse Effects on European Site Integrity Alone?	Potential for Adverse Effects on European Site Integrity In-combination?
	- **11.22 Water Quality** – "*Proposed developments, which include the storage and/or run-off of potential polluting substances, such as oil and chemicals shall be accompanied with details and specifications, which indicate how risk of pollution will be minimised by using best available practices. This shall also apply to the construction stage.*"	
	Potential Impact Pathway – Habitat Degradation – Air Quality	
	Policy 9.10 Air Quality and Noise - "*Maintain air quality to a satisfactory standard by regulating and monitoring atmospheric emissions in accordance with EU policy directives on air quality and Ambient Air Quality and Cleaner Air for Europe (CAFÉ) Directive (2008/50/EC), by promoting and supporting initiatives to reduce air pollution and by increasing the use of sustainable transport modes and developing urban woodland, encouraging tree planting, conserving and creating green open space.*"	
	Potential Impact Pathway – Non-native Invasive Species	
	Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance - "*Support and implement measures to control and manage alien/invasive species, where appropriate.*"	
	Potential Impact Pathway – Disturbance/Displacement, Barrier Effect	
	Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance - "*Protect and conserve rare and threatened flora and fauna and their key habitats, (wherever they occur) listed on Annex I and Annex IV of the EU Habitats Directive (92/43EEC) and listed for protection under the Wildlife Acts 1976-2000.*" **Policy 4.3 Blue Spaces: Coast, Canals and Waterways** - "*Ensure that development does not have a significant adverse impact, incapable of satisfactory mitigation, on protected species.*" - "*Ensure the protection of the River Corrib as a Salmonid River, where appropriate.*" - "*Ensure that development does not have a significant adverse impact, incapable of satisfactory mitigation, on protected species.*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
Draft Clare County Development Plan 2017-2023	According to the conclusions of its Natura Impact Report (Scott Cawley Ltd., 2015), *the* ***Draft Clare County Development Plan 2017-2023*** **will not have any adverse effects on the SAC Qualifying Interest habitats or species, or SPA Special Conservation Interest bird species** via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the implementation of the following objectives and mitigation measures: ***Potential Impact Pathways – Habitat Degradation – Hydrogeology, Habitat Degradation – Water Quality (Construction/Operation), Habitat Degradation – Non-native Invasive Species, Disturbance/Displacement*** • The implementation of specific objectives (outlined in the plan) which reinforce statutory requirements, such as: **Objective CD 12.1** – "*It is an objective of the development plan: To require proposals for development which may impact on a European Site to undertake and submit a Natura Impact Statement in accordance with the requirements of the Habitats Directive as part of any planning application.*" **Objective CD 14.9** – "*It is an objective of Clare County Council:* *(a) To implement the EIA Directive, ensuring that all elements/stages or components of the project are included in one overall assessment and all reasonable alternatives are taken into consideration in choosing the option with the least environmental impact.* *(b) To have regard to "Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessments (2013) when considering proposals for which an EIA is required.* *(c) To ensure full compliance with the requirements of the EU Habitats Directive, SEA Directive and associated legislation/regulations, including the associated European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011), European Communities (Environmental Assessment of Certain Plans and Programmes) Regulations 2004-2011, and the European Communities (Environmental Impact Assessment) Regulations 1989 – 2011 (or any updated/superseding legislation).*" • Implementation of objectives that place conditions and caveats, such as: **Objective CDP 9.7** - "*It is an objective of Clare County Council:* *(a) To work with local communities and relevant agencies to achieve the sustainable development of County Clare as a world-class destination for sports and recreation-related tourism development at appropriate locations and in full compliance with all relevant environmental legislation in particular the requirements of the Habitats Directive.* *(b) To support the appropriate development of low-impact experiential tourism in order to diversify the range of tourist activities available in the County and expand the tourist season;* *(c) To support the sustainable development of watersports, surfing, sailing and water-related events at appropriate locations in the County, subject to an analysis of their potential environmental impact.*" **Objective CDP 9.12** – "*It is an objective of the development plan: To support the development of tourism activities in lakeland areas and waterways subject to normal planning and environmental criteria. All proposed*	There is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the *Draft Clare County Development Plan 2017-2023*. This is due to the following reasons: • No adverse effects on European Site integrity will arise from the *Draft Clare County Development Plan 2017-2023* alone, due to the objectives and mitigation measures • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of the NIS report for: **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR), **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); and, **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement)

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	developments shall be in accordance with the Birds and Habitats Directive, Water Framework Directive and all other relevant EC Directives.” **Objective CDP 12.11** – *“It is an objective of the development plan: To facilitate the sustainable development of marinas and associated amenities at appropriate locations along the Atlantic coastlines, ensuring that such developments shall not adversely affect species and habitats designated by the Birds and Habitats Directives and is in compliance with all relevant environmental designations.*” **Objective CDP 12.12** – “*It is an objective of Clare County Council:* *(a) To engage with the OPW to develop appropriate strategies for the management of identified coastal flood and erosion hazards and associated risks;* *(b) To have regard to the Clare County Strategic Flood Risk Assessment, CFRAM Flood Risk Management Plans (when finalised), the OPW Coast Protection Strategy Study, and any updated version/more detailed local studies, in the assessment of development applications in coastal areas;* *(c) To permit developments only where the Council is satisfied that they will not be at risk from coastal erosion or inundation in the future;* *(d) To permit developments only where the Council is satisfied that it will not result in an increase in coastal erosion or increase the risk of inundation, either at the subject site or at another location in the vicinity;* *(e) To prohibit developments outside the boundaries of existing settlements where such development could not be adequately defended over the lifetime of the development without the need to construct additional or new coastal defences;* *(f) To seek funding for coastal defence works based on the outcome of detailed Coastal Erosion and Flood Risk Management Studies undertaken in areas identified as being at risk from coastal flooding;* *(g) To ensure full compliance with the requirements of the Habitats Directive with regard to developments in the coastal area;* (h) *To have regard to any future adopted Integrated Coastal Zone Management Plan for the coastal and estuarine areas of the county, undertaken in accordance with the Habitats and SEA Directive.*”	
	Potential Impact Pathway – Habitat Degradation - Hydrogeology	
	• **Mitigation measure** to ensure no potential impacts on the hydrology of groundwater-dependent Qualifying interests: “*Ensure any development application is accompanied by a hydrogeological assessment and concludes that the development will not interfere with groundwater movement to the groundwater dependent Qualifying Interest of the European Site.*”	

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	Potential Impact Pathway – Water Quality (Construction/Operation)	
	• **Mitigation measures** to ensure no potential impacts on water quality: "*Ensure any further development application is connected to a WWTP with adequate capacity for foul water during operation, or that it is serviced by an on-site treatment system that will ensure no impact to water quality in the area.*" "*Ensure a Construction Environmental Management Plan (CEMP) is produced as part of any planning application for development detailing how surface water run-off, especially in relation to release of silt and other pollutants, will be controlled during construction.*" "*Ensure that surface water run-off during operation is treated via a combination of appropriate SUDS (i.e. green roofs, permeable paving, petrol interceptor, silt trap) prior to discharge to any surface water features.*"	
	Potential Impact Pathway – Non-native Invasive Species	
	• **Mitigation measure** to ensure no potential impacts caused by invasive species: "*Any development application should address the potential for introduction and spread of invasive species via water craft/equipment movement into the area and/or out of the area to other European Sites.*"	
	Potential Impact Pathway – Disturbance/Displacement	
	• **Mitigation measure** to ensure no potential impacts on nesting Special Conservation interest bird species: "*Any development applications should include an assessment by a suitably- qualified Ecologist as to the potential for the site to support SPA SCI bird species. If the site is deemed suitable, detailed bird surveys should be undertaken on the site to accompany the development application. These assessments and/or surveys should inform an Appropriate Assessment Screening Report and/or Natura Impact Statement, dependent on the outcome of the site survey. If the site is deemed suitable, a full light- spill modelling study should accompany all development applications and demonstrate that the chosen lighting design would not create any increase in ambient light levels beyond the perimeter of the development applications and demonstrate that the chosen lighting design would not create any increase in ambient light levels beyond the perimeter of the development footprint in relation to SCI birds.*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
Mayo County Development Plan 2014-2020[5]	According to the conclusions of its Natura Impact Report (Mayo County Council, 2013), *the* ***Mayo County Development Plan 2017-2023*** **will not have any adverse effects on the SAC Qualifying Interest habitats or species, or SPA Special Conservation Interest bird species** via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the implementation of the following objectives and policies:	There is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the *Mayo County Development Plan 2014-2020*. This is due to the following reasons: • No adverse effects on European Site integrity will arise from the *Mayo County Development Plan 2014-2020* alone, due to the policies and objectives • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); and, **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments)
	Potential Impact Pathways – Habitat Degradation – Hydrogeology, Habitat Degradation – Water Quality (Construction & Operation)	
	Economic Development Strategy Objectives (Mayo County Council, 2014) • **E-05 General** – "*It is the objective of the Council to encourage and facilitate home-based employment of appropriate type, size and scale, where it can be demonstrated that the development will not have significant adverse effects on the environment, including the integrity of the Natura 2000 network, residential amenity or visual amenity.*" • **AG-01 Agriculture** – "*It is an objective of the Council to support the sustainable development of agriculture, with emphasis on local food supply and agriculture diversification (e.g. agri-business and tourism enterprises) where it can be demonstrated that the development will not have significant adverse effects on the environment, including the integrity of the Natura 2000 network, residential amenity or visual amenity.*" • **FY-01 Forestry** – "*It is an objective of the Council to promote sustainable forestry development of appropriate scale in accordance with the Indicative Forest Strategy for Mayo or any amendment to it where it can be demonstrated that the development will not have significant adverse effects on the environment, including the integrity of the Natura 2000 network, residential amenity or visual amenity.*" • **MF-02 Marine Resources, Aquaculture & Fishing** – "*It is an objective of the Council to support the sustainable development of marine aquaculture and fishing industries having regard to best environmental practices so as to maximize their contribution to jobs and growth in coastal communities where it can be demonstrated that the development will not have significant adverse effects on the environment, including the integrity of the Natura 2000 network, residential amenity or visual amenity.*" • **TM-01 Tourism** – "*It is an objective of the Council to support and promote sustainable tourism development, accessible to all throughout the County and to work in partnership with tourism organisations, and adjoining Local Authorities where necessary, in securing the development of tourism enterprises and infrastructure in suitable locations where it can be demonstrated that the development will not have significant adverse effects on the environment, including the integrity of the Natura 2000 network, residential amenity or visual amenity.*" • **EI-01 Extractive Industries** – "*It is an objective of the Council to ensure that the development of aggregate resources (stone and sand/gravel deposits) is carried out in a manner which minimises effects on the environment,*	

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[5] The Local Area Plans for the towns of Ballinrobe, Ballyhaunis and Claremorris have been integrated into the *Mayo County Development Plan 2014-2020*. As these towns are located within the River Corrib catchment, their associated plans have the potential to act in-combination with the GTS.

Plan or Project	Potential for Adverse Effects on European Site Integrity Alone?	Potential for Adverse Effects on European Site Integrity In-combination?
	including the Natura 2000 network, amenities, infrastructure and the community, and has full regard to the principles of sustainability." • **RE-02 Renewable Energy** – "*It is an objective of the Council to identify at least one renewable energy hub in the County which will allow for the development of renewable energy devices and associated infrastructure/vessels/equipment and deployment of the same having regard to the needs of the industry while ensuring no adverse impact on the environment including Natura 2000 sites.*" **Infrastructure Strategy Objectives (Mayo County Council, 2014)** • **I-01 General** – "*It is an objective of the Council to provide, or facilitate the provision of, all infrastructure projects set out in Table 3, with priority given to infrastructure serving the Linked-Hub and Key Towns or areas where significant environmental or safety issues are evident and require the particular infrastructure to solve the issues and where it can be demonstrated that the development will not have significant adverse effects on the environment, the integrity of the Natura 2000 network or visual amenity.*" • **RD-02 Roads** – "*It is an objective of the Council to support improvements to the existing National Road and Regional Road network including road schemes and by-passes where it can be demonstrated that the development will not have significant adverse effects on the environment, the integrity of the Natura 2000 network or visual amenity.*" • **RD-03 Roads** – "*It is an objective of the Council, in co-operation with the Department of Environment, Community and Local Government, to continue with the strengthening and improvement of the local road network including links, by-passes and relief roads, with priority given to those serving the Linked-Hub and Key Towns and interconnection between such settlements, where it can be demonstrated that the development will not have significant adverse effects on the environment or Natura 2000 network.*" • **PP-01 Parking Provision** – "*It is an objective of the Council to support and facilitate the provision of public parking facilities at appropriate locations, including the provision of bus parking facilities within and on the edge of towns and villages, and at appropriate scenic viewing points and scenic routes where it can be demonstrated that the development will not have significant adverse effects on the environment, including the integrity of the Natura 2000 network, residential or visual amenity.*" • **PC-01 Pedestrians & Cyclists** – "*It is an objective of the Council to encourage and facilitate the maintenance and further development of the public footpath network, public rights of way, walking and cycling routes and associated infrastructure, including the provision of bicycle racks in all towns and villages, in the County, including where possible the retrofitting of cycle and pedestrian routes into the existing urban road network, by carrying out works in accordance with the National Transport Authority's National Cycle Manual and to support the establishment of a network of interlinked cycle ways and walk ways in the County and the adjoining Counties, having regard to best practice standards and where it can be demonstrated that the development will not have significant adverse effects on the environment or the integrity of the Natura 2000 network.*" • **RL-01 Rail** – "*It is an objective of the Council to support and encourage the provision of a high-quality rail network and service (including commuter services) and ancillary works for passenger and freight carriage to, from and*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	within the County, including the re-opening of the Western Rail Corridor where it can be demonstrated that the development will not have significant adverse effects on the environment including the integrity of the Natura 2000 network." • **BS-01 Bus** – "*It is an objective of the Council to support the provision of public and private bus services, including the Rural Transport Programme, in the County by:* *(a) Encouraging appropriate and sustainable development patterns that will support the provision of services; and* (b) *Supporting the provision of bus shelters and park & ride facilities at appropriate locations in the County where it can be demonstrated that the development will not have significant adverse effects on the environment including the integrity of the Natura 2000 network.*" • **AT-04 Air Transport** – "*It is an objective of the Council to ensure any development associated with light aircraft/helicopter activity is located in areas that avoid significant adverse effects on the environment, the integrity of the Natura 2000 network and residential amenity.*" • **PH-01 Ports, Harbours and Piers** – "*It is an objective of the Council to develop and improve ports, harbours, piers, slipways and associated shore facilities and access, including those that can be shared by leisure, tourism, fishing, renewable energy and aquaculture, where it can be demonstrated that the development will not have significant adverse effects on the environment including the integrity of the Natura 2000 network.*" • **WS-01 Water Services** – "*It is an objective of the Council to ensure the provision of an adequate level of water services infrastructure throughout the County to meet domestic, commercial, industrial and other needs, having regard to the Core Strategy and Settlement Strategy of this Plan, the Water Services Investment Programme, the Rural Water Programme… and where it can be demonstrated that the development will not have significant adverse effects on the environment including the integrity of the Natura 2000 network.*" • **WL-01 Waste** – "*It is an objective of the Council to implement the Regional Waste Management Plan for the Connaught Region (as amended) or replacement plan with particular emphasis on reuse, recycling and disposal of residual waste in the most appropriate manner where it can be demonstrated that the development will not will not have significant adverse effects on the environment, the integrity of the Natura 2000 network, residential or visual amenity.*" • **TC-01 Information and Communication Technology** – "*It is an objective of the Council to support and facilitate the delivery of high capacity ICT infrastructure, broadband networks and digital broadcasting in the County having regard to the Government Guidelines Telecommunications Antennae and Support Structures-Guidelines for Planning Authorities 1996 (DoEHLG) and Circular Letter PL 07/12 and where it can be demonstrated that the development will not have significant adverse effects on the environment including the integrity of the Natura 2000 network.*" **<u>Environment, Heritage & Amenity Strategy Objectives (Mayo County Council, 2014)</u>** • **CC-01 Climate Change** – "*It is an objective of the Council to support the National Climate Change Strategy and methods of reducing anthropogenic greenhouse gases on an ongoing basis through implementation of supporting*	

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	objectives in this Plan, particularly those supporting use of alternative and renewable energy sources, sustainable transport, air quality, coastal zone management, flooding and soil erosion and promotion of the retention of, and planting of trees, hedgerows and afforestation subject to no significant adverse effects on the environment including the integrity of the Natura 2000 network." • **WQ-01 Water Quality** – "*It is an objective of the Council to implement the Western River Basin District Management Plan "Water Matters" 2009-2015 to ensure the protection, restoration and sustainable use of all waters in the County, including rivers, lakes, ground water, coastal and transitional waters, and to restrict development likely to lead to deterioration in water quality or quantity.*" • **NH-01 Natural Heritage** – "*It is an objective of the Council to protect, enhance, conserve and, where appropriate restore:* *(a) Candidate Special Areas of Conservation, Special Areas of Conservation, Special Protection Areas, Natural Heritage Areas and proposed National Heritage Areas, Statutory Nature Reserves, Ramsar Sites and Biogenetic Reserves, including those listed in the Environmental Report documenting the Strategic Environmental Assessment of this plan and any modifications or additional areas that may be so designated during the lifetime of the plan.* *(b) Natural habitats and plant and animal species identified under the Habitats Directive, Birds Directive, Wildlife Act and the Flora Protection Order, or any other relevant legislation that may be implemented during the lifetime of the plan.* *(c) Bogs, fens and turloughs listed in the Environmental Report documenting the Strategic Environmental Assessment of this plan.* *(d) The conservation value of disused railway lines, waterways, walkways etc. notwithstanding that some of these items (e.g. disused rail lines) may be developed at some future date as part of the County's infrastructure where it can be demonstrated that the development will not have significant adverse effects on the environment including the integrity of the Natura 2000 network.* *(e) Surface waters, aquatic and wetland habitats and freshwater and water-dependent species through the implementation of all appropriate and relevant Directives and transposed legislation."* • **NH-03 Natural Heritage** – "*It is an objective of the Council to implement Article 6(3) and 6(4) of the EU Habitats Directive, by screening all plans and projects for appropriate assessment and to ensure those with potential to have significant effects on the integrity of Natura 2000 or European Sites (cSACs, SPAs), whether directly (in situ), indirectly (ex-situ) or in combination with other plans or projects, are subject to an appropriate assessment and the preparation of an NIR or NIS in order to inform decision making.*" • **AoH-01 Archaeological Heritage** – "*It is an objective of the Council to: Facilitate public access to National Monuments in State care or in the ownership of the State where it can be demonstrated that the development will not have significant adverse effects on the environment, the integrity of the Natura 2000 network, residential amenity or visual amenity.*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
Galway City Local Economic and Community Plan 2015-2021	According to the conclusions of the Appropriate Assessment Screening Statement (McCarthy Keville O'Sullivan Ltd., 2015) no likely significant effects will arise from the *Galway City Local Economic and Community Plan*. Based on the in-combination effects assessment for the GTS, it is considered that the ***Galway City Local Economic and Community Plan 2015-2021*** **will not have any adverse effects on SAC Qualifying Interest habitats or species, or SPA Special Conservation Interest bird species** via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the fact that any development that may arise in relation to the *Galway City Local Economic and Community Plan 2015-2021* which has the potential to affect the same European Sites as GTS will have to adhere to the following policies and objectives of the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023*.	Following on from this strategic level assessment, it is determined that there is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the *Galway City Local Economic and Community Plan 2015-2021*. This is due to the following reasons: • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* will ensure no adverse effects will occur from any development alone that may arise in relation to the *Galway City Local Economic and Community Plan 2015-2021*. This will include the requirement for any development taking place within the county to undergo Screening for Appropriate Assessment and/or Appropriate Assessment where necessary and in doing so to demonstrate that the project will not give rise to any adverse direct, indirect or secondary effects on the integrity of any European Site • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Loss** (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality**
	Potential Impact Pathways – Habitat Loss; Habitat Degradation – Hydrogeology; Habitat Degradation – Water Quality (Construction/Operation); Habitat Degradation – Air Quality; Habitat Degradation – Non-native Invasive Species; Disturbance/Displacement; and, Barrier Effect	
	Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment; **Objective DS 9** Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment; **Objective DS** 10 Impacts of Development on Protected Sites; **Objective EQ 4** Compliance with Article 6(3) of the EU Habitats Directive; **Policy NHB 1** Natural Heritage and Biodiversity; **Objective NHB 1** Protected Habitats and Species**;** and, **Objective AFF 5** Compliance with the EU Habitats Directive (Galway County Council, 2014a) **Natural Heritage, Recreation and Amenity Aim**; **Natural Heritage, Recreation and Amenity Strategy**; **Policy 4.1** Green Network; **European Designated sites**; **Policy 4.2** Protected Spaces: Sites of European, **National and Local Ecological Importance**; **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.5.1** Community Spaces: Greenways and Public Rights of Way; **Environment and Infrastructure Aim**; **Environment and Infrastructure Strategy**; **Policy 9.3** Flood Risk Assessment; **Policy 9.5** Sustainable Building Design and Construction; **Policy 9.14** Energy and Associated Infrastructure; **Zoning objective for RA**; **Specific Developments Objectives for RA Zones**; **Specific Development Standard 11.28** Extract Industries/Quarries; **Specific Development Standard 11.31** Natura Impact Assessment (Galway City Council, 2016)	
	Potential Impact Pathway –Habitat Degradation – Hydrogeology	
	Objective NHB12 Soil/Ground Water Protection; **Objective WS 1** Protection of Ground Waters; **Objective WS 11** Regionally & Locally Important Aquifers; and, **Policy WS 4** Water Quality (Galway County Council, 2014a)	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Policy 4.3 Blue Spaces: Coast, Canals and Waterways; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22** Water Quality (Galway City Council, 2016)	**(Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Air Quality** (i.e. Box 7 GTS – Habitat Degradation – Air Quality); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement); and, **Barrier Effect** (i.e. Box 10 GTS – Barrier Effect)
	Potential Impact Pathway –Habitat Degradation – Water Quality (Construction/Operation)	
	Policy WS 4 Water Quality; **Objective WS 2** EU Policies and Directives; **Objective WW 1** EU Policies and Directives; **Objective WW 6** Adherence to Environmental Standards; **Policy NHB 4**; and, **Objective NHB 3** Water Resources (Galway County Council, 2014a) **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.6.2** Open Spaces: Agricultural Lands; Environment and Infrastructure Strategy; **Policy 9.3** Flood Risk Assessment; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.8** Sustainable Urban Drainage Systems (SUDS); **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22 Water Quality** (Galway City Council, 2016)	
	Potential Impact Pathway –Habitat Degradation – Non-native Invasive Species	
	Policy NHB 7 Invasive Species (Galway County Council, 2014a) **Policy 4.2** Protected Spaces: Sites of European, National and Local Ecological Importance (Galway City Council, 2016)	
	Potential Impact Pathway – Disturbance/Displacement	
	Objective NHB 2 Biodiversity and Ecological Networks; and, **Objective NHB 6** Protection of Bats and Bats Habitats (Galway County Council, 2014a) **Policy 4.2** Protected Spaces: Sites of European, National and Local Ecological Importance; and, **Policy 4.3** Blue Spaces: Coast, Canals and Waterways (Galway City Council, 2016)	
Gaeltacht Local Area Plan 2008-2018	According to the conclusions of its Natura Impact Report (CAAS Ltd., 2012b), the ***Gaeltacht Local Area Plan 2008-2018*** **will not have any adverse effects on the SAC Qualifying Interest habitats or species or SPA Special Conservation Interest bird species** via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the implementation of the following objectives and policies (as detailed in the plan):	There is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the *Gaeltacht*

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathways – Habitat Loss, Habitat Degradation – Hydrogeology, Habitat Degradation – Water Quality (Construction & Operation), Habitat Degradation – Air Quality, Habitat Degradation – Non-native Invasive Species, Disturbance/Displacement, Barrier Effect	*Local Area Plan 2008-2018*. This is due to the following reasons: • No adverse effects on European Site integrity will arise from the *Gaeltacht Local Area Plan 2008-2018* alone, due to the policies and objectives • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* will further more ensure no adverse effects will arise from the implementation of the *Gaeltacht Local Area Plan 2008-2018* • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Loss** (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Air Quality** (i.e. Box 7 GTS – Habitat Degradation – Air Quality); **Habitat Degradation – Non-native Invasive Species**
	<u>**Strategic Development Objective**</u> • **Objective O.S.D. 3 Natura 2000 Network and Habitats Directive Assessment** – "*Protect European Sites that form part of the Natura 2000 network (including Special Protection Areas and Special Areas of Conservation) in accordance with the requirements in the EU Habitats Directive (92/43/EEC), EU Birds Directive (2009/147/EC), the Planning and Development (Amendment) Act 2010, the European Communities (Birds and Natural Habitats) Regulations 2011 (SI No. 477 of 2011) (and any subsequent amendments or updated legislation) and having due regard to the guidance in the Appropriate Assessment Guidelines 2010 (and any subsequent or updated guidance). A plan or project (e.g. proposed development) within the Plan Area will only be authorised after the competent authority (Galway County Council) has ascertained, based on scientific evidence, screening for appropriate assessment, and a Habitats Directive Assessment where necessary, that:* *(a) The plan or project will not give rise to significant adverse direct, indirect or secondary effects on the integrity of any European Site (either individually or in combination with other plans or projects); or* *(b) The plan or project will have significant adverse effects on the integrity of any European Site (that does not host a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or* (c) *The plan or project will have significant adverse effects on the integrity of any European Site (that hosts a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000.*" <u>**Environmental Policies – Biodiversity/Flora and Fauna**</u> • **Policy P.B. 5** – "*Conserve and protect any new areas or sites that are designated in the lifetime of this plan and to take cognisance of any revisions and adjustments to designated sites as furnished by the Department of Environment, Heritage and Local Government.*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	• **Policy P.B. 11** – "*Implement Article 6(3) of the EU Habitats Directive and to subject any plan or development proposal likely to directly or indirectly (or in combination with other plans or projects) impact Natura 2000 or European Sites (SACs or SPAs), to an appropriate assessment in order to inform decision making.*"	(i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement); and, **Barrier Effect** (i.e. Box 10 GTS – Barrier Effect)
	Potential Impact Pathways –Habitat Degradation – Water Quality (Construction & Operation)	
	<u>Environmental Policies – Biodiversity/Flora and Fauna</u> • **Policy P.B. 8** – "*To protect rivers, streams, lakes, coastal waters and their associated wetlands both as functioning ecosystems and as ecological corridors and networks.*" **<u>Policies and Objectives included in Plan and Designed to protect Water Quality and Quantity</u>** • **Objective O.S.D. 5 Service Led Development** – "*Ensure that urban developments are preceded by sufficient capacity in the public waste water and potable water infrastructure and that developments in rural areas are accompanied by adequate infrastructure and services in accordance with applicable standards and requirements.*" • **Policy P.S. 3 Environmental Policies** – "*Protect fen and other wetland areas from the direct impact of development and infilling, or from indirect effects such as a change in water regime.*"	
Athenry Local Area Plan 2012-2018	The ***<u>Athenry Local Area Plan 2012-2018</u>*** **<u>will not have any adverse effects on the SAC Qualifying Interest habitats or species or SPA Special Conservation Interest bird species</u>** via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the implementation of the following objectives and policies (as detailed in the plan):	There is **<u>no potential for adverse in-combination effects</u>** on European Site integrity to occur as a result of the implementation of the GTS and the *Athenry Local Area Plan 2012-2018*. This is due to the following reasons: • No adverse effects on European Site integrity will arise from the *Athenry Local Area Plan 2012-2018* alone, due to the policies and objectives • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* will further more ensure no adverse effects will arise from the implementation of the *Athenry Local Area Plan 2012-2018* • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of
	Potential Impact Pathways – Habitat Degradation – Hydrogeology, Habitat Degradation – Water Quality (Construction/Operation)	
	• **Objective DS3 Natura 2000 Network and Habitats Directive Assessment** – "*Protect Natura 2000 sites, that form part of the Natura 2000 network (including Special Protection Areas and Special Areas of Conservation) in accordance with the requirements in the EU Habitats Directive (92/43/EEC), EU Birds Directive (2009/147/EC), the Planning and Development (Amendment) Act 2010, the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No 477 of 2011) (and any subsequent amendments or updated legislation) and having due regard to the guidance in the Appropriate Assessment Guidelines 2010 (and any subsequent or updated guidance). A plan or project (e.g. proposed development) within the Plan Area will only be authorised after the competent authority (Galway County Council) has ascertained, based on scientific knowledge and a Habitats Directive Assessment where necessary, that:*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	(a) The plan or project will not give rise to significant adverse direct, indirect or secondary impacts on the integrity of any Natura 2000 site (either individually or in combination with other plans or projects); or *(b) The plan or project will adversely affect the integrity of any Natura 2000 site (that does not host a priority habitat and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or* (c) *The plan or project will adversely affect the integrity of any Natura 2000 site (that hosts a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000.*" • **Objective DS5 Service Led Development** - "*Development under the Plan shall be preceded by sufficient capacity in the public waste water treatment plant and appropriate extensions in the existing public wastewater infrastructure.*" • **Policy UI 2 Water Quality** – "*It is the policy of Galway County Council to protect and improve water quality, in conjunction with other agencies and stakeholders in accordance with the EU Water Framework Directive (2006/60/EC) and to support the implementation of the Western River Basin District Management Plan and consider both when considering new development proposals.*" • **Objective UI 2 Wastewater Disposal** – "*New developments shall only be permitted where it can be clearly demonstrated that they can be serviced and that there is adequate capacity in the wastewater disposal infrastructure in accordance with applicable requirements and standards, including urban wastewater treatment disposal standards, in order to protect the River Clarin, the Galway Bay Complex and its qualifying interests. Any developments for single dwellings will be required to adhere to the EPA Code of Practice and will be subject to monitoring in order to assess impacts on water. Continue to support the delivery of the Galway Main Drainage scheme in relation to the Athenry Local Area Plan Area.*" • **Objective UI 6 Western River Basin District Management Plan and Protection of Waters** – "*Support the implementation of the relevant recommendations and measures as outlined in the Western River Basin Management Plan 2009-2015 or any other plan that may supersede same during the lifetime of this Local Area Plan. Development shall only be permitted where it can be clearly demonstrated that the proposal would not have an unacceptable impact on the water environment, including surface water, groundwater quality and quantity, river corridors and associated wetlands. Galway County Council is statutorily obliged to prevent any further deterioration in the quality status of the waters in Athenry (Clarin River and the Clare River Drainage Area) and to ensure good quality status by 2021.*"	this report for: **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); and, **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments)

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	- **Objective UI 13 Waterbodies and Watercourses** – "*Protect waterbodies and watercourses within the Plan Area from inappropriate development, including rivers, streams, associated undeveloped riparian strips and natural floodplains. This will include a 10m environmental management buffer on either side of the River Clarin and its tributary, measured from the near river bank. Promote the sustainable management and use of watercourses and avoid the culverting or realignment of these features.*" - **Objective NH1 Natura 2000 Network and Habitats Directive Assessment** – "*Protect Natura 2000 sites, that form part of the Natura 2000 network (including Special Protection Areas and Special Areas of Conservation) in accordance with the requirements in the EU Habitats Directive (92/43/EEC), EU Birds Directive (2009/147/EC), the Planning and Development (Amendment) Act 2010, the Natura 2000 Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No 477 of 2011) (and any subsequent amendments or updated legislation) and having due regard to the guidance in the Appropriate Assessment Guidelines 2010 (and any subsequent or updated guidance). A plan or project (e.g. proposed development) within the Plan Area will only be authorised after the competent authority (Galway County Council) has ascertained, based on scientific knowledge and a Habitats Directive Assessment where necessary, that:* *(a) The plan or project will not give rise to significant adverse direct, indirect or secondary impacts on the integrity of any Natura 2000 site (either individually or in combination with other plans or projects); or* *(b) The plan or project will adversely affect the integrity of any Natura 2000 site (that does not host a priority habitat and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or* (c) *The plan or project will adversely affect the integrity of any Natura 2000 site (that hosts a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000.*" - **Objective NH4 Impact Assessment** – "*Ensure full compliance with the requirements of the EU Habitats Directive (92/43/EEC), SEA Directive (2001/42/EC) and EIA Directive 2011/92/EU), and associated legislation/regulations, including the associated European Communities (Birds and Natural Habitats) Regulations 2011 (SI No. 477 of 2011), European Communities (Environmental Assessment of Certain Plans and Programmes) Regulations 2004-2011, Planning and Development (Strategic Environmental Assessment) Regulations 2004-2011 and the European Communities (Environmental Impact Assessment) Regulations 1989-2011 (or any updated/superseding legislation). Planning applications for proposed developments within the Plan Area that may give rise to likely significant effects on the environment may need to be accompanied by one or more of the following: an Environmental Impact*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Statement, an Ecological Impact Assessment Report, a Habitats Directive Assessment Screening Report or a Natura Impact Statement, as appropriate. Ensure that Natura Impact Statements and any other environmental or ecological impact assessments submitted in support of proposals for development are carried out according to best practice methodologies and contain all necessary baseline assessment." - **Objective NH6 Water Resources** – "*Protect all water resources in the Plan Area, including the River Clarin, its tributaries, other streams, springs, surface waters, and groundwater quality, in accordance with the requirements and guidance in the EU Water Framework Directive 2000 (2000/60/EC), the European Union (Water Policy) Regulations 2003 (as amended) and the Western River Basin Management Plan 2009-2015 (including any superseding versions of same). Support the application and implementation of a catchment planning and management approach to development and conservation, including the implementation of Sustainable Drainage System techniques for new development in the Plan Area.*" - **Objective NH7 Environmental Management Buffer** – "*Protect and seek to improve the water quality in the River Clarin. Limit development within the environmental management buffer so as to protect the qualifying interests of the Galway Bay SAC andInner Galway Bay SPA which are linked directly to the Athenry Local Area Plan area via the River Clarin. Seek to ensure that a minimum setback of 10 metres is maintained on either side of the River Clarin, save for exceptional circumstances where it can be reasonably demonstrated that this setback is not feasible. Refer to the Specific Objectives Maps (2A/2B) of the LAP.*"	
Bearna Local Area Plan 2007 – 2017	According to the conclusions of the Appropriate Assessment Screening Statement (CAAS Ltd., 2012a), no likely significant effects will arise from the *Bearna Local Area Plan 2007-2017*. Based on this in-combination effects assessment of the GTS, it is considered that the ***Bearna Local Area Plan 2007-2017* will not have any adverse effects on SAC Qualifying Interest habitats or species, or SPA Special Conservation Interest bird species** via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the implementation of the following policies and objectives (as detailed in the plan):	There is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the *Bearna Local Area Plan 2007-2017*. This is due to the following reasons: - No adverse effects on European Site integrity will arise from the *Bearna Local Area Plan 2007-2017* alone, due to the policies and objectives - Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* will further more ensure no adverse effects will arise from the implementation of the *Bearna Local Area Plan*, including those that may arise from the potential impact pathway of Non-native invasive species
	Potential Impact Pathways – Habitat Degradation – Water Quality (Construction & Operation), Habitat Degradation – Non-native Invasive Species, Disturbance/Displacement	
	Natural Heritage Strategy Objectives (Galway County Council, 2007) - **Objective NH18 Buffer Area** – "*Establish an appropriate buffer around all environmental designations to protect them from land use and development impacts. This shall be determined on a site specific basis depending on local ecological and drainage conditions and other factors as appropriate and shall in no case be less than 10m in width. This shall apply along Silver Strand Road and the north-western corner of the Plan Area to protect these designated sites.*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	• **Objective NH14 European Sites and Habitats Directive Assessment** – "*Protect European Sites that form part of the Natura 2000 network (including Special Protection Areas and Special Areas of Conservation) in accordance with the requirements in the EU Habitats Directive (92/43/EEC), EU Birds Directive (2009/147/EC), the Planning and Development (Amendment) Act 2010, the European Communities (Birds and Natural Habitats) Regulations 2011 (SI No. 477 of 2011) (and any subsequent amendments or updated legislation) and having due regard to the guidance in the Appropriate Assessment Guidelines 2010 (and any subsequent or updated guidance). A plan or project (e.g. proposed development) within the Plan Area will only be authorised after the competent authority (Galway County Council) has ascertained, based on scientific evidence and a Habitats Directive Assessment where necessary, that:* *(a) The plan or project will not give rise to significant adverse direct, indirect or secondary impacts on the integrity of any European Site (either individually or in combination with other plans or projects); or* *(b) The plan or project will adversely affect the integrity of any European Site (that does not host a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or* *(c) The plan or project will adversely affect the integrity of any European Site (that hosts a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000"* • **Objective NH15 Protected Habitats and Species** – "*Support the protection of protected habitats and species listed in the annexes to the EU Habitats Directive (92/43/EEC) and Birds Directive (2009/147/EC). This includes the protection of bats and their roosts, and the maintenance of woodland, hedgerows, treelines, ecological networks and corridors that serve as feeding areas, flight paths and commuting routes for bats. Both the existing and amended LAP include provisions to ensure that pollution from waste water disposal and septic tanks is continuously controlled. The provision of adequate wastewater treatment and disposal in Bearna will be guided by the following:* *(a) EU Directives, in particular 91/271/EEC and 98/15/EEC Directive on Urban Wastewater Treatment, and associated Irish legislation, including Environmental Protection Agency Act 1992 and Urban Waste Water Treatment Regulations 1994.* *(b) Section 2.8.1 of this LAP and other relevant strategies, policies, objectives and standards in the Plan.* *(c) The SEA undertaken for the Bearna LAP, including the recommended mitigation measures and monitoring measures.* *Development proposals that cannot connect to the existing wastewater network, will be restricted and discouraged. Where it is not possible to connect to a public sewerage system, development proposals will be dependent on 'on site' treatment systems. Proposals for such systems would need to demonstrate that they comply with all relevant*	• No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); and, **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement)

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	standards that they are environmentally sustainable, that they do not undermine residential amenity, that they do not result in ad hoc development and that the site can be reinstated and connected to any future public wastewater scheme.” • **Objective NH10 Designated Sites and Non-Designated Areas** – “*Recognise that nature conservation is not just confined to designated sites and acknowledge the need to protect non-designated habitats and landscapes and to conserve the biological diversity of the area.*” • **Objective NH23 Designated Sites** – “*Protect the designated sites as core areas of high biodiversity that provide the basis for the ecological functioning of the EcoNet.*” • **Objective NH25 Coastal Corridor** – “*Protect the coastal buffer/amenity and adjacent lands as a coastal corridor that connects the various stream corridors, protects coastal habitats and processes and provides high amenity areas at the land-sea interface.*” • **Objective NH26 Important Habitats** – “*Protect important habitats in the Plan Area, particularly those in Class 1, 2 and 3 of the EcoNet, including the Class 2 areas of salt marsh, poor flush and orchid Class 2 areas and the Class 3 areas of trees and hedgerows.*” • **Objective NH27 Buffer Areas** – “*Provide adequate buffer areas around the main core areas, corridors and important habitats to protect them from development impacts and ensure their continued ecological functioning.*” • **Objective NH36 Coastal Development Setback** – “*Establish an appropriate coastal development setback appropriate to local conditions and requirements to:* *(a) Protect the sensitive coastal edge, coastal habitats and natural processes from destruction, degradation and/or disruption to ensure that their roles as ecological corridors, coastal flooding and storm surge buffers are retained and enhanced.* *(b) Maintain and improve public access to the seashore and the utilisation of the coastal edge as a focus for public use and recreation.* *(c) Provide a buffer to protect against coastal flooding and erosion and the increasing incidence and severity of storm surges, flooding and erosion that is likely to result from global warming and sea level rises.* *(d) Allow sufficient space for the development of important public infrastructure and amenities, such as a promenade, public ablutions, park areas, etc.* (e) *Provide for the creation of a positive relationship between new built development, the coastal amenity park, the promenade and the seashore.*” • **Objective NH37 Coastal Edge** – “*An appropriate coastal development setback will be required as follows in the Coastal Edge area:* *(a) A minimum horizontal setback of 100m from the foreshore field boundary line for new development or along the 10m natural contour line, whichever is the greater.* *(b) A consideration of the permanent line of vegetation and the 200 year tide level in the layout, design and installation of any new development, infrastructure or landscaping.* *(c) A high quality of siting and design in the area between the 100m setback/10m contour line and the R336.*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	(d) *No development seaward of Lenarevagh Stream in the eastern portion of the Coastal Edge, other than as permitted under other sections in the LAP or as considered by the Planning Authority to be in the interests of proper planning and sustainable development.*”	
	Potential Impact Pathways – Habitat Degradation – Water Quality (Construction & Operation)	
	Natural Heritage Strategy Objectives (Galway County Council, 2007) • **Objective NH5 Groundwater and Surface Water Protection** – “*The surface and groundwaters should be protected from pollution. In particular, proposals for on-site septic tanks and/or effluent treatment systems should include specific proposals to deal with the shallow soil cover to granite bedrock, the high water table and the potential pollution of surface and groundwaters.*” • **Objective NH6 Legislative and Policy Requirements** – “*Support the application and implementation of the relevant international and national legislative and policy requirements as they apply in Bearna, including the following:* *(a) The provisions of the EU Water Framework Directive 2000 and associated Irish legislation, namely the European Union (Water Policy) Regulations 2003, and projects, in particular the findings and recommendations of the Western RBD Project.* *(b) The recommendations of the OPW with regard to Flood Risk and Development.*” • **Objective NH7 Local Streams** – “*The existing streams in Bearna should be protected as follows:* *(a) Restore and reinstate streams or portions of streams that have been filled in or covered over as part of new developments.* *(b) Culverting of the streams should be restricted.* *(c) There will be a general minimum 6m wide buffer on either side of streams to protect these watercourse and associated habitats. Additional areas should be incorporated as required to provide for attenuation, habitat conservation, etc.*” • **Objective NH8 Catchment Impacts** – “*Ensure that new developments consider the potential impact on existing developments, infrastructure and natural habitats, wildlife and processes within the same catchment.*”	
	Potential Impact Pathways – Disturbance/Displacement, Barrier Effect	
	Natural Heritage Strategy Objectives (Galway County Council, 2007) • **Objective NH12 Interconnectivity** – “*Maintain and enhance the area, quality and interconnectivity of woodlands, trees, hedgerows and stone walls and other associated features. Where boundaries have been removed or it is considered necessary for them to be removed, these should be replaced with similar boundary types.*”	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	• **Objective NH13 Wildlife** – "*Protect birds and bats and their roosts, and to maintain woodland, hedgerows, treelines and ecological networks and corridors which serve as feeding areas, flight paths and commuting routes for birds and bats.*" • **Objective NH24 Stream Corridors** – "*Protect the watercourses as stream corridors for wildlife that provide north-south ecological linkages connecting core areas. Liberty Stream, Trusky Stream and Barna Stream in particular provide opportunities to link the inland designated sites with the coastal designated sites, Galway Bay and the coastal corridor.*" • **Objective NH29 Ecological Functioning** – "*Support the ecological functioning of the open spaces and ecosystems within the Plan Area and their ability to deliver ecosystem services for the local and broader community.*" • **Objective NH30 New Development** – "*New developments should consider their potential impact on ecological functioning and the delivery of ecosystem services.*"	
Gort Local Area Plan 2013-2019	According to the conclusions of its Natura Impact Report (RPS, 2013b), the ***<u>Gort Local Area Plan 2013-2019</u>* <u>will not have any adverse effects on the SAC Qualifying Interest habitats or species or SPA Special Conservation Interest bird species</u>** via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the implementation of the following objectives and policies (as detailed in the plan):	There is **<u>no potential for adverse in-combination effects</u>** on European Site integrity to occur as a result of the implementation of the GTS and the *Gort Local Area Plan 2013-2019*. This is due to the following reasons: • No adverse effects on European Site integrity will arise from the *Gort Local Area Plan 2013-2019* alone, due to the policies and objectives; • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* will further more ensure no adverse effects will arise from the implementation of the *Bearna Local Area Plan* • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments)
	Potential Impact Pathways – Habitat Degradation – Water Quality (Construction/Operation)	
	• **Objective DS 3 Natura 2000 Network and Habitats Directive Assessment** – "*Protect European Sites that form part of the Natura 2000 network (including Special Protection Areas and Special Areas of Conservation) in accordance with the requirements in the EU Habitats Directive (92/43/EEC), EU Birds Directive (2009/147/EC), the Planning and Development (Amendment) Act 2010, the European Communities (Birds and Natural Habitats), Regulations 2011 (SI No. 477 of 2011) (and any subsequent amendments or updated legislation) and having due regard to the guidance in the Appropriate Assessment Guidelines 2010 (and any updated/superseding guidance). A plan or project (e.g. proposed development) within the Plan Area will only be authorised after the competent authority (Galway County Council) has ascertained, based on scientific evidence, screening for Appropriate Assessment, and a Habitats Directive Assessment where necessary, that:* *(a) The plan or project will not give rise to significant adverse direct, indirect or secondary effects on the integrity of any European Site (either individually or in combination with other plans or projects); or* *(b) The plan or project will have significant adverse effects on the integrity of any European Site (that does not host a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or (c) *The plan or project will have significant adverse effects on the integrity of any European Site (that hosts a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000.*" • **Objective DS 5 Service Led Development** – "*Ensure that development is preceded by sufficient capacity in the public waste water and potable water infrastructure.*" • **Policy UI 1 Water Supply, Wastewater and Surface Water Infrastructure** – "*It is the policy of Galway County Council to support the provision and maintenance of adequate wastewater disposal, water supply and surface water drainage infrastructure, in accordance with EU Directives, national legislation and applicable standards. This will include the provision of adequate capacity in the public wastewater, wastewater treatment plant and storm-water sewer network, an adequate quantity and quality of water supply and the promotion of Sustainable Drainage System approaches and techniques for developments within the Plan Area.*" • **Objective UI 1 Water Services Infrastructure** – "*Support the maintenance, improvement and monitoring of the public water supply, wastewater disposal and surface water drainage infrastructure, as necessary to address any deficiencies in infrastructure capacity and/or service the development needs of the town. This will include the following and any other projects approved during the period of the Plan:* *(a) Continue to carry out improvements to the existing infrastructure and quality of the town's water supply system, including the partial network and reservoir upgrade works under the Water Conservation Rehabilitation works as proposed to commence in 2014/2015.* *(b) Monitor the capacity of the updated wastewater treatment plant as development takes place.* *(c) Ensure that trade effluent from new development is managed properly and discharged to sewer in accordance with relevant discharge licenses, where appropriate.* *(d) Progress the upgrading of the existing wastewater treatment plant and the sewer network for the town under the Water Services Investment Programme.* (e) *Improve and maintain an adequate surface water drainage system throughout the Plan Area.*" • **Objective UI2 Water Services for New Developments** – "*Require all new developments to be adequately serviced with water supply, wastewater disposal and surface water drainage in accordance with applicable legislation, standards and guidelines and to submit the necessary documentation with their planning applications to confirm same. Encourage only as much development, both in terms of quantity and type of development that can be provided for based on the utility services available and prohibit any proposed development that cannot be adequately serviced,*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	that would lead to a significant environmental effects or that would pose an unacceptable threat to the capacity of water, wastewater or surface water infrastructure in the Plan area.” • **Objective UI4 Wastewater Disposal** – “*Restrict development that does not connect to the public sewer and discourage the proliferation of individual septic tanks and treatment plants in order to protect groundwaters, consolidate the town structure and control ribbon development along the approach roads into Gort. Ensure that any trade effluent from new development is managed properly and discharged to sewer in accordance with relevant discharge licenses, where appropriate.*” • **Objective UI 5 Wastewater Treatment Plant Buffer** – “*Provide and protect a 100m buffer around the wastewater treatment plant (Public Utilities Zoning Objective) site and protect buffer zones around any other treatment plant in the town as appropriate.*” • **Objective UI 6 Surface Water Drainage and Sustainable Drainage Systems** – “*Maintain and enhance, as appropriate, the existing surface water drainage system throughout the Plan Area and ensure that new developments are adequately serviced with surface water drainage infrastructure and promote the use of Sustainable Drainage Systems in new developments. Surface water runoff from development sites will be limited to pre-development levels and planning applications for new developments will be required to provide details of surface water drainage and Sustainable Drainage Systems proposals.*” • **Objective UI7 The Cannahowna/Gort River and Drainage Catchment** – “*Require new development proposals within the catchment of the Cannahowna/Gort River or that potentially drain towards this river to include full details of proposals to address the high probability of flooding associated with the river and its catchment and the need to provide adequate surface water drainage, including the incorporation of Sustainable Drainage Systems.*” • **Objective UI10 Water Bodies and Watercourses** – “*Protect water bodies and watercourses within the Plan Area from inappropriate development, including lakes, rivers, canals, streams, associated undeveloped riparian strips, wetlands and natural floodplains. This will include a 10 metre environmental management buffer on either side of the Cannahowna/Gort River, measured from the near river bank. Promote the sustainable management and uses of water bodies and avoid culverting or realignment of these features.* • **Objective UI11 Groundwater and Pluvial Flood Risk** – “*Planning applications on lands identified within groundwater and pluvial PFRA areas shall be accompanied by a Site-specific Flood Risk Assessment that corresponds with that outlined under Chapter 5 ‘Flooding and Development Management’ of the DEHLG Flood Guidelines (2009). Such assessments shall be prepared by suitably qualified experts with hydrological experience and shall quantify the risks and the effects of any necessary mitigation, together with the measures needed or proposed to manage residual risks.*” • **Policy UI 4 Water Quality** – “*It is the policy of Galway County Council to protect and improve water quality in all waters, in conjunction with other agencies and stakeholders in accordance with the EU Water Framework Directive (2006/60/EC), EU Groundwater Directive (2006/118/EC) and other relevant EU Directives, including associated national legislation and policy guidance, (including any superseding versions of same), and to support the implementation of the Western River Basin District Management Plan, Galway County Council will take account of the above requirements to protect and improve water quality when considering new development proposals.*”	

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	• **Objective UI13 Western River Basin District Management Plan and Protection of Waters** – "*Support the protection of water quality in accordance with the EU Water Framework Directive (2006/60/EC) and the European Communities (Water Policy) Regulations 2003 (SI No. 722 of 2003) (as amended) (or any updated legislation), including the implementation of the relevant recommendations and measures as outlined in the Western River Basin District Management Plan 2009-2015, (and any updated/ superseding documents). Development will only be permitted where it can be clearly demonstrated that the proposal would not have an unacceptable impact on the water environment, including surface water, groundwater quality and quantity, river corridors and associated wetlands. Galway County Council is statutorily obliged to protect the existing good quality status of the waters in the Gort area (including the Cannahowna/Gort River and tributary/stream, the Kiltartan drainage area and including the surface water catchments of the Coole-Garryland turlough (a wetland system of global significance).*"' • **Objective UI14 Groundwater and Aquifers** – "*Support the protection of groundwater resources and dependent wildlife/habitats in accordance with the EU Groundwater Directive (2006/118/EC) and the European Communities Environmental Objectives (Groundwater) Regulations 2010 (SI No. 9 of 2010) (or any updated legislation). Protect the regionally important aquifer that under lays the Plan Area from risk of environmental pollution and have regard to any groundwater protection schemes and groundwater source protection zones where data has been made available by the Geological Survey of Ireland.*" • **Policy NH1 Natural Heritage and Biodiversity** – "*It is the policy of Galway County Council to support the conservation and enhancement of natural heritage and biodiversity, including the protection of the integrity of European Sites, that form part of the Natura 2000 network, the protection of Natural Heritage Areas and proposed Natural Heritage Areas and the promotion of the development of a green/ecological network within the Plan Area, in order to support ecological functioning and connectivity, create opportunities in suitable locations for active and passive recreation and to structure and provide visual relief from the built environment. The protection of natural heritage and biodiversity, including European Sites that form part of the Natura 2000 network, will be implemented in accordance with relevant EU environmental directives and applicable national legislation, policies, plans and guidelines, including the following (and any updated/superseding documents):* *(a) EU Directives, including the Habitats Directive (92/43/EEC), the Birds Directive (2009/147/EC), the Environmental Impact Assessment Directive (85/337/EEC), the Water Framework Directive (2000/60/EC) and the Strategic Environmental Assessment Directive (2001/42/EC),* *(b) National legislation, including the Wildlife Act 1976, the European Communities (Environmental Impact Assessment) Regulations 1989 (SI No. 349 of 1989) (as amended), the Wildlife (Amendment) Act 2000, the European Union (Water Policy) Regulations 2003 (as amended), the Planning and Development Act 200 (as amended) and the European Communities (Birds and Natural Habitats) Regulations 2011 (SI No. 477 of 2011).* *(c) National policy guidelines, including the Landscape and Landscape Assessment Draft Guidelines 2000, the Environmental Impact Assessment Sub-Threshold Development Guidelines 2003, Strategic Environmental Assessment Guidelines 2004 and the Appropriate Assessment Guidelines 2010.*	

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	(d) *Catchment and water resource management plans, including the Western River Basin District Management Plan 2009-2015.* (e) *Biodiversity plans and guidelines, including Actions for Biodiversity 2011-2016: Ireland's National Biodiversity Plan, the Biodiversity Action Plan for County Galway 2008- 2013 and the Biodiversity Guidelines produced by Galway County Council.*" • **Objective NH1 European Sites** - "*Protect European Sites that form part of the Natura 2000 network (including Special Protection Areas and Special Areas of Conservation) in accordance with the requirements in the EU Habitats Directive (92/43/EEC), EU Birds Directive (2009/147/EC), the Environmental Liability Directive, the Planning and Development (Amendment) Act 2010, the European Communities (Birds and Natural Habitats) Regulations 2011 (SI No. 477 of 2011) (and any subsequent amendments or updated legislation) and having due regard to the guidance in the Appropriate Assessment Guidelines 2010 (and any subsequent or updated guidance). A plan or project (e.g. proposed development) within the Plan Area will only be authorised after the competent authority (Galway County Council) has ascertained, based on scientific evidence, screening for appropriate assessment, and a Habitats Directive Assessment where necessary, that:* *(a)* *The plan or project will not give rise to significant adverse direct, indirect or secondary effects on the integrity of any European Site (either individually or in combination with other plans or projects); or* *(b)* *The plan or project will have significant adverse effects on the integrity of any European Site (that does not host a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or* *(c)* *The plan or project will have significant adverse effects on the integrity of any European Site (that hosts a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000.*" • **Objective NH2 Protected Habitats and Species** – "*Support the protection of habitats and species listed in the annexes to and/or covered by the EU Habitats Directive (92/43/EEC, as amended) and Birds Directive (2009/147/EC), and regularly occurring-migratory birds and their habitats, and species protected under the Wildlife Acts 1976- 2000.*" • **Objective NH4 Impact Assessment** – "*Ensure full compliance with the requirements of the EU Habitats Directive (92/43/EEC), SEA Directive (2001/42/EC) and EIA Directive 2011/92/EU and associated legislation/regulations, including the European Communities (Birds and Natural Habitats) Regulations 2011 (SI No. 477 of 2011), European*	

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	Communities (Environmental Assessment of Certain Plans and Programmes) Regulations 2004-2011, the Planning and Development (Strategic Environmental Assessment) Regulations 2004-2011 and the European Communities (Environmental Impact Assessment) Regulations 1989-2011 (or any updated/superseding legislation). Planning applications for proposed developments within the Plan Area that may give rise to likely significant effects on the environment and/or any designated site may need to be accompanied by one of more of the following: an Environmental Impact Statement, an Ecological Impact Assessment Report, a Habitats Directive Assessment Screening Report or a Natura Impact Statement, as appropriate. Ensure that Natura Impact Statements and any other environmental or ecological impact assessments submitted in support of proposals for development are carried out in accordance with best practice methodologies and contain all necessary baseline assessments." • **Objective NH6 Water Resources** – "*Protect the water resources in the Plan Area, including the Cannahowna/Gort, its tributaries and downstream water bodies, other streams, springs, surface water and groundwater quality and wetlands in accordance with the requirements and guidance in the EU Water Framework Directive 2000 (2000/60/EC), the European Union (Water Policy) Regulations 2003 (as amended), the Western River Basin District Management Plan 2009-2015 and other relevant EU Directives, including associated national legislation and policy guidance (including any superseding versions of same). Support the application and implementation of a catchment planning and management approach to development and conservation, including the implementation of Sustainable Drainage System techniques for new development in the Plan Area.*" • **Objective NH7 Environmental Management Buffer** – "*Protect and seek to improve the water quality in the Cannahowna/Gort River. Limit development within the environmental management buffer so as to protect the qualifying interests of all European Sites which are linked indirectly to the Gort Local Area Plan area via the Cannahowna/Gort River and to mitigate against pollution risks, reduce flooding potential and maintain habitat. Seek to ensure that a minimum setback of 10 metres is maintained on either side of the Cannahowna/Gort River, save for exceptional circumstances where it can be reasonably demonstrated that this setback is not feasible. In the event of lighting being proposed along watercourse corridors an Ecological Impact Assessment (and where necessary an Appropriate Assessment) including bat and otter survey shall be conducted by specialists. The recommendations of the specialist studies shall be implemented to the greatest extent possible. No lighting will be installed without prior consultation with NPWS and shall be in line with advances in knowledge into the impact of lighting on bats and other species and also to reflect advances in technology in the lighting industry. Support the carrying out of a river corridor habitat survey of the Cannahowna/Gort River as resources permit.*"	
Headford Local Area Plan 2015-2021	According to the conclusions of the Appropriate Assessment Screening Statement[6] (Galway County Council, 2015), no likely significant effects will arise from the *Headford Local Area Plan 2015-2021*. Based on this in-combination effects assessment of the GTS, it is considered that the ***Headford Local Area Plan 2015-2021* will not have any adverse effects on SAC Qualifying Interest habitats or species, or SPA Special Conservation Interest bird species** via any of the	There is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and *the Headford*

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[6] To note: Appropriate Assessment was only completed for the Material Alterations of the Plan. Ministerial Direction removed these material alterations.

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	identified impact pathways set out below and outlined in **Table E-1** above. This is due to the implementation of the following policies and objectives (as detailed in the plan):	*Local Area Plan 2015-2021* This is due to the following reasons: • No adverse effects on European Site integrity will arise from the *Headford Local Area Plan*
	Potential Impact Pathways – Habitat Degradation – Hydrogeology, Habitat Degradation – Water Quality (Construction/Operation)	

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	• **Objective DS 3 Natura 2000 Network and Habitats Directive Assessment** – "*Protect European Sites that form part of the Natura 2000 network (including Special Protection Areas and Special Areas of Conservation) in accordance with the requirements in the EU Habitats Directive (92/43/EEC), EU Birds Directive (2009/147/EC), the Planning and Development (Amendment) Act 2010, the European Communities (Birds and Natural Habitats) Regulations 2011 (SI No. 477 of 2011) (and any subsequent amendments or updated legislation) and having due regard to the guidance in the Appropriate Assessment Guidelines 2010 (and any updated/superseding guidance). A plan or project (e.g. proposed development) within the Plan Area will only be authorised after the competent authority (Galway County Council) has ascertained, based on scientific evidence and a Habitats Directive Assessment where necessary, that:* *(a) The plan or project will not give rise to significant adverse direct, indirect or secondary impacts on the integrity of any Natura 2000 site (either individually or in combination with other plans or projects); or* *(b) The plan or project will adversely affect the integrity of any Natura 2000 site (that does not host a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or* *(c) The plan or project will adversely affect the integrity of any Natura 2000 site (that hosts a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000.*" • **Objective DS 5 Service Led Development** – "*Development under the plan shall be preceded by sufficient capacity in the public waste water infrastructure and potable water infrastructure.*" • **Policy UI 1 Water Supply, Wastewater And Surface Water Infrastructure** – "*Support Irish Water in the provision and maintenance of adequate wastewater disposal and water supply and the maintenance of the existing combined (sewage and surface water) drainage infrastructure, in accordance with EU Directives, to service Headford. This will include satisfactory capacity for public wastewater and a satisfactory quantity and quality of water supply, Sustainable Drainage System approaches and techniques within the plan area shall also be supported.*" • **Objective UI 3 Wastewater Disposal** – "*New developments shall only be permitted where it can be clearly demonstrated that they can be serviced and that there is adequate capacity in the wastewater disposal infrastructure in accordance with applicable requirements and standards, including urban wastewater treatment disposal standards, in order to protect Lough Corrib cSAC and SPA and its respective qualifying interests.*"	*2015-2021* alone, due to the policies and objectives • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* will further more ensure no adverse effects will arise from the implementation of the *Headford Local Area Plan 2015-2021* • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); and, **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments)

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	• **Objective UI 5 Surface Water Drainage and Sustainable Drainage Systems** – "*Maintain and enhance, as appropriate, the existing surface water drainage system throughout the plan area and ensure that new developments are adequately serviced with surface water drainage infrastructure and promote the use of Sustainable Drainage Systems in new developments. Surface water runoff from development sites will be limited to pre-development levels and planning applications for new developments will be required to provide details of surface water drainage and Sustainable Drainage Systems proposals, with the developer responsible for the satisfactory disposal of surface water*" • **Policy WQ 1 Water Quality** – "*It is the policy of Galway County Council to seek the protection and improvement in water quality in all waters, in conjunction with other agencies and stakeholders in accordance with the EU Water Framework Directive (2006/60/EC), EU Groundwater Directive (2006/118/EC) and other relevant EU Directives, including associated national legislation and policy guidance, (including any superseding versions of same), and to support the implementation of the Western River Basin District Management Plan (as updated), including its Programme of Measures and the actions and measures that form part of the Corrib Water Management Unit Action Plan and consider the above when assessing new development proposals.*" • **Objective WQ 2 Groundwater & Aquifer** – "*Support the protection of groundwater resources and dependent wildlife/habitats in accordance with the Groundwater Directive 2006/118/EC and the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010) as amended by the European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2012 or any other updates. In addition, protect the regionally important aquifer that underlays the plan area from risk of environmental pollution and have regard to any groundwater protection schemes and groundwater source protection zones where data has been made available by the Geological Survey of Ireland.*" • **Objective FL 9 Water Bodies and Watercourses** – "*Protect water bodies and watercourses within the plan area from inappropriate development, including rivers, streams, associated undeveloped riparian strips, wetlands and natural floodplains. This will include a general 10 metre protection buffer from rivers within the plan area, as measured from the near river bank (this distance may be increased and decreased on a site by site basis, as appropriate). In addition, promote the sustainable management and uses of water bodies and avoid culverting or realignment of these features.*" • **DM Guideline WQ 1 Water Bodies and Watercourses** – "*Require all relevant applications, which are located in close proximity to water bodies or watercourses to submit measures to reduce and prevent pollution to the water body/watercourse, both during construction and after completion of the scheme.*" • **Policy NH 1 Natural Heritage, Landscape and Environment** – "*It is the policy of Galway County Council, to support the conservation and enhancement of natural heritage and biodiversity, including the protection of the integrity of Natura 2000 sites, the protection of Natural Heritage Areas and proposed Natural Heritage Areas and the promotion of the development of a green/ecological network within the plan area, in order to support ecological functioning and connectivity, create opportunities in suitable locations for active and passive recreation and to structure and provide visual relief from the built environment. The protection of natural heritage and biodiversity, including Natura 2000 sites, will be implemented in accordance with relevant EU environmental directives and*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	applicable national legislation, policies, plans and guidelines, including the following (and any updated/superseding documents): • EU Directives, including the Habitats Directive (92/43/EEC), the Birds Directive (2009/147/EC codified version of Directive), the Environmental Impact Assessment Directive (85/337/EEC) & EIA Directive (2014/52/EU), the Water Framework Directive (2000/60/EC) and the Strategic Environmental Assessment Directive (2001/42/EC); the Environmental Liability Directive 2004/35/EC; • National legislation, including the Wildlife Act 1976, the European Communities (Environmental Impact Assessment) Regulations 1989 (SI No. 349 of 1989) (as amended), the Wildlife (Amendment) Act 2000, the European Union (Water Policy) Regulations 2003 (as amended), the Planning and Development (Amendment) Act 2010 and the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011) and the Regulation of the European Parliament and of the Council on the Prevention and Management of the Introduction and Spread of Invasive Non-Native Species [2013/0307 (COD)] (adopted by European Council coming into effect January 2015) • National policy guidelines, including the Landscape and Landscape Assessment Draft Guidelines 2000, the Environmental Impact Assessment Sub-Threshold Development Guidelines 2003, Strategic Environmental Assessment Guidelines 2004 and the Appropriate Assessment Guidelines 2010. *(a) Catchment and water resource management plans, including the Western River Basin District Management Plan 2009-2015 (and as updated).* *(b) Biodiversity plans and guidelines, including Actions for Biodiversity 2011-2016: Ireland's National Biodiversity Plan, the Biodiversity Action Plan for County Galway 2008-2013 and the Biodiversity Guidelines produced by Galway County Council.* *(c) EU Directives, including the Habitats Directive (92/43/EEC), the Birds Directive (2009/147/EC codified version of Directive), the Environmental Impact Assessment Directive (85/337/EEC) & EIA Directive (2014/52/EU), the Water Framework Directive (2000/60/EC) and the Strategic Environmental Assessment Directive (2001/42/EC); the Environmental Liability Directive 2004/35/EC;* *(d) National legislation, including the Wildlife Act 1976, the European Communities (Environmental Impact Assessment) Regulations 1989 (SI No. 349 of 1989) (as amended), the Wildlife (Amendment) Act 2000, the European Union (Water Policy) Regulations 2003 (as amended), the Planning and Development (Amendment) Act 2010 and the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011) and the Regulation of the European Parliament and of the Council on the Prevention and Management of the Introduction and Spread of Invasive Non-Native Species [2013/0307 (COD)] (adopted by European Council coming into effect January 2015)* *(e) National policy guidelines, including the Landscape and Landscape Assessment Draft Guidelines 2000, the Environmental Impact Assessment Sub-Threshold Development Guidelines 2003, Strategic Environmental Assessment Guidelines 2004 and the Appropriate Assessment Guidelines 2010.* *(f) Catchment and water resource management plans, including the Western River Basin District Management Plan 2009-2015 (and as updated).* *(g) Biodiversity plans and guidelines, including Actions for Biodiversity 2011-2016: Ireland's National Biodiversity Plan, the Biodiversity Action Plan for County Galway 2008-2013 and the Biodiversity Guidelines produced by Galway County Council."*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	• **Objective NH 1 Natura 2000 Sites** – "*Protect European Sites that form part of the Natura 2000 network (including Special Protection Areas and Special Areas of Conservation) in accordance with the requirements in the EU Habitats Directive (92/43/EEC), EU Birds Directive (2009/147/EC), the Planning and Development (Amendment) Act 2010, the European Communities (Birds and Natural Habitats) Regulations 2011 (SI No. 477 of 2011) (and any subsequent amendments or updated legislation) and having due regard to the guidance in the Appropriate Assessment Guidelines 2010 (and any updated/superseding guidance). A plan or project (e.g. proposed development) within the plan area will only be authorised after the competent authority (Galway County Council) has ascertained, based on scientific evidence and a Habitats Directive Assessment where necessary, that:* *(a) The plan or project will not give rise to significant adverse direct, indirect or secondary impacts on the integrity of any Natura 2000 site (either individually or in combination with other plans or projects); or* *(b) The plan or project will adversely affect the integrity of any Natura 2000 site (that does not host a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or* *(c) The plan or project will adversely affect the integrity of any Natura 2000 site (that hosts a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000.*" • **Objective NH 2 Protected Habitats and Species –** *(a)* "*Support the protection of protected habitats and species listed in the annexes to the EU Habitats Directive 1992 (92/43/EEC) and the Birds Directive (2009/147/EC) and regularly occurring-migratory birds and their habitats, species protected under the Wildlife Acts and the Flora Protection Order. This includes the protection of the barn owl, otters, salmon, brook lamprey, bats and their roosts and the maintenance of woodland, hedgerows, tree lines, waterways and ecological networks and corridors which serve as feeding areas, flight paths and community routes for bats.* *(b) Areas for particular species afforded protection include in the vicinity of St. John the Baptist Church) where barn owl activity is known and in the vicinity of the Demesne Road, Lowery's Stream where bat activity is known and the Annacurta (Headford) River and associated streams for otter, salmon and lamprey.*" • **Objective NH 6 Water Resources** – "*Protect all water resources in the plan area, including rivers, streams, springs, wetlands, surface waters and groundwater quality, in accordance with the requirements and guidance in the EU Water Framework Directive 2000 (2000/60/EC), the European Union (Water Policy) Regulations 2003 (as amended), the Western River Basin Management Plan 2009-2015 (including any updated or superseding document) and other relevant EU Directives, including associated national legislation and policy guidance (including any*	

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	superseding versions of same). Support the application and implementation of a catchment planning and management approach to development and conservation, including the implementation of Sustainable Drainage System techniques for new development in the plan area." • **Objective NH 7 Wetlands, Springs, Rivers and Streams** – "*Seek to preserve the wetlands of Headford, identify and protect natural springs, streams/rivers, where possible and ensure that any plans/projects with the potential to adversely affect groundwater, springs, streams or rivers, identify the presence of these features and adequately assess the impacts to them. Protect springs identified on Ordnance Survey mapping or any springs newly identified during project assessment, so that they are not impeded.*" • **Objective NH 8 Riparian Zones** – "*Protect the riparian zones of watercourse systems throughout the plan area, recognising the benefits they provide in relation to flood risk management and in relation to the ecological integrity of watercourse systems. This will include a general 10 metre protection buffer from rivers within the plan area as measured from the near river bank, (this distance may be increased and decreased on a site by site basis, as appropriate).*" • **Objective NH 10 Geological and Geomorphological Systems** – "*Protect and conserve geological and geo-morphological systems, sites and features from inappropriate development that would detract from their heritage value and interpretation and ensure that any plan or project affecting karst formations are adequately assessed with regard to their potential geophysical, hydrological, hydro-geological or ecological impacts on the environment.*"	

<table>
<tr><th>Plan or Project</th><th>Potential for Adverse Effects on European Site Integrity Alone?</th><th>Potential for Adverse Effects on European Site Integrity In-combination?</th></tr>
<tr><td rowspan="3">Loughrea Local Area Plan 2011-2018</td><td>According to the conclusions of the Appropriate Assessment Screening Statement (Doherty Environmental, 2012a), no likely significant effects will arise from the Loughrea Local Area Plan 2011-2018. Based on this in-combination effects assessment of the GTS, it is considered that the <u>Loughrea Local Area Plan 2011-2018</u> <u>will not have any adverse effects on SAC Qualifying Interest habitats or species, or SPA Special Conservation Interest bird species</u> via any of the identified impact pathways set out below and outlined in Table E-1 above. This is due to the implementation of the following policies and objectives (as detailed in the plan):</td><td rowspan="3">There is <u>no potential for adverse in-combination effects</u> on European Site integrity to occur as a result of the implementation of the GTS and the Loughrea Local Area Plan 2011-2018 This is due to the following reasons:
• No adverse effects on European Site integrity will arise from the Loughrea Local Area Plan 2011-2018 alone, due to the policies and objectives outlined in the plan
• Adherence to the overarching policies and objectives of the Galway County Development Plan 2015-2021 will further more ensure no adverse effects will arise from the implementation of the Loughrea Local Area Plan 2011-2018
• No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: Habitat Degradation – Water Quality (Construction/Operation) (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments)</td></tr>
<tr><td>Potential Impact Pathways –Habitat Degradation – Water Quality (Construction/Operation)</td></tr>
<tr><td>• Objective DS 3 Natura 2000 Network and Habitats Directive Assessment – “Protect European Sites that form part of the Natura 2000 network (including Special Protection Areas and Special Areas of Conservation) in accordance with the requirements in the EU Habitats Directive (92/43/EEC), EU Birds Directive (2009/147/EC), the Planning and Development (Amendment) Act 2010, the European Communities (Birds and Natural Habitats) Regulations 2011 (SI No. 477 of 2011) (and any subsequent amendments or updated legislation) and having due regard to the guidance in the Appropriate Assessment Guidelines 2010 (and any updated/superseding guidance). A plan or project (e.g. proposed development) within the Plan Area will only be authorised after the competent authority (Galway County Council) has ascertained, based on scientific evidence and a Habitats Directive Assessment where necessary, that:
(a) The plan or project will not give rise to significant adverse direct, indirect or secondary impacts on the integrity of any Natura 2000 site (either individually or in combination with other plans or projects); or
(b) The plan or project will adversely affect the integrity of any Natura 2000 site (that does not host a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or
(c) The plan or project will adversely affect the integrity of any Natura 2000 site (that hosts a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000.”
• Objective DS 5 Service Led Development – “Development under the plan shall be preceded by sufficient capacity in the public waste water infrastructure and potable water infrastructure.”</td></tr>
</table>

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	• **Objective LU 9 Environmental Management Area (EM)** – "*Protect lands and sites with high biodiversity value and/or Environmental sensitivity and promote their sustainable management and use. This will include the protection of the integrity of European Sites that form part of the Natura 2000 network, in particular Special Protection Areas and Special Areas of Conservation, in accordance with the conservation management objectives for these sites and the requirements of the EU Habitats Directive (92/43/EEC).*" • **Objective UI2 Water Services for New Developments** – "*Require all new developments to be adequately serviced with water supply, wastewater disposal and surface water drainage in accordance with applicable legislation, standards and guidelines and to submit the necessary documentation with their planning applications to confirm same. Encourage only as much development, both in terms of quantity and type of development that can be provided for based on the utility services available and prohibit any proposed development that cannot be adequately serviced, that would lead to a significant environmental effects or that would pose an unacceptable threat to the capacity of water, wastewater or surface water infrastructure in the Plan area.*" • **Objective UI 4 Wastewater Disposal** - "*New developments shall only be permitted where it can be clearly demonstrated that they can be serviced and that there is adequate capacity in the wastewater disposal infrastructure in accordance with applicable requirements and standards, including urban wastewater treatment disposal standards, in order to protect the Galway Bay Complex and its qualifying interests.*" • **Objective UI 5 Surface Water Drainage and Sustainable Drainage Systems** - "*Maintain and enhance, as appropriate, the existing surface water drainage system throughout the plan area and ensure that new developments are adequately serviced with surface water drainage infrastructure and promote the use of Sustainable Drainage Systems in new developments. Surface water runoff from development sites will be limited to pre-development levels and planning applications for new developments will be required to provide details of surface water drainage and Sustainable Drainage Systems proposals, with the developer responsible for the satisfactory disposal of surface water*" • **Objective UI 6 St. Cleran's River Tributary and Drainage Catchment** – "*Require new development proposals within the catchment of the St. Cleran's River tributary or that potentially drain towards this tributary to include full details of proposals to address the high probability of flooding associated with the tributary and the need to provide adequate surface water drainage, including the incorporation of Sustainable Drainage Systems.*" • **Objective UI 9 (Waterbodies and Watercourses)** – "*Protect waterbodies and watercourses within the Plan Area from inappropriate development, including the lake, rivers, streams, associated undeveloped riparian strips, wetlands and natural floodplains. This will include a 10 metre environmental management buffer on either side of St Cleran's River and its tributary in the least of the Plan Area, measured from the near river bank. Promote the sustainable management and uses of watercourses and avoid the culverting or realignment of these features.*" • **Policy UI 3 Water Quality –** "*It is the policy of Galway County Council to protect and improve water quality in conjunction with other agencies and stakeholders and in accordance with the EU Water Framework Directive (2006/60/EC), EU Groundwater Directive (2006/118/EC) and associated national legislation and to support the implementation of the Western River Basin District Management Plan, including the actions and measures that*	

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	form part of the Clarin/Kilcolgan Water Management Unit Action Plan. Galway County Council will take account of the above requirements to protect and improve water quality when considering new development proposals." • **Objective UI 10** ***Western River Basin District Management Plan and Protection of Waters*** **-** *Support the protection of water quality in accordance with the EU Water Framework Directive (2006/60/EC) and the European Communities (Water Policy) Regulations 2003 (SI No. 722 of 2003) (as amended) (or any updated legislation), including the implementation of the relevant recommendations and measures as outlined in the Wester River Basin District Management Plan 2009 2015, including the Clarin/Kilcolgan Water Management Unit Action Plan (and any updated/ superseding documents). Development will only be permitted where it can be clearly demonstrated that the proposal would not have an unacceptable impact on the water environment, including surface water, groundwater quality and quantity, river corridors and associated wetlands. Galway County Council is statutorily obliged to protect the existing good quality status of the waters in Loughrea (including Lough Rea, St. Cleran's River and tributary and the Clarin/Kilcolgan drainage area).* • **DM Guideline UI 2 Waterbodies and Watercourses** – "*Require all relevant applications, which are located in close proximity to waterbodies or watercourses (including Lough Rea, St.Cleran's River and tributaries), to submit measures to reduce and prevent pollution to the waterbody/watercourse, both during construction and after completion of the scheme.*" • **Policy NH 1 Natural Heritage, Landscape and Environment** – "*It is the policy of Galway County Council, to support the conservation and enhancement of natural heritage and biodiversity, including the protection of the integrity of European Sites, the protection of Natural Heritage Areas and proposed Natural Heritage Areas and the promotion of the development of a green/ecological network within the Plan Area, in order to support ecological functioning and connectivity, create opportunities in suitable locations for active and passive recreation and to structure and provide visual relief from the built environment. The protection of natural heritage and biodiversity, including European Sites, will be implemented in accordance with relevant EU environmental directives and applicable national legislation, policies, plans and guidelines, including the following (and any updated/superseding documents):* *(a) EU Directives, including the Habitats Directive (92/43/EEC), the Birds Directive (2009/147/EC codified version of Directive), the Environmental Impact Assessment Directive (85/337/EEC), the Water Framework Directive (2000/60/EC) and the Strategic Environmental Assessment Directive (2001/42/EC).* *(b) National legislation, including the Wildlife Act 1976, the European Communities (Environmental Impact Assessment) Regulations 1989 (SI No. 349 of 1989) (as amended), the Wildlife (Amendment) Act 2000, the European Union (Water Policy) Regulations 2003 (as amended), the Planning and Development (Amendment) Act 2010 and the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011). • National policy guidelines, including the Landscape and Landscape Assessment Guidelines 2000, the Environmental Impact Assessment SubUThreshold Development Guidelines 2003, Strategic Environmental Assessment Guidelines 2004 and the Appropriate Assessment Guidelines 2010.* *(c) Catchment and water resource management plans, including the Western River Basin District Management Plan 2009U2015.*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	(d) *Biodiversity plans and guidelines, including Actions for Biodiversity 2011U2016: Ireland s National Biodiversity Plan, the Biodiversity Action Plan for County Galway 2008U2013 and the Biodiversity Guidelines produced by Galway County Council.*” • **Objective NH 1 European Sites** – “*Protect European 2000 sites, (including Special Protection Areas and Special Areas of Conservation), that form part of the Natura 2000 network, in accordance with the requirements in the EU Habitats Directive'(92/43/EEC), EU Birds'Directive'2009/147/EC codified version of Directive), the Planning and Development (Amendment)'Act'2010, the European Communities (Birds and Natural Habitats) Regulations'2011 (S.I. No. 477 of 2011) (and any subsequent amendments or updated legislation) and having due regard to the guidance in the Appropriate Assessment Guidelines 2010 (and any subsequent or updated guidance). A plan or project (e.g. proposed development) within the Plan Area will only be authorised after the competent authority (Galway County Council) has ascertained, based on scientific evidence and a Habitats Directive Assessment where necessary, that:* *(a) The plan or project will not give rise to adverse direct, indirect or secondary impacts on the integrity of any European Site (either individually or in combination with other plans or projects); or* *(b) The plan or project will adversely affect the integrity of any European Site (that does not host a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure The protection of the overall coherence of Natura 2000; or* *(c) The plan or project will adversely affect the integrity of any European Site (that hosts a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000.”* • **Objective NH 2 Protected Habitats and Species** – “*Support the protection of protected habitats and species listed in the annexes to the EU Habitats'Directive'1992 (92/43/EEC) and the Birds Directive'(2009/147/EC codified version of Directive). This includes the protection of bats and their roosts, and the maintenance of woodland, hedgerows, treelines, ecological networks and corridors which serve as feeding areas, flight paths and community routes for bats.*” • **Objective NH 6 Water Resources** – “*Protect all water resources in the Plan Area, including Lough Rea, St Cleran’s River, its tributaries and downstream waterbodies, other streams, springs, surface water and groundwater quality, in accordance with the requirements and guidance in the EU Water Framework Directive 2000 (2000/60/EC), the European Union (Water Policy) Regulations 2003 (as amended) and the Western River Basin Management Plan 2009U2015 (including any superseding versions of same). Support the application and implementation of a*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	catchment planning and management approach to development and conservation, including the implementation of Sustainable Drainage System techniques for new development in the Plan Area."	
Maigh Cuilinn Local Area Plan 2013-2019	According to the conclusions of the Appropriate Assessment Screening Statement (RPS, 2013a), no likely significant effects will arise from the *Maigh Cuilinn Local Area Plan 2013-2019*. Based on this in-combination effects assessment of the GTS, it is considered that the ***Maigh Cuilinn Local Area Plan 2013-2019* will not have any adverse effects on SAC Qualifying Interest habitats or species, or SPA Special Conservation Interest bird species** via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the implementation of the following policies and objectives (as detailed in the plan): ***Potential Impact Pathways – Habitat Degradation – Hydrogeology, Habitat Degradation – Water Quality (Construction/Operation), Habitat Degradation – Air Quality, Non-native Invasive Species, Disturbance/Displacement, Barrier Effect*** • **Objective LU 8 Environmental Management (EM)** – "*Protect lands and sites with high biodiversity value and/or environmental sensitivity and promote their sustainable management and use. This will include the protection of the integrity of European Sites that form part of the Natura 2000 network, in particular Special Areas of Conservation, in accordance with the conservation management objectives of these sites and the requirements of the EU Habitats Directive (92/43/EEC).*" **Natural Heritage & Biodiversity Policies** • **Policy NH 1 Natural Heritage, Landscape and Environment** – "*It is the policy of Galway County Council, to support the conservation and enhancement of natural heritage and biodiversity, including the protection of the integrity of Natura 2000 sites, the protection of Natural Heritage Areas and proposed Natural Heritage Areas and the promotion of the development of a green/ecological network within the Plan Area, in order to support ecological functioning and connectivity, create opportunities in suitable locations for active and passive recreation and to structure and provide visual relief from the built environment. The protection of natural heritage and biodiversity, including European Sites that form part of the Natura 2000 network, will be implemented in accordance with relevant EU environmental directives and applicable national legislation, policies, plans and guidelines, including the following (and any updated/superseding documents):* *(a) EU Directives, including the Habitats Directive (92/43/EEC), the Birds Directive (2009/147/EC the Environmental Impact Assessment Directive (85/337/EEC), the Water Framework Directive (2000/60/EC) and the Strategic Environmental Assessment Directive (2001/42/EC).* *(b) National legislation, including the Wildlife Act 1976, the European Communities (Environmental Impact Assessment) Regulations 1989 (SI No. 349 of 1989) (as amended), the Wildlife (Amendment) Act 2000, the European Union (Water Policy) Regulations 2003 (as amended), the Planning and Development Act 2000,*	There is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the *Maigh Cuilinn Local Area Plan 2013-2019*. This is due to the following reasons: • No adverse effects on European Site integrity will arise from the *Maigh Cuilinn Local Area Plan 2013-2019* alone, due to the policies and objectives outlined in the plan • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* will further more ensure no adverse effects will arise from the implementation of the *Maigh Cuilinn Local Area Plan 2013-2019* • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Air Quality** (i.e. Box 7 GTS – Habitat Degradation – Air Quality); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-

Plan or Project	Potential for Adverse Effects on European Site Integrity Alone?	Potential for Adverse Effects on European Site Integrity In-combination?
	(as amended) and the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011). *(c) National policy guidelines, including the Landscape and Landscape Assessment Draft Guidelines 2000, the Environmental Impact Assessment Sub-Threshold Development Guidelines 2003, Strategic Environmental Assessment Guidelines 2004 and the Appropriate Assessment Guidelines 2010.* *(d) Catchment and water resource management plans, including the Western River Basin District Management Plan 2009-2015.* *(e) Biodiversity plans and guidelines, including Actions for Biodiversity 2011-2016: Ireland's National Biodiversity Plan, the Biodiversity Action Plan for County Galway 2008-2013 and the Biodiversity Guidelines produced by Galway County Council."* <u>Natural Heritage & Biodiversity Objectives</u> - **Objective NH 1 Natura 2000 Sites -** "*Protect European Sites that form part of the Natura 2000 network (including Special Protection Areas and Special Areas of Conservation) in accordance with the requirements in the EU Habitats Directive (92/43/EEC), EU Birds Directive (2009/147/EC), the Planning and Development (Amendment) Act 2010, the European Communities (Birds and Natural Habitats) Regulations 2011 (SI No. 477 of 2011) (and any subsequent amendments or updated legislation) and having due regard to the guidance in the Appropriate Assessment Guidelines 2010 (and any updated/superseding guidance). A plan or project (e.g. proposed development) within the Plan Area will only be authorised after the competent authority (Galway County Council) has ascertained, based on scientific evidence and a Habitats Directive Assessment where necessary, that:* *(a) The plan or project will not give rise to significant adverse direct, indirect or secondary effects on the integrity of any European Site (either individually or in combination with other plans or projects); or* *(b) The plan or project will have significant adverse effects on the integrity of any European Site (that does not host a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000; or* *(c) The plan or project will have significant adverse effects on the integrity of any European Site (that hosts a priority natural habitat type and/or a priority species) but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, restricted to reasons of human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest. In this case, it will be a requirement to follow procedures set out in legislation and agree and undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000."* - **Objective NH 2 Protected Habitats and Species** – "*Support the protection of protected habitats and species listed in the annexes to the EU Habitats Directive 1992 (92/43/EEC), the Birds Directive (2009/147/EC) and regularly*	native Invasive Species); **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement); and, **Barrier Effect** (i.e. Box 10 GTS – Barrier Effect)

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	occurring-migratory birds and their habitats, and species that are protected under the Wildlife Acts 1976-2000. This includes the protection of bats and their roosts, and the maintenance of woodland, hedgerows, tree lines, ecological networks and corridors that serve as feeding areas, flight paths and commuting routes for bats.” • **Objective NH 5 Biodiversity & Ecological Networks** – “*Support the protection of biodiversity and ecological connectivity within the Plan area including woodlands, trees, hedgerows, rivers, streams, canals, natural springs, wetlands, stonewalls, fens, blanket bog, heath, rock outcrops, geological and geo-morphological systems, other landscape features and associated wildlife, where these form part of the ecological network.* *(a) Seek to retain and/or incorporate these natural features into developments, in order to avoid ecological fragmentation and maintain ecological corridors and stepping stones.* *(b) Protect and enhance water quality and ecology of the Ballycuirke Canal and the area of River Kip in the Plan area and their function of ecological corridors, by maintaining the existing banks and channels and ensuring that new developments in the Plan area are set back a minimum of 10 metres from the top bank of the watercourses.* (c) *Ensure greater biodiversity through the appropriate planting of native trees, shrubs and hedgerows indigenous to the Maigh Cuilinn area and of Irish provenance in public and private areas and new developments.*” • **Objective NH 7 Environmental Management Area** – “*Ensure that new development proposals on or near the Environmental Management Area that may impact on the Lough Corrib SAC are adequately assessed, undergo environmental and/or Habitats Directive Assessments, including the evaluation of cumulative/in combination effects, and any impacts identified can be avoided, reduced and/or mitigated, as appropriate, in accordance with applicable environmental legislation and policy prior to any consent being given.*” • **Objective NH 11 Screening for Appropriate Assessment** – “*Ensure that all development proposals in the Plan area are subject to an Appropriate Assessment Screening to determine whether they are likely to have a significant direct, indirect or cumulative effect on any European Site in view of its conservation objectives. Where significant effects are likely or uncertain, the Planning Authority may request such information from the applicant as it considers necessary to enable it to carry out „Screening for Appropriate Assessment" and/or Appropriate Assessment as the case may be. See ‘Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities 2000’ (or any superseding document) for guidance on the type of information that may be requested.*”	
	Potential Impact Pathway – Habitat Degradation - Hydrogeology	
	Water Quality Policy • **Objective UI 12 (b) Western River Basin District Management Plan and Protection of Waters** - “*Support the protection of water quality in accordance with the EU Water Framework Directive (2006/60/EC) and the European Communities (Water Policy) Regulations 2003 (SI No. 722 of 2003) and as amended (or any updated legislation), including the implementation of the relevant recommendations and measures as outlined in the Western River Basin District Management Plan 2009-2015, including the Corrib Water Management Unit Action Plan (and any*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	updated/or superseding documents). Development will only be permitted where it can be clearly demonstrated that the proposal would not have an unacceptable impact on the water environment, including surface water, groundwater quality and quantity, river corridors and associated wetlands. Galway County Council is statutorily obliged to protect existing good quality status of waters." • **Objective UI 13 Groundwater & Aquifer** – "*Support the protection of groundwater resources and dependent wildlife/habitats in accordance with the Groundwater Directive 2006/118/EC and the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010) or any updated legislation. Protect the regionally important aquifer to the east of the N59 and the poor aquifer to the west of the N59 that under lays the Plan Area, from risk of environmental pollution and have regard to any groundwater protection schemes and groundwater source protection zones where data has been made available by the Geological Survey of Ireland.*" **<u>Water Quality Development Management Guideline</u>** • **DM Guideline UI 2 Water Bodies and Watercourse** – "*Require all relevant applications, which are located in close proximity to water bodies or watercourses to submit measures to reduce and prevent pollution to the water body/watercourse, both during construction and after completion of the scheme.*" **<u>Natural Heritage & Biodiversity Objectives</u>** • **Objective NH 6 Water Resources** – "*Protect the water resources in the Plan Area, including Ballycuirke Canal and the River Kip that falls within the Plan area, tributaries and downstream water bodies, other rivers, streams, springs, surface waters, and groundwater quality, in accordance with the requirements and guidance in the EU Water Framework Directive 2000 (2000/60/EC), the European Union (Water Policy) Regulations 2003 (as amended) and the Western River Basin Management Plan 2009-2015 (including any superseding versions of same) and other relevant EU Directives including associated national legislation and policy guidance. Support the application and implementation of a catchment planning and management approach to development and conservation, including the implementation of Sustainable Drainage System techniques for new development in the Plan Area.*" • **Objective NH 9 Geological and Geomorphological Systems** – "*Protect and conserve geological and geomorphological systems, sites and features from inappropriate development that would detract from their heritage value and interpretation and ensure that any plan or project affecting karst formations are adequately assessed with regard to their potential geophysical, hydrological, hydro-geological or ecological impacts on the environment.*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathway – Habitat Degradation – Water Quality (Construction/Operation)	
	• **Objective UI 1 Water Services Infrastructure** – "*Support the maintenance, improvement and monitoring of the public water supply, wastewater disposal and surface water drainage infrastructure as necessary to address any deficiencies in infrastructure capacity and/or service the development needs of the town. This will include the following and any other projects approved during the period of the plan:* *(a) Progress and facilitate the delivery of the Galway City Western Environs Water Supply Scheme network upgrade under the Water Services Investment Programme that relates to the Plan Area.* *(b) Any appropriately approved necessary upgrades to the treatment plant.* *(c) Facilitate and provide a surface water drainage network.* *(d) Facilitate the provision of trunk water mains from which a distribution mains can be developed.* *(e) Ensure that all new developments served by the public sewer are constructed with separate surface and foul water sewers in order to assist and optimise the use of the existing collection system and wastewater sewage system.* *(f) Monitor the capacity of the wastewater treatment plant as development takes place.* *(g) Improve and maintain an adequate surface water drainage system throughout the Plan.* (h) *Ensure that trade effluent from new development is managed properly and discharged in accordance with the relevant discharge licences.*" • **Objective UI 2 Water Services for New Developments** – "*Require all new developments to be adequately serviced with water supply, wastewater disposal and surface water drainage in accordance with applicable legislation, standards and guidelines and to submit the necessary documentation with their planning applications to confirm same. Encourage only as much development, both in terms of quantity and type of development that can be provided for based on the utility services available and prohibit any proposed development that cannot be adequately serviced, that would lead to significant environmental effects or that would pose an unacceptable threat to the capacity of water, wastewater or surface water infrastructure in the Plan area.*" • **Objective UI 4 Wastewater Disposal** – "*New developments shall only be permitted where it can be clearly demonstrated that they can be serviced and that there is adequate capacity in the wastewater disposal infrastructure in accordance with applicable requirements and standards, including urban wastewater treatment disposal standards, in order to protect Lough Corrib Special Area of Conservation, other nearby European Sites and their respective qualifying interests.*" • **Objective UI 5 Development Not Connecting to Public Sewer** – "*Restrict development that does not connect to the public sewer and discourage the proliferation of individual septic tanks and treatment plants, in order to protect ground waters, consolidate the village structure and control ribbon development along approach roads into Maigh Cuilinn.*" • **Objective UI 6 Wastewater Treatment Plant Buffer** – "*Provide and protect a 100 metre buffer around the wastewater treatment plant site and protect buffer zones around other treatment plants in the Plan area, as appropriate.*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	- **Objective UI 7 Surface Water Drainage and Sustainable Drainage Systems** – "*Maintain and enhance, as appropriate, the existing surface water drainage system throughout the Plan Area and ensure that new developments are adequately serviced with surface water drainage infrastructure and promote the use of Sustainable Drainage Systems in new developments. Surface water runoff from development sites will be limited to pre-development levels and planning applications for new developments will be required to provide details of surface water drainage and Sustainable Drainage Systems proposals.*" **Flood & Flood Related Objectives** - **Objective UI 10 Water Bodies and Watercourses** – "*Protect water bodies and watercourses within the Plan Area from inappropriate development, including lakes, rivers, canals, streams, associated undeveloped riparian strips, wetlands and natural floodplains. This will include a 10 metre protection buffer from rivers/canal within the Plan Area or adjacent to the Plan Area, as appropriate, measured from the near river/canal bank. Promote the sustainable management and uses of water bodies and avoid culverting or realignment of these features.*" **Water Quality Policy** - **Policy UI 3 Water Quality** - "*It is the policy of Galway County Council to protect and improve water quality in all waters, in conjunction with other agencies and stakeholders in accordance with the EU Water Framework Directive (2006/60/EC), EU Groundwater Directive (2006/118/EC) and other relevant EU Directives, including associated national legislation and policy guidance, (including any superseding versions of same), and to support the implementation of the Western River Basin District Management Plan, including the actions and measures that form part of the Corrib Water Management Unit Action Plan. Galway County Council will take account of the above requirements to protect and improve water quality when considering new development proposals.*" - **Objective UI 12 (b) Western River Basin District Management Plan and Protection of Waters** - "*Support the protection of water quality in accordance with the EU Water Framework Directive (2006/60/EC) and the European Communities (Water Policy) Regulations 2003 (SI No. 722 of 2003) and as amended (or any updated legislation), including the implementation of the relevant recommendations and measures as outlined in the Western River Basin District Management Plan 2009-2015, including the Corrib Water Management Unit Action Plan (and any updated/or superseding documents). Development will only be permitted where it can be clearly demonstrated that the proposal would not have an unacceptable impact on the water environment, including surface water, groundwater quality and quantity, river corridors and associated wetlands. Galway County Council is statutorily obliged to protect existing good quality status of waters.*" **Water Quality Development Management Guideline** - **DM Guideline UI 2 Water Bodies and Watercourse** – "*Require all relevant applications, which are located in close proximity to water bodies or watercourses to submit measures to reduce and prevent pollution to the water body/watercourse, both during construction and after completion of the scheme.*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Surface water Network Development Management Guidelines • **DM Guideline UI 3 Surface Water Network** – "*Require all relevant applications to provide for separate surface and foul water sewers to assist and optimise the use of the existing collection system and the wastewater sewage system.*" **Natural Heritage & Biodiversity Objectives** • **Objective NH 6 Water Resources** – "*Protect the water resources in the Plan Area, including Ballycuirke Canal and the River Kip that falls within the Plan area, tributaries and downstream water bodies, other rivers, streams, springs, surface waters, and groundwater quality, in accordance with the requirements and guidance in the EU Water Framework Directive 2000 (2000/60/EC), the European Union (Water Policy) Regulations 2003 (as amended) and the Western River Basin Management Plan 2009-2015 (including any superseding versions of same) and other relevant EU Directives including associated national legislation and policy guidance. Support the application and implementation of a catchment planning and management approach to development and conservation, including the implementation of Sustainable Drainage System techniques for new development in the Plan Area.*"	
	Potential Impact Pathway – Non-native Invasive Species	
	Natural Heritage & Biodiversity Objectives • **Objective NH 10 Control of Invasive and Alien Species** – "*Seek to promote measures to prevent the spread of invasive and alien invasive species. Require a landscaping plan to be produced for developments near water bodies and ensure that such plans do not include invasive species. Where the potential for spread of invasive species are identified as part of a development proposal the developer will be required to submit an invasive species management plan.*"	
	Potential Impact Pathway – Disturbance/Displacement, Barrier Effect	
	Natural Heritage & Biodiversity Objectives • **Objective NH 13 Protection of Bats and Bat Habitats** – "*Ensure that development proposals in areas recognised as potentially important for bats, including areas of woodland and hedgerows… shall be subject to suitable assessment for potential impacts on bats. This will include an assessment of the cumulative loss of habitat or the impact on bat populations and activity in the area and may include a specific bat survey. Any assessment shall be carried out by a suitably qualified professional and where development is likely to result in significant adverse*	

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	effects on bat populations or activity in the area, development will be prohibited or require mitigation and/or compensatory measures, as appropriate."	
Oranmore Local Area Plan 2012 – 2018	According to the conclusions of its Natura Impact Report (Doherty Environmental, 2012b), the ***Oranmore Local Area Plan 2012-2018* will not have any adverse effects on the SAC Qualifying Interest habitats or species or SPA Special Conservation Interest bird species** via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the implementation of the following objectives and policies (as detailed in the plan): ***Potential Impact Pathways – Habitat Loss, Habitat Degradation – Hydrogeology, Habitat Degradation – Water Quality (Construction/Operation), Habitat Degradation – Non-native Invasive Species, Displacement/Disturbance, Barrier Effect*** • **Policy DS 1 Development Strategy** – "*It is the overarching policy of Galway County Council to support and facilitate the sustainable development of the Plan Area in line with the preferred development strategy option, Option 3 - A Combination of a Future Strategic Development Area with Consolidation of the Town Centre and Surrounding Areas, Informed by Environmental Assessments, which allows Oranmore to develop in a manner, that maintains and enhances the quality of life of local communities, promotes opportunities for economic development, sustainable transport options and social integration, protects the cultural, built, natural heritage and environment and complies with relevant statutory requirements.*" • **Objective DS 3 Natura 2000 Network and Habitats Directive Assessment** – "*Protect Natura 2000 sites, including Special Protection Areas and Special Areas of Conservation, in accordance with the requirements in the EU Habitats Directive 1992 (92/43/EEC), EU Birds Directive 1979 (79/409/EEC), the European Communities (Natural Habitats) Regulations 1997 (S.I. No 94 of 1997), the Planning and Development (Amendment) Act 2010, the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011) (and any subsequent amendments or updated legislation) and having due regard to the guidance in the Appropriate Assessment Guidelines 2010 (and any subsequent or updated guidance). A plan or project (e.g. proposed development) within the Plan Area will only be authorised after the competent authority (Galway County Council) has ascertained, based on scientific knowledge and a Habitats Directive Assessment where necessary, that:* *(a) The plan or project will not give rise to significant adverse direct, indirect or secondary impacts on the integrity of any Natura 2000 site (either individually or in combination with other plans or projects); or* (b) *The plan or project will adversely affect the integrity of any Natura 2000 site but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000.*"	There is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the *Oranmore Local Area Plan 2012-2018*. This is due to the following reasons: • No adverse effects on European Site integrity will arise from the *Oranmore Local Area Plan 2012-2018* alone, due to the policies and objectives outlined in the plan • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* will further more ensure no adverse effects will arise from the implementation of the *Oranmore Local Area Plan 2012-2018* • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Loss** (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) –

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	- **Objective DS 5 Service Led Development** – "*Development under the Plan shall be preceded by sufficient capacity in the public waste water infrastructure.*" - **Objective LU 9 Environmental Management Area -** "*Promote the sustainable use and management of lands with high biodiversity value and/or environmental sensitivity, including flood risk and those with natural heritage designations such as Special Protection Areas and Special Areas of Conservation.*" - **Policy NH 1 Natural Heritage, Landscape and Environment** – "*It is the policy of Galway County Council, to support the conservation and enhancement of natural heritage and biodiversity, including the protection of the integrity of Natura 2000 sites, the protection of Natural Heritage Areas and proposed Natural Heritage Areas and the promotion of the development of a green/ecological network within the Plan Area, in order to support ecological functioning and connectivity, create opportunities in suitable locations for active and passive recreation and to structure and provide visual relief from the built environment. The protection of natural heritage and biodiversity, including Natura 2000 sites, will be implemented in accordance with relevant EU environmental directives and applicable national legislation, policies, plans and guidelines, including the following (and any updated/superseding documents):* *(a) EU Directives, including the Habitats Directive (92/43/EEC), the Birds Directive (2009/147/EC codified version of Directive), the Environmental Impact Assessment Directive (85/337/EEC), the Water Framework Directive (2000/60/EC) and the Strategic Environmental Assessment Directive (2001/42/EC).* *(b) National legislation, including the Wildlife Act 1976, the European Communities (Environmental Impact Assessment) Regulations 1989 (SI No. 349 of 1989) (as amended), the Wildlife (Amendment) Act 2000, the European Union (Water Policy) Regulations 2003 (as amended), the Planning and Development (Amendment) Act 2010 and the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011).* *(c) National policy guidelines, including the Landscape and Landscape Assessment Draft Guidelines 2000, the Environmental Impact Assessment Sub-Threshold Development Guidelines 2003, Strategic Environmental Assessment Guidelines 2004 and the Appropriate Assessment Guidelines 2010.* *(d) Catchment and water resource management plans, including the Western River Basin District Management Plan 2009-2015.* (e) *Biodiversity plans and guidelines, including Actions for Biodiversity 2011-2016: Ireland's National Biodiversity Plan, the Biodiversity Action Plan for County Galway 2008-2013 and the Biodiversity Guidelines produced by Galway County Council.*" - **Objective NH 1 Natura 2000 Sites** – "*Protect Natura 2000 sites, including Special Protection Areas and Special Areas of Conservation, in accordance with the requirements in the EU Habitats Directive 1992 (92/43/EEC), EU Birds Directive 1979 (79/409/EEC), the European Communities (Natural Habitats) Regulations 1997 (S.I. No 94 of 1997), the Planning and Development (Amendment) Act 2010, the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011) (and any subsequent amendments or updated legislation) and having due regard to the guidance in the Appropriate Assessment Guidelines 2010 (and any subsequent or updated guidance). A plan or project (e.g. proposed development) within the Plan Area will only be authorised after the*	Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement); and, **Barrier Effect** (i.e. Box 10 GTS – Barrier Effect)

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	competent authority (Galway County Council) has ascertained, based on scientific knowledge and a Habitats Directive Assessment where necessary, that: *(a) The plan or project will not give rise to significant adverse direct, indirect or secondary impacts on the integrity of any Natura 2000 site (either individually or in combination with other plans or projects); or* *(b) The plan or project will adversely affect the integrity of any Natura 2000 site but there are no alternative solutions and the plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature. In this case, it will be a requirement to undertake all compensatory measures necessary to ensure the protection of the overall coherence of Natura 2000."* • **Objective NH 5 Biodiversity & Ecological Networks** – "*Support the protection of biodiversity and ecological connectivity within the Plan area including woodlands, trees, hedgerows, rivers, streams, natural springs, wetlands, stonewalls, fens, salt marshes, geological and geomorphological systems, other landscape features and associated wildlife, where these form part of the ecological network. Seek to retain and incorporate these natural features into developments, in order to avoid ecological fragmentation and maintain ecological corridors.*" **Specific *Mitigation* Recommendations** • **Objective DS 7 Strategic Reserve** – "*Protect and safeguard the lands within the designated Strategic Reserve Area from any development that would prejudice their potential as a reserve for the future, longer term strategic growth of Oranmore, the County or the Region. Ensure that any future plan or project within the Strategic Reserve that has the potential to result in likely significant effects to the environment and/or Natura 2000 Sites undergo environmental and/or Habitats Directive assessments, including the evaluation of the cumulative/in combination effects. Any future plan or project within the Strategic Reserve Area will be subject to the requirements of The Planning System and Flood Risk Management Guidelines for Planning Authorities 2009, as appropriate.*"	
	Potential Impact Pathways – Habitat Degradation - Hydrogeology	
	• **Objective UI 8 Groundwater & Aquifer** – "*Support the protection of groundwater resources and dependent wildlife/habitats in accordance with the Groundwater Directive 2006/118/EC and the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010) or any updates. Protect the regionally important aquifer that under lays the Plan Area from risk of environmental pollution and have regard to any groundwater protection schemes and groundwater source protection zones where data has been made available by the Geological Survey of Ireland.*" • **Objective UI 4 Development Not Connecting to Public Sewer** – "*Restrict development that does not connect to the public sewer and discourage the proliferation of individual septic tanks and treatment plants, in order to protect groundwaters, consolidate the town structure and control ribbon development along approach roads into Oranmore.*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	• **Objective UI 7 Western River Basin District Management Plan and Protection of Waters** – "*Support the implementation of the relevant recommendations and measures as outlined in the Western River Basin Management Plan 2009-2015 or any other plan that may supersede same during the lifetime of this Local Area Plan. Development shall only be permitted where it can be clearly demonstrated that the proposal would not have an unacceptable impact on the water environment, including surface water, groundwater quality and quantity, river corridors and associated wetlands, estuarine waters and coastal waters*"	
	Potential Impact Pathways –Habitat Degradation – Water Quality (Construction/Operation)	
	• **Policy UI 1 Water Supply, Wastewater And Surface Water Infrastructure** – "*It is the policy of Galway County Council to support the provision and maintenance of adequate wastewater disposal, water supply and surface water drainage infrastructure, in accordance with EU Directives, to service the development of Oranmore. This will include adequate capacity for public wastewater and storm-water sewers as appropriate, an adequate quantity and quality of water supply and the promotion of Sustainable Drainage System approaches and techniques within the Plan Area.*" • **Objective UI 1 Water Supply & Water Conservation** – "*Ensure that new developments are adequately serviced with a suitable quantity and quality of drinking water supply, promote water conservation to reduce the overall level of water loss in the public supply and require that new domestic developments provide for water supply metering.*" • **Objective UI 3 Wastewater Disposal** – "*New developments shall only be permitted where it can be clearly demonstrated that they can be serviced and that there is adequate capacity in the wastewater disposal infrastructure in accordance with applicable requirements and standards, including urban wastewater treatment disposal standards, in order to protect the Galway Bay Complex and its qualifying interests.*" • **Objective UI 7 Western River Basin District Management Plan and Protection of Waters** – "*Support the implementation of the relevant recommendations and measures as outlined in the Western River Basin Management Plan 2009-2015 or any other plan that may supersede same during the lifetime of this Local Area Plan. Development shall only be permitted where it can be clearly demonstrated that the proposal would not have an unacceptable impact on the water environment, including surface water, groundwater quality and quantity, river corridors and associated wetlands, estuarine waters and coastal waters*" • **Objective UI 5 Surface Water Drainage and Sustainable Drainage Systems** – "*Maintain, and enhance as appropriate, the existing surface water drainage system throughout the Plan Area and ensure that new developments are adequately serviced with surface water drainage infrastructure and promote the use of Sustainable Drainage Systems in new developments. Surface water runoff from development sites will be limited to pre-development levels and planning applications for new developments will be required to provide details of surface water drainage and Sustainable Drainage Systems proposals*" • **Policy UI 2 Water Quality** – "*It is the policy of Galway County Council to protect and improve water quality in all waters, in conjunction with other agencies and stakeholders in accordance with the EU Water Framework Directive*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	(2006/60/EC and other relevant EU Directives, including associated national legislation and policy guidance, (including any superseding versions of same), and to support the implementation of the Western River Basin District Management Plan and consider the above when assessing new development proposals.” • **Objective UI 15 Waterbodies and Watercourses** – “*Protect waterbodies and watercourses within the Plan Area from inappropriate development, including rivers, streams, associated undeveloped riparian strips, wetlands and natural floodplains. This will include a 10 metre protection buffer from rivers within the plan area, measured from the near river bank. Promote the sustainable management and uses of waterbodies and avoid culverting or realignment of these features*” • **Objective NH 6 Water Resources** – “*Protect all water resources in the Plan Area, including rivers, streams, springs, surface waters, coastal waters, estuarine waters and groundwater quality, in accordance with the requirements and guidance in the EU Water Framework Directive 2000 (2000/60/EC), the European Union (Water Policy) Regulations 2003 (as amended) and the Western River Basin Management Plan 2009-2015 (including any superseding versions of same). Support the application and implementation of a catchment planning and management approach to development and conservation, including the implementation of Sustainable Drainage System techniques for new development in the Plan Area.*” • **Objective NH 7 Wetlands, Springs, Rivers and Streams** – “*Seek to preserve the wetlands of Oranmore, identify and protect natural springs, streams/rivers, where possible.*”	
	Potential Impact Pathways – Habitat Degradation – Non-native Invasive Species	
	• **Objective NH 12 Control of Invasive and Alien Invasive Species** – “*Seek to prevent and promote measures to prevent the spread of invasive and alien species. Require a landscaping plan to be produced for developments near water bodies and ensure that such plans do not include alien invasive species.*”	
	Potential Impact Pathways – Displacement/Disturbance, Barrier Effect	
	• **Objective NH 2 Protected Habitats and Species** – “*Support the protection of protected habitats and species listed in the annexes to the EU Habitats Directive 1992 (92/43/EEC) and the Birds Directive (2009/147/). This includes the protection of bats and their roosts, and the maintenance of woodland, hedgerows, treelines, ecological networks and corridors which serve as feeding areas, flight paths and community routes for bats.*”	
Tuam Local Area Plan 2011-2017	According to the conclusions of the Appropriate Assessment Screening Statement (EcoFact Environmental Consultants Ltd., 2010) no likely significant effects will arise from the *Tuam Local Area Plan 2011-2017*. Based on this in-combination effects assessment of the GTS, it is considered that the ***Tuam Local Area Plan 2011-2017* will not have any adverse**	There is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the *Tuam*

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	effects on SAC Qualifying Interest habitats or species, or SPA Special Conservation Interest bird species via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the implementation of the following policies and objectives (as detailed in the plan):	*Local Area Plan 2011-2017*. This is due to the following reasons: • No adverse effects on European Site integrity will arise from the *Tuam Local Area Plan 2011-2017* alone, due to the policies and objectives outlined in the plan • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* will further more ensure no adverse effects will arise from the implementation of the *Tuam Local Area Plan 2011-2017* • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Air Quality** (i.e. Box 7 GTS – Habitat Degradation – Air Quality); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); and, **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement)
	Potential Impact Pathways – Habitat Degradation – Hydrogeology, Habitat Degradation – Water Quality (Construction & Operation), Habitat Degradation – Air Quality, Habitat Degradation – Non-native Invasive Species, Disturbance/Displacement	
	Natural Heritage & Biodiversity Policies and Objectives • **Policy NH5** – "*Implement the EU Directives and associated national legislation and directives with regard to the protection and enhancement of the natural environment, including the Birds Directive, Habitats Directive, Wildlife Act, Flora Protection Order, Ramsar Sites ,Water Framework Directive and any other directives, Acts or Policies which may be issued during the lifetime of this plan.*" • **Policy NH14** – "*It is the policy of Galway County Council to implement Article 6(3) of the EU Habitats Directive, and to subject proposed projects likely to impact on Natura 2000 or European Sites (SAC's, SPA's), whether directly (in situ), indirectly (ex-situ) or in combination with other plans or projects, to an Appropriate Assessment/Screening in order to inform decision making.*" • **Objective NH4** – "*Enhance biodiversity richness by protecting all rivers/streams and water bodies within the plan area by reserving riparian zones/ecological corridors, maintaining them free from inappropriate development.*" • **Objective NH5** – "*Ensure a minimum setback of 10 metres is maintained in any new development proposals along the Rivers Nanny/Clare and their tributaries.*" • **Objective NH6** – "*Require screening for Appropriate Assessment and/or Appropriate Assessment with all applications where it is considered that the proposed development may impact (directly or indirectly), or in combination with other projects, on a Natura 2000 designated site i.e. a Special Area of Conservation (SAC) or a Special Protection Area (SPA) to inform decision making.*" • **Objective NH7** – "*Require an ecological assessment by a suitably qualified person, to inform decision making of all proposed significant planning applications, where it is considered that the proposed development may have an adverse impact on the environment or designated site.*" • **Objective NH18** – "*New developments proposals shall be required to conform with relevant regulatory provisions for the prevention of pollution, nuisance or other environmental effects likely to affect the status of the Natura 2000 site.*" **Water Services Policies and Objectives** • **Objective WS6** – "*Ensure that any development that would have an unacceptable impact on the water environment, including drinking water, surface water and groundwater quality and quantity, river corridors and associated wetlands will not be permitted.*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathways – Habitat Degradation – Hydrogeology	
	Natural Heritage & Biodiversity Objective • **Objective NH16** – "*Ensure that proposed developments do not adversely affect groundwater resources.*" **Water Services Objective** • **Objective WS4** – "*Support the protection of groundwater resources and associated habitats and species in accordance with the Groundwater Directive 2006/118/EC and by having regard to any groundwater protection schemes and groundwater protection zones data made available at the Geological Survey of Ireland.*"	
	Potential Impact Pathways – Habitat Degradation – Water Quality (Construction & Operation)	
	Natural Heritage & Biodiversity Objective • **Objective NH15** – "*Implement water protection measures to prevent any deterioration of 'good status' waters, and to restore substandard waters to 'good status'.*" **Water Services Policies** • **Policy WS1** – "*Ensure that the provision of water and wastewater treatment facilities is undertaken in accordance with EU policies and Directives, relevant national legislation and national/regional policies and guidelines and delivered through the Water Services Investment Programme.*" • **Policy WS4** – "*Protect and improve water quality, in conjunction with other agencies and stakeholders, in accordance with the EU Water Framework Directive and the Western River Basin District Management Plan.*"	
	Potential Impact Pathways – Habitat Degradation – Non-native Invasive Species	
	Natural Heritage & Biodiversity Policy • **Policy NH13** – "*Seek to prevent and promote measures to prevent the spread of invasive and alien invasive species. Require a landscaping plan to be produced for developments near water bodies and ensure that such plans do not include alien invasive species.*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathways – Disturbance/Displacement	
	Natural Heritage & Biodiversity Objective - **Objective NH9** – "*Minimise disturbance to wildlife, including fish, birds and bats, by reducing external lighting, and prevent spotlighting of trees, rivers, or other features of ecological significance.*"	
Greenway Projects		
Galway Dublin Greenway and Oranmore to Ballinasloe Cycleway	Based on the level of project information available at present, it is possible that the Galway-Dublin Greenway and the Oranmore-Ballinasloe Cycleway in isolation will have adverse effects on European Site integrity. Construction and operation stages of the Galway-Dublin Greenway and the Oranmore to Ballinasloe Cycleway will have to adhere to policies and objectives described in the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023*. Based on our professional judgement, these specific policies and objectives will ensure that no adverse effects on site integrity will arise from the Galway Dublin Greenway (and more specifically from the Oranmore to Ballinasloe Cycleway) via any of the identified potential impact pathways set out below and outlined in **Table E-1** above (see Section above on *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* for more detail on each policy and objective).	Following on from this strategic level assessment, it is determined that there is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the Galway Dublin Greenway Oranmore to Ballinasloe Cycleway. This is due to the following reasons: - Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* will ensure no adverse effects will arise from the Galway Dublin Greenway Oranmore to Ballinasloe Cycleway. This will include the requirement for any development taking place within the county to undergo Screening for Appropriate Assessment and/or Appropriate Assessment where necessary and in doing so to demonstrate that the project will not give rise to any adverse direct, indirect or secondary effects on the integrity of any European Site. If, despite the implementation of mitigation measures, there remains a risk that the project element will adversely affect the integrity of a European Site via any of the identified potential impact pathways, the project element
	Potential Impact Pathways – Habitat Loss, Habitat Degradation – Hydrogeology, Habitat Degradation – Water Quality (Construction), Non-native Invasive Species	
	Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment; **Objective DS 9** Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment; **Objective DS** 10 Impacts of Development on Protected Sites; **Objective EQ 4** Compliance with Article 6(3) of the EU Habitats Directive; **Policy NHB 1** Natural Heritage and Biodiversity; **Objective NHB 1** Protected Habitats and Species**;** and, **Objective AFF 5** Compliance with the EU Habitats Directive (Galway County Council, 2014a) **Natural Heritage, Recreation and Amenity Aim**; **Natural Heritage, Recreation and Amenity Strategy**; **Policy 4.1** Green Network; **European Designated sites**; **Policy 4.2** Protected Spaces: Sites of European, **National and Local Ecological Importance**; **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.5.1** Community Spaces: Greenways and Public Rights of Way; **Environment and Infrastructure Aim**; **Environment and Infrastructure Strategy**; **Policy 9.3** Flood Risk Assessment; **Policy 9.5** Sustainable Building Design and Construction; **Policy 9.14** Energy and Associated Infrastructure; **Zoning objective for RA**; **Specific Developments Objectives for RA Zones**;	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Specific Development Standard 11.28 Extract Industries/Quarries; **Specific Development Standard 11.31** Natura Impact Assessment (Galway City Council, 2016)	concerned will not be progressed unless that risk is resolved • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Loss** (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); and, **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species) Any projects implemented through the GTS must take into account any other plans and/or projects that may act in-combination with it to affect any European Sites, including any damage to the Site since its designation.
	Potential Impact Pathways – Habitat Degradation – Hydrogeology	
	Objective NHB12 Soil/Ground Water Protection; **Objective WS 1** Protection of Ground Waters; **Objective WS 11** Regionally & Locally Important Aquifers; and, **Policy WS 4** Water Quality (Galway County Council, 2014a) **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22** Water Quality (Galway City Council, 2016)	
	Potential Impact Pathways – Habitat Degradation – Water Quality (Construction)	
	Policy WS 4 Water Quality; **Objective WS 2** EU Policies and Directives; **Objective WW 1** EU Policies and Directives; **Objective WW 6** Adherence to Environmental Standards; **Policy NHB 4**; and, **Objective NHB 3** Water Resources (Galway County Council, 2014a) **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.6.2** Open Spaces: Agricultural Lands; Environment and Infrastructure Strategy; **Policy 9.3** Flood Risk Assessment; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.8** Sustainable Urban Drainage Systems (SUDS); **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22 Water Quality** (Galway City Council, 2016)	
	Potential Impact Pathway – Non-native Invasive Species	
	Policy NHB 7 Invasive Species (Galway County Council, 2014a) **Policy 4.2** Protected Spaces: Sites of European, National and Local Ecological Importance (Galway City Council, 2016)	
Connemara Greenway	Based on the level of project information available at present, it is possible that the Connemara Greenway Clifden to Oughterard Cycleway in isolation will have adverse effects on European Site integrity. Construction and operation stages of the Connemara Greenway Clifden to Oughterard Cycleway will have to adhere to policies and objectives described in the *Galway County Development Plan 2015-2021*. Based on our professional judgement, the specific policies and	Following on from this strategic level assessment, it is determined that there is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
Clifden to Oughterard Cycleway	objectives will ensure that no adverse effects on site integrity will arise from the Connemara Greenway (and more specifically from the Clifden to Oughterard Cycleway) via any of the identified potential impact pathways set out below and outlined in **Table E-1** above (see Section above on *Galway County Development Plan 2015-2021* for more detail on each policy and objective).	and the Connemara Greenway Clifden to Oughterard Cycleway. This is due to the following reasons: • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* will ensure no adverse effects will arise from the Connemara Greenway Clifden to Oughterard Cycleway. This will include the requirement for any development taking place within the county to undergo Screening for Appropriate Assessment and/or Appropriate Assessment where necessary and in doing so to demonstrate that the project will not give rise to any adverse direct, indirect or secondary effects on the integrity of any European Site. If, despite the implementation of mitigation measures, there remains a risk that the project element will adversely affected the integrity of a European Site via any of the identified potential impact pathways, the project element concerned will not be progressed unless that risk is resolved • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Loss** (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments);
	Potential Impact Pathways – Habitat Loss, Habitat Degradation – Water Quality (Construction), Non-native Invasive Species, Disturbance/Displacement	
	Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment; **Objective DS 9** Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment; **Objective DS** 10 Impacts of Development on Protected Sites; **Objective EQ 4** Compliance with Article 6(3) of the EU Habitats Directive; **Policy NHB 1** Natural Heritage and Biodiversity; **Objective NHB 1** Protected Habitats and Species**;** and, **Objective AFF 5** Compliance with the EU Habitats Directive (Galway County Council, 2014a)	
	Potential Impact Pathways – Habitat Degradation – Water Quality (Construction)	
	Policy WS 4 Water Quality; **Objective WS 2** EU Policies and Directives; **Objective WW 1** EU Policies and Directives; **Objective WW 6** Adherence to Environmental Standards; **Policy NHB 4**; and, **Objective NHB 3** Water Resources (Galway County Council, 2014a)	
	Potential Impact Pathway – Non-native Invasive Species	
	Policy NHB 7 Invasive Species (Galway County Council, 2014a)	

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
		Habitat Degradation – Non-native Invasive Species (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); and, **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement) Any projects implemented through the GTS must take into account any other plans and/or projects that may act in-combination with it to affect any European Sites, including any damage to the Site since its designation.
Galway to Spiddal Greenway and Bearna to Spiddal Cycleway	It is possible that the Galway to Spiddal Greenway and the Bearna to Spiddal Cycleway in isolation will have adverse effects on European Site integrity. Construction and operation stages of the Galway to Spiddal Greenway and the Bearna to Spiddal Cycleway will have to adhere to policies and objectives described in the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023.* Based on our professional judgement, the specific policies and objectives will ensure that no adverse effects on site integrity will arise from the Galway to Spiddal Greenway (and more specifically from the Bearna to Spiddal Cycleway) via any of the identified potential impact pathways set out below and outlined in **Table E-1** above (see Section above on *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* for more detail on each policy and objective). ***Potential Impact Pathways – Habitat Degradation – Water Quality (Construction), Non-native Invasive Species, Disturbance/Displacement*** **Objectives DS 6** Natura 2000 Network and Habitats Directive Assessment; **Objective DS 9** Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment; **Objective DS** 10 Impacts of Development on Protected Sites; **Objective EQ 4** Compliance with Article 6(3) of the EU Habitats Directive; **Policy NHB 1** Natural Heritage and Biodiversity; **Objective NHB 1** Protected Habitats and Species**;** and, **Objective AFF 5** Compliance with the EU Habitats Directive (Galway County Council, 2014a) **Natural Heritage, Recreation and Amenity Aim**; **Natural Heritage, Recreation and Amenity Strategy**; **Policy 4.1** Green Network; **European Designated sites**; **Policy 4.2** Protected Spaces: Sites of European, **National and Local Ecological Importance**; **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.5.1** Community Spaces: Greenways and Public Rights of Way; **Environment and Infrastructure Aim**; **Environment and Infrastructure Strategy**; **Policy 9.3** Flood Risk Assessment; **Policy 9.5** Sustainable Building Design and Construction; **Policy 9.14** Energy and Associated Infrastructure; **Zoning objective for RA**; **Specific Developments Objectives for RA Zones**;	Following on from this strategic level assessment, it is determined that there is **<u>no potential for adverse in-combination effects</u>** on European Site integrity to occur as a result of the implementation of the GTS and the Galway to Spiddal Greenway and the Bearna to Spiddal Cycleway. This is due to the following reasons: • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* will ensure no adverse effects will arise from the Galway to Spiddal Greenway and the Bearna to Spiddal Cycleway. This will include the requirement for any development taking place within the county to undergo Screening for Appropriate Assessment and/or Appropriate Assessment where necessary and in doing so to demonstrate that the project will not give rise to any adverse direct, indirect or secondary effects on the integrity of any European Site. If, despite the implementation of mitigation measures, there remains a risk that the project element will adversely affected the integrity of a European Site via any of the identified potential impact pathways, the project element

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Specific Development Standard 11.28 Extract Industries/Quarries; **Specific Development Standard 11.31** Natura Impact Assessment (Galway City Council, 2016) *Potential Impact Pathways – Habitat Degradation – Water Quality (Construction)* **Policy WS 4** Water Quality; **Objective WS 2** EU Policies and Directives; **Objective WW 1** EU Policies and Directives; **Objective WW 6** Adherence to Environmental Standards; **Policy NHB 4**; and, **Objective NHB 3** Water Resources (Galway County Council, 2014a) **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.6.2** Open Spaces: Agricultural Lands; Environment and Infrastructure Strategy; **Policy 9.3** Flood Risk Assessment; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.8** Sustainable Urban Drainage Systems (SUDS); **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22 Water Quality** (Galway City Council, 2016) *Potential Impact Pathway – Non-native Invasive Species* **Policy NHB 7** Invasive Species (Galway County Council, 2014a) **Policy 4.2** Protected Spaces: Sites of European, National and Local Ecological Importance (Galway City Council, 2016)	concerned will not be progressed unless that risk is resolved • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); and, **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement) Any projects implemented through the GTS must take into account any other plans and/or projects that may act in-combination with it to affect any European Sites, including any damage to the Site since its designation.
Road Projects		
M6 Motorway Service Area (Rathmorrissy Interchange)	Based on the level of project information available at present, it is possible that the M6 Motorway Service Area (Rathmorrissy Interchange) in isolation will have adverse effects on European Site integrity. Construction and operation stages of the M6 Motorway Service Area will have to adhere to policies and objectives described in the *Galway County Development Plan 2015-2021*. Based on our professional judgement, the specific policies and objectives will ensure that no adverse effects on site integrity will arise from the M6 Motorway Service Area (Rathmorrissy Interchange) via the identified potential impact pathway set out below and outlined in **Table E-1** above (see Section above on *Galway County Development Plan 2015-2021* for more detail on each policy and objective).	Following on from this strategic level assessment, it is determined that there is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the M6 Motorway Service Area (Rathmorrissy Interchange). This is due to the following reasons:

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathway – Habitat Degradataion – Hydrogeology **Objectives DS 6** Natura 2000 Network and Habitats Directive Assessment; **Objective DS 9** Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment; **Objective DS** 10 Impacts of Development on Protected Sites; **Objective EQ 4** Compliance with Article 6(3) of the EU Habitats Directive; **Policy NHB 1** Natural Heritage and Biodiversity; **Objective NHB 1** Protected Habitats and Species**;** and, **Objective AFF 5** Compliance with the EU Habitats Directive, **Objective NHB12** Soil/Ground Water Protection; **Objective WS 1** Protection of Ground Waters; **Objective WS 11** Regionally & Locally Important Aquifers; and, **Policy WS 4** Water Quality (Galway County Council, 2014a)	• Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* will ensure no adverse effects will arise from the M6 Motorway Service Area (Rathmorrissy Interchange). This will include the requirement for any development taking place within the county to undergo Screening for Appropriate Assessment and/or Appropriate Assessment where necessary and in doing so to demonstrate that the project will not give rise to any adverse direct, indirect or secondary effects on the integrity of any European Site • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR) Any projects implemented through the GTS must take into account any other plans and/or projects that may act in-combination with it to affect any European Sites, including any damage to the Site since its designation.
M17 Galway to Tuam	The following mitigation measures (as outlined in the EIS (PCP, 2007)) will ensure no adverse effects will arise on European Site integrity via the potential impact pathways of Habitat Degradation – Hydrogeology; Habitat Degradation – Water Quality (Construction/Operation); and, Air Quality.	Following on from this strategic-level assessment, it is determined that there is **<u>no potential for adverse in-combination effects</u>** on European Site integrity to occur as a result of the implementation of the GTS and the M17 Galway to Tuam proposed road development. This is due to the following reasons:

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	Potential Impact Pathways –Habitat Loss; Habitat Degradation – Hydrogeology; Habitat Degradation – Water Quality (Construction/Operation); Air Quality; Habitat Degradation – Non-native Invasive Species; Disturbance/Displacement; Barrier Effect, and, Mortality Risk	• No adverse effects on site integrity will arise from the M17 Galway to Tuam proposed road development via the impact pathways Habitat Degradation – Hydrogeology, Habitat Degradation – Water Quality (Construction/Operation) and Air Quality alone, due to the mitigation measures outlined in the NIS • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* will ensure no adverse effects will arise from the M17 Galway to Tuam proposed road development. • It is not possible to state that no adverse effects on European Site integrity will arise from the M17 Galway to Tuam proposed road development in isolation via the potential impact pathways of Habitat Degradation – Invasive Species, Disturbance/Displacement, Barrier Effect and Mortality, however the GTS will not have any adverse effect on the same sites via the same potential impact pathways, and therefore there is no potential for in-combination effects to occur, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Loss** (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality**
	• “… *A combination of traditional piped drainage and a series of sustainable drainage measures. These would regulate flows of road related run-off to achieve discharge rates reflecting existing greenfield run-off. They would also ensure that pollutants associated with the road drainage would be intercepted prior to discharge. Where sections of the drainage would be close to the underlying aquifer they would be sealed or filtered to prevent release of concentrations of the pollutants to the watercourses and groundwater.*” • “*The design of the two open span bridges and other culverts would be in accordance with guidelines published by the NRA and the requirements of the OPW. This would ensure that there would be minimal potential disturbance to the watercourse within the cSAC. The combination of these two approaches would ensure that the value of the watercourses and their fisheries interests would be appropriately safeguarded.*”	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathways –Habitat Degradation – Air Quality	**(Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Air Quality** (i.e. Box 7 GTS – Habitat Degradation – Air Quality); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement); **Barrier Effect** (i.e. Box 10 GTS – Barrier Effect), and **Mortality Risk** (i.e. Box 11 GTS – Mortality Risk). Any projects implemented through the GTS must take into account any other plans and/or projects that may act in-combination with it to affect any European Sites, including any damage to the Site since its designation.
	• "*The relocation of existing traffic on the N1 7 to a new line to the east, would result in a reduction in concentrations of traffic related pollutants along the existing road. There would be a resultant improvement in local air quality for residents close to the road. It would result in potential increases in concentrations of these pollutants where the new motorway would be introduced close to properties currently not associated with such flows of traffic.*"	
N18 Oranmore to Gort	It is considered that the N18 Oranmore to Gort proposed road development will not have any adverse effects on SAC Qualifying Interest habitats or species, or SPA Special Conservation Interest bird species in Co. Galway via any of the identified impact pathways set out below and outlined in Table E-1 above. This is due to the following mitigation measures outlined in the Environmental Impact Statement (McCarthy Hyder Tobin Consulting Engineers, 2006):	There is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the N18 Oranmore to Gort proposed road development. This is due to the following reasons: • No adverse effects on European Site integrity will arise from the N18 Oranmore to Gort proposed road development via any of the identified potential impact pathways alone due to the mitigation measures outlined in the EIS • Adherence to the overarching policies and objectives of the *Galway County Development*
	Potential Impact Pathways – Habitat Degradation – Hydrogeology	
	• "*Pollution control facilities developed as part of the detailed drainage design for the proposed road will entail the construction of attenuation ponds specifically designed to collect surface water run-off from the road and attenuate it. This will then pass through a constructed wetland system at all attenuation ponds before discharging to surface or groundwater, depending on location.*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	• "*A series of surface treatment measures are proposed (interceptors, lined swales and attenuation ponds that will reduce the concentration of contaminants to a minimum, and to a concentration that will not affect the integrity of the sensitive ecological site in the area. These mitigation measures will also temporarily contain any accidental spillages to allow them to be recovered prior to their discharge to the environment. As these mitigation measures will not completely remove contaminants from the runoff, and as an added precaution, all groundwater supplies within 200m of a soakaway have been identified as being at risk. To mitigate these potential impacts, further information will be obtained on the domestic water supplies identified at being at risk of derogation and on the local groundwater regime. If they are still considered to be at risk they will be monitored, or an alternative supply found*"	*Plan 2015-2021* will further more ensure no adverse effects will arise from the implementation of the N18 Oranmore to Gort proposed road development • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments). Any projects implemented through the GTS must take into account any other plans and/or projects that may act in-combination with it to affect any European Sites, including any damage to the Site since its designation.
	Potential Impact Pathway –Habitat Degradation – Water Quality (Construction/Operation)	
	• "*Sustainable Drainage Systems (SuDS) will be used wherever possible, to minimise the environmental impact of the road drainage system.*" • "*Swales (one type of SuDS) are shallow flat grass channels that collect and convey road run off slowly before being discharges to attenuation ponds. Where possible swales will be used to channel surface water run-off. Attenuated ditches, or swales, are linear grassed or vegetated drainage features in which surface water can be stored or conveyed.*" • "*Drainage ponds will be used at each of the outfall locations. These ponds are vegetated depressions formed by the construction of bunds or below the surrounding ground level and incorporate a permanent wetland to facilitate extended retention times. The ponds provide storage to allow flow attenuation, and also improve water quality by extending the pond detention to facilitate the settlement of course silts.*" • "*Petrol/Oil interceptors will be used upstream of each inlet to the location of each outfall upstream of the ponds. Bypass interceptors are used in low risk areas such as roadways and car parks because the majority of containments will be washed from the surface in the early stages of rainfall. Flows up to 1 0% of peak flows are retained in the separation chamber for long enough to promote quiescent conditions, so that lighter than water pollutants such as oils and petrol can rise to the surface of the water. The pollutants are stored in a separator and the separated water discharges from the unit by gravity. If the flow rate rises above 1 0% of peak flows the excess is diverted by a bypass arrangement at the inlet and discharged without passing through the separation chamber. This ensures that peak flows will not cause "wash out" of stored pollutants.*" • "*Best practice during construction will considerably reduce the risk of pollution of receiving watercourses.*"	
N17 Tuam Bypass	According to the conclusions of the Appropriate Assessment Screening (McCarthy Keville O'Sullivan Ltd., 2009), no likely significant effects will arise from the N17 Tuam Bypass. Based on this in-combination effects assessment for the GTS, the mitigation measures (and relevant project information) provided in the AA Screening and the EIR (Ryan Hanley WSP, 2006) will ensure that the N17 Tuam Bypass will not adversely affect site integrity via any of the potential impact pathways set out below and outlined in Table E-1 above.	Following on from this strategic level assessment, it is determined that there is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathway – Habitat Degradation - Hydrogeology	and the N17 Tuam Bypass. This is due to the following reasons: - No adverse effects on European Site integrity will arise via the potential impact pathways of Habitat Degradation – Hydrogeology, Habitat Degradation – Water Quality, Air Quality, Non-native Invasive Species and Disturbance/Displacement from the N17 Tuam Bypass alone due to the mitigation measures, outlined in the Appropriate Assessment Screening and EIR, to be implemented during construction and operation - No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Air Quality** (i.e. Box 7 GTS – Habitat Degradation – Air Quality); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); and, **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement) Any projects implemented through the GTS must take into account any other plans and/or projects that
	- *"All oils, solvents and chemicals used during construction will be stored within temporary bunded areas or specifically designed chemical storage containers. Oil and fuel storage tanks will be stored in designated areas, and these areas will be bunded to a volume of 110% of the capacity of the largest tank/container within the bunded area(s) (plus an allowance of 30 mm for rainwater ingress). Filling and drawoff points will be located entirely within the bunded area(s). Drainage from the bunded area(s) will be diverted for collection and safe disposal."* - *"Where possible refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles, will take place in a designated area of the site, using a drip tray and this area will be away from water courses or excavations where bedrock is exposed or has only a shallow covering of subsoil."* - *"Fuel will be transported in a mobile double skinned tank. Spill kits and hydrocarbon adsorbent packs will be stored along the proposed route. Personnel will be fully trained in the use of this equipment. These measures will ensure that contamination of ground water and surface water does not occur during normal and/or emergency conditions."* - *"All associated hazardous construction waste will be stored within temporary bunded storage areas prior to removal by an appropriate EPA approved waste management contractor. Other construction waste will be disposed of appropriately."* - *"Any surface water run-off collecting in excavations or groundwater ingress to excavations will be pumped from the excavation and treated by use of suitably sized grit chambers and a 3 chamber Class I hydrocarbon interceptor prior to discharge to a holding tank. Once the water is deemed to be uncontaminated with respect to suspended solids and hydrocarbons, it will be discharged at a controlled rate to the surface water courses."* During operation the bedrock aquifer will be protected by overlying substrata. The mitigation measures for soils and geology outlined	
	Potential Impact Pathway - Habitat Degradation – Water Quality (Construction/Operation)	
	Mitigation measures to ensure no negative impacts on water quality during construction: - "*Any potential impacts on water quality are not considered significant due to the contractual obligations on the PPP contractor to adhere to the relevant NRA and CIRIA guidelines and to design and implement an Environmental Operating System (EOP), which will include details of pollution control methods and management of surface runoff. In addition, the NRA's Guidance on the Crossing of Watercourses during the Construction of National Road Schemes states that all works should be agreed and documented in consultation with the Central Fisheries Board (CFB), the relevant Fisheries Board and the National Parks and Wildlife Service (NPWS) in order to safeguard ecological and fisheries interests. The guidelines also state that any works not agreed at the design stage by these and other relevant parties should not be carried out unless there is a written agreement between the relevant statutory body and the contractor. The use of silt traps and lagoons are mentioned as a method of*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	control for site run off. Possible locations of these silt traps for the N17 Tuam Bypass have been identified on the attached drawing number 2077/EIAAS/001. However, it will be the responsibility of the contractor to determine the most appropriate methods of pollution control for the project and agree this with the Western Regional Fisheries Board (WRFB) and NPWS. Based on the objective information available, such as; the distance of the Natura 2000 site from the proposed works; the lack of instream works, the fact that only competent contractor's will be allowed to bid; and the fact that the contractor's method of construction will have to be planned and implemented in accordance with strict contractual requirements with respect to pollution control, it is considered that the risk of a significant effect on the site can be excluded." **Mitigation measures to ensure no negative impacts on water quality during Operation:** • "*...In the operational phase of a road project, the primary source of potential water pollution is surface run-off from the road carriageway, which may carry elevated levels of hydrocarbons and possibly grit. The drainage design for the proposed road development will both attenuate run-off via the use of the drainage system itself and attenuation ponds to greenfield rates and provide treatment via interceptor drains, petrol/oil interceptors and sedimentation in the attenuation ponds. Appropriate vegetation will be planted in the attenuation ponds to provide further treatment. Therefore, the treatment provided via the drainage system will prevent any significant impacts on the River Clare and hence Lough Corrib cSAC.*"	may act in-combination with it to affect any European Sites, including any damage to the Site since its designation.
	Potential Impact Pathway – Air Quality	
	• A satisfactory dust minimisation plan will be implemented during construction to ensure only a slight effect on air quality. • "*Results of the dispersion modelling study indicate that no site-specific mitigation measures are required during the operational phase of the proposed road development. Levels of traffic-derived air pollutants will not exceed the ambient air quality standards either with or without the proposed road development in place. Thus, the impact of the proposed road development in terms of NO2, PM10, PM2.5, CO and benzene is imperceptible.*"	
	Potential Impact Pathway – Non-native Invasive Species	
	• "*Only native species will be used...* "	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathway - Disturbance/Displacement	
	<u>Mitigation measure to ensure no disturbance to species during construction:</u> • "*Any potential impacts during the construction phase on Annex II species using the River Nanny in the vicinity of the proposed road bridge are not likely to be significant due to the temporary nature of the impact, the relatively small area of river to be affected by the works and the lack of any instream works on the River Nanny. As there will be no physical barrier for fish or other aquatic species such as Crayfish, it is unlikely that these species will experience any significant disturbance at this location. Otter is the species most likely to be disturbed by the works as it uses bankside or riparian habitat to rest up. However the highly mobile and crepuscular nature of this species and the fact that they have large home ranges and are largely solitary in nature means that it is likely that individuals rather than entire populations would be affected in any manner. Although an Otter spraint was identified during the field survey, no definite evidence of Otter holts was observed within the vicinity of the proposed road bridge location over the River Nanny; therefore it is highly unlikely that any direct impact would affect this species. Temporary habitat fragmentation may occur. However Otter are a highly mobile, crepuscular species and therefore are unlikely to experience any significant habitat fragmentation as a result of these temporary works. Works to culvert the Ballygaddy Stream will include diversions as per the NRA's Guidance on the Crossing of Watercourses during the Construction of National Road Schemes, in order to allow for the passage of aquatic fauna. Therefore no physical barriers will impede the movement of any aquatic species using this small watercourse. In the operational phase, potential impacts also include disturbance due to noise from traffic and fragmentation of habitat along the River Nanny and other watercourses to be traversed by the proposed road development. Where culverts are to be installed such as at the Ballygaddy Stream, suitable mammal ledges will be provided according to the NRA's Guidance on the Crossing of Watercourses during the Construction of National Road Schemes. Likewise access along the riverbank will be maintained under the bridge to cater for the movement of Otter and other species. As mentioned above, Otter are crepuscular in nature, being active chiefly at dawn and dusk and therefore would not be using the river when noise due to traffic is at its peak. Therefore it is considered that there will not be a significant impact on any Annex II as a result of the operation of the proposed bypass.*"	
N59 Clifden to Maam Cross Proposed Road Development	This scheme has been refused permission by An Bord Pleanala, and therefore, does not have a status at this time. A decision on whether an alternate development proposal will be advanced in the future has not been made at this time. Based on the level of project information available at present, it is possible that the N59 Clifden to Maam Cross Proposed Road Development in isolation will have adverse effects on European Site integrity via the potential impact pathway of habitat loss. Construction and operation stages of the N59 Clifden to Maam Cross Proposed Road Development will have to adhere to policies and objectives described in the *Galway County Development Plan 2015-2021*. Based on our professional judgement, these specific policies and objectives will ensure that no adverse effects on site integrity will arise from the N59 Clifden to Maam Cross Proposed Road Development via the identified potential impact pathways that are in common	Following on from this strategic-level assessment, it is determined that there is **<u>no potential for adverse in-combination effects</u>** on European Site integrity to occur as a result of the implementation of the GTS and the N59 Clifden to Maam Cross Proposed Road Development. This is due to the following reasons:

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	with GTS impact pathways (i.e. Habitat Degradation – Water Quality during construction and operation) (see Section above on *Galway County Development Plan 2015-2021* for more detail on each policy and objective). It should be noted that the original NIS (Galway County Council, 2014b) set out specific mitigation measures to ensure no adverse effects will arise via the potential impact pathways of Habitat Degradation – Water Quality (Construction/Operation). These included implementation of general pollution prevention control measures, an erosion and sediment control plan and principal avoidance measures. ***Potential Impact Pathway - Habitat Degradation – Water Quality (Construction/Operation)*** **Objectives DS 6** Natura 2000 Network and Habitats Directive Assessment; **Objective DS 9** Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment; **Objective DS** 10 Impacts of Development on Protected Sites; **Objective EQ 4** Compliance with Article 6(3) of the EU Habitats Directive; **Policy NHB 1** Natural Heritage and Biodiversity; **Objective NHB 1** Protected Habitats and Species**;** and, **Objective AFF 5** Compliance with the EU Habitats Directive (Galway County Council, 2014a) **Policy WS 4** Water Quality; **Objective WS 2** EU Policies and Directives; **Objective WW 1** EU Policies and Directives; **Objective WW 6** Adherence to Environmental Standards; **Policy NHB 4**; and, **Objective NHB 3** Water Resources (Galway County Council, 2014a)	• Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* will ensure no adverse effects will arise from the N59 Clifden to Maam Cross Proposed Road Development, if it was to be progressed again through the planning process. This will include the requirement for any development taking place within the county to undergo Screening for Appropriate Assessment and/or Appropriate Assessment where necessary and in doing so to demonstrate that the project will not give rise to any adverse direct, indirect or secondary effects on the integrity of any European Site • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Degradation –Water Quality (Construction/Operation)** (i.e. Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments) Any projects implemented through the GTS must take into account any other plans and/or projects that may act in-combination with it to affect any European Sites, including any damage to the Site since its designation.
N59 Maam Cross to Oughterard	According to the conclusions of its Natura Impact Statement (Galway County Council, 2012), the N59 Maam Cross to Oughterard Road Development will not have adverse effects on European Site integrity via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the implementation of the following mitigation measures (as detailed in the NIS):	There is **<u>no potential for adverse in-combination effects</u>** on European Site integrity to occur as a result of the implementation of the GTS and the N59 Maam

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
Proposed Road Development	***Potential Impact Pathways – Habitat Loss; Habitat Degradation – Hydrogeology; Habitat Degradation – Water Quality (Construction/Operation); Habitat Degradation – Non-native Invasive Species; Disturbance/Displacement; and Barrier Effect***	Cross Oughterard Proposed Road Development. This is due to the following reasons: • No adverse effects on European Site integrity will arise from the N59 Maam Cross to Oughterard Proposed Road Development via the impact pathways Habitat Loss, Habitat Degradation – Hydrogeology, Habitat Degradation – Water Quality (Construction/Operation) and Habitat Degradation – Non-native Invasive Species alone, due to the mitigation measures outlined in the NIS • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* will further more ensure no adverse effects will arise from the implementation of the N59 Maam Cross to Oughterard Proposed Road Development • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Loss** (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality
	• "*Lands within Lough Corrib cSAC/SPA will be excluded from proposed borrow sites or potential recovery areas and construction site compounds. Access to these lands will be restricted outside the landtake of the road. To reduce the risk of damage due to trampling, operation of machinery, etc, this area will be fenced off prior to site clearance.*" • "*Prior to any works, all personnel involved with the construction works will receive an on-site induction relating to bridge operations and the environmentally sensitive nature of the proximity of the Natura 2000 site and reemphasise the precautions that are required as well as the mitigation to be implemented. The site agent will ensure that the engineer setting out the works is fully aware of the ecological constraints and mitigation requirements. All matters relating to the bridge operations within the vicinity of the European Sites will be reported on a regular basis to the site agent for on-going review. Any incident or observation of anything that may be considered as causing or likely to cause disturbance or damage to the European Sites will be reported to the site agent immediately. The site agent will take immediate action to prevent or limit the impact and will notify the Client contact of the incident and the actions taken. The amount of bare ground created by excavation and vegetation removal will be minimised to prevent erosion and spread of invasive species. In-stream works will be carried out outside of the salmonid spawning season and the times that early life stages of salmonid fish will be present. In-stream work within the period October to May (inclusive) will only be undertaken with advanced approval of Inland Fisheries Ireland and the NPWS.*" • *"All access scaffolding used within watercourses and all footwear/ waders, etc used within watercourses must be steam cleaned prior to arrival on site to prevent the spread of invasive aquatic species such as Zebra Mussel. A sign off sheet must be maintained to confirm cleaning, Establish site boundary markings to safeguard features of interest/value, Tools and equipment are not to be cleaned in watercourses, Chemicals used shall be stored in sealed containers in the Contractor's vans prior to use, The chemicals shall be applied in such a way as to avoid any spillage or leakage. Any and all excavated material is NOT to be temporarily stored adjacent to watercourses, and Temporary gangways should be erected if required between river banks and working platforms to avoid the need for walking through watercourses."*	
	Potential Impact Pathway – Habitat Degradation – Hydrogeology and Habitat Degradation – Water Quality (Construction/Operation)	
	• *"Fuelling and lubrication will not be conducted within 50m of the watercourses, Storage areas, machinery depots and site offices will be located at least 50m from the watercourses, Foul drainage from the site offices and facilities will be properly treated and removed to a suitable treatment facility, Spill kits will be made available close to streams and all staff will be properly trained on correct use, All fuels, lubricants and hydraulic fluids will be kept in secure*	

Plan or Project	*Potential for Adverse Effects on European Site Integrity Alone?*	*Potential for Adverse Effects on European Site Integrity In-combination?*
	bunded areas at a minimum of 50m from the watercourses. The bunded area will accommodate 110% of the total capacity of the containers within it. Containers will be properly secured to prevent unauthorised access and misuse. An effective spillage procedure will be put in place with all staff properly briefed. Any waste oils or hydraulic fluids will be collected, stored in appropriate containers and disposed of offsite in an appropriate manner, All plant shall be well maintained with any fuel or oil drips attended to on an ongoing basis, and Any minor spillage during this process will be cleaned up immediately. Should any incident occur, the situation will be dealt with and coordinated by the nearest supervisor who will be responsible for instructions by the site agent." • *"Disposal of raw or uncured waste concrete will be controlled to ensure that watercourses or other sensitive areas will not be impacted, Demolition and removal of bridge structures will be undertaken in such way as to prevent any debris falling into the watercourses. A "crash deck" will be provided at each structure to contain the demolition product. At each location the crash deck will be fully boarded out and effectively screened and sealed on all edges to ensure that no demolition products enter the watercourse. Debris will be removed from the crash deck at the end of each working day to avoid the build up of material on the crash deck. The crash decking described above for the removal of the structural deck slabs will be modified to provide retention of the demolition product from the abutment wall partial demolitions. Where existing bridge or culvert structures will need to be demolished and will include in-stream works in order to fully remove the existing structure from the watercourse channel; All waste material resulting from the demolition of the bridge will be removed from the site with no stockpiling near the river channel, Demolition of bridges should occur in two stages with the river being channelled firstly under one side of the bridge and then the other allowing the demolition of the bridge superstructure to occur in the dry, and Inland Fisheries Ireland must be consulted to agree all methods of demolition and construction over watercourses."* • Implementation of a Preliminary Erosion and Sediment Control Plan which will include *"water quality mitigations for avoidance, reduction and remediation of impacts"*. ***Potential Impact Pathway – Habitat Degradation – Non-native Invasive Species*** • Non-native invasive species will be managed following best practice guidelines (including *Guidelines on The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads (NRA, 2008c)*. Physical and/or chemical control measures will be employed (dependent on the invasive species present). The NIR includes specific control measures to be followed for individual invasive species. In the event a non-native invasive species is identified within a European Site, only physical control methods will be adopted.	(Construction) – New Road Developments); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement); and, **Barrier Effect** (i.e. Box 10 GTS – Barrier Effect). Any projects implemented through the GTS must take into account any other plans and/or projects that may act in-combination with it to affect any European Sites, including any damage to the Site since its designation.

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathways – Displacement/Disturbance and Barrier Effect	
	- "*Upgraded water crossings will provide more accessible to otter crossing under the road. Natural riparian vegetation cover will be retained, to ensure that watercourses may continue as contiguous natural habitat for this species.*" - "*Bridge Works at the watercourse should make a 'short-start' to activities to allow salmon and other fish to move away before the full intensity of works begins, and Work will be undertaken during daylight hours, starting no earlier than two hours after dawn and finishing no later than two hours before dusk, between March and October; and to start no earlier than one hour after dawn and finish one hour before dusk from November to February; and shall not continue for periods of more than 12 hours, to prevent disturbance to nocturnal species.*"	
N59 Maigh Cuilinn (Moycullen) Bypass Road Project	According to the conclusions of its Natura Impact Statement (Galway County Council, 2011), the N59 Maigh Cuilinn (Moycullen) Bypass Road Project will not have adverse effects on European Site integrity via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the implementation of the following mitigation measures (as detailed in the NIS):	There is **<u>no potential for adverse in-combination effects</u>** on European Site integrity to occur as a result of the implementation of the GTS and the N59 Maigh Cuilinn (Moycullen) Bypass Road Project. This is due to the following reasons: - No adverse effects on European Site integrity will arise from the N59 Maigh Cuilinn (Moycullen) Bypass Road Project via the impact pathways Habitat Degradation – Hydrogeology and Habitat Degradation – Water Quality (Construction/Operation) alone, due to the mitigation measures outlined in the NIS - Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* will further more ensure no adverse effects will arise from the implementation of the N59 Maigh Cuilinn (Moycullen) Bypass Road Project

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathways – Habitat Degradation – Hydrogeology; Habitat Degradation – Water Quality (Construction/Operation)	• No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: Habitat Loss (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); and, **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments) Any projects implemented through the GTS must take into account any other plans and/or projects that may act in-combination with it to affect any European Sites, including any damage to the Site since its designation.
	• "*Release of suspended solids to all surface waters will be controlled by interception and management of site run-off. Any surface water run-off will be treated appropriately to ensure that suspended solids levels are minimised. Silty water shall be treated using ponds and temporary interceptors and silt traps will be installed until such time as permanent facilities are constructed. Dewatering and surface water runoff discharges from the construction site, including any advance works, during and for the duration of the construction works will be controlled, collected and and routed via appropriate treatment measures. These measures will be in accordance with the CIRIA publication C648, 'Control of Water from Linear Construction Project' (CIRIA, 2006), as a minimum, will be appropriately sized settlement ponds (providing at least 6 hours retention time based on a 0.5m deep pond and for a 1 in 10 year rainfall event), with a double silt curtain at the outfall from the pond and a further double silt fence located between the pond and the discharge point. These facilities will be maintained at least on a daily basis and the maintenance record will be maintained and available for inspection by the Client and other statutory organisations.*" • "*In-addition straw bales or silt fences shall be appropriately located near watercourses to help prevent untreated surface water run-off entering any watercourse. Due to the sensitivity of many of the watercourses, discharges to watercourses shall therefore not exceed 25mg/l of total suspended solids in accordance with the Second Schedule of the European Communities (Quality Of Salmonid Waters) Regulations, 1988 (S.I. No. 293/1988). The outflows from the interceptor facility must be monitored to ensure the water quality complies with the standards and monitoring regimes must be agreed with the NPWS and IFI.*" • "*The works area either side of any watercourse or land drain crossing will be fenced with silt fencing comprising Terram or equivalent geo-textile fencing, secured to the ground to prevent the wash-out of suspended solids from the site to the watercourse. Silt Fence Installation Guidelines are as follows;* *(a) Silt fences are to be constructed on a level contour. Sufficient area should exist behind the fence for ponding to occur without flooding or overtopping the fence,* *(b) Construct silt fences with a setback of at least 900mm from the toe of a slope. Where a silt fence is determined to be not practicable due to specific site conditions, the silt fence may be constructed at the toe of the slope, but should be constructed as far from the toe of the slope as practicable. Silt fences close to the toe of the slope will be less effective and difficult to maintain,* *(c) A trench should be excavated approximately 150mm wide and 150mm deep along the line the proposed silt fence,* *(d) Bottom of the silt fence should be keyed-in a minimum of 300mm,* *(e) Posts should be spaced a maximum of 3.5m apart and driven securely into the ground a minimum of 300mm below the bottom of the trench,*	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	(f) *When standard strength filter fabric is used, a plastic or wire mesh support fence should be fastened securely to the upslope side of posts using heavy–duty wire staples at least 25mm long. The mesh should extend into the trench. When extrastrength filter fabric and closer post spacing are used, the mesh support fence may be eliminated,* (g) *Filter fabric should be purchased in a long roll, then cut to the length of the barrier. When joints are necessary, filter cloth should be spliced together only at a support post, with a minimum 150mm overlap and both ends securely fastened to the post,* (h) *The trench should be backfilled with compacted native material.*" • "*Maintenance of the silt fence is imperative. Repairs must be carried out immediately in the event of damage and collected must be removed and disposed of in material recovery sites on site or at a licensed facility off site.*" • "*All culverts installed will be oversized, as per IFI recommendations, to allow for the retention of the existing riparian features and avoidance of impacts to the bed of the river. Oversized culverts will also allow for the passage of mammals (including otter)*" • "*All instream and riparian works along the minor watercourses crossed by the project will incorporate a silt-trap placed within the watercourse directly downstream of the works. Furthermore, sedi-mats will be placed on the bed of the stream, downstream of the silt trap to provide additional reduction of suspended solids and silt load which may occur during instream/bankside works*" • "*Silty water shall be treated using silt trays/settlement ponds and temporary interceptors and traps will be installed until such time as permanent facilities are constructed. Straw bales or silt fences shall be appropriately located near watercourses to help prevent untreated surface water run-off entering any watercourse*" • "*All fuels, lubricants and hydraulic fluids will be kept in secure bunded areas at a minimum of 50m from watercourses. The bunded area will accommodate 110% of the total capacity of the containers within it. Containers will be properly secured to prevent unauthorised access and misuse. An effective spillage procedure will be put in place with all staff properly briefed. Any waste oils or hydraulic fluids will be collected, stored in appropriate containers and disposed of offsite in an appropriate manner*" • "*Fuelling and lubrication will not be conducted within 50m of watercourse*" • "*Storage areas, machinery depots and site offices will be located at least 50m from the nearest watercourses*" • "*Foul drainage from the site offices and facilities will be properly treated and removed to a suitable treatment facility*" • "*Spill kits will be made available close to streams and all staff will be properly trained on correct use*" • "*Disposal of raw or uncured waste concrete will be controlled to ensure that watercourses or other sensitive areas will not be impacted*" "*The proposed outfall design provides for each of the outfalls to be routed via a hybrid pond/wetland treatment system before final discharge to the receiving environment. Such wetland systems have proved to be the most effective attenuation system for treating road runoff.*"	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
R336 Bearna to Scríb via Ros an Mhíl Road Scheme	Based on the level of project information available at present, it is possible that the R336 Bearna to Scríb via Ros an Mhíl Road Scheme in isolation will have adverse effects on European Site integrity. Construction and operation stages of the R336 Bearna to Scríb via Ros an Mhíl Road Scheme will have to adhere to policies and objectives described in the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023*. Based on our professional judgement, these specific policies and objectives will ensure that no adverse effects on site integrity will arise from the R336 Bearna to Scríb via Ros an Mhíl Road Scheme via any of the identified potential impact pathways set out below and outlined in **Table E-1** above (see Section above on *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* for more detail on each policy and objective).	Following on from this strategic-level assessment, it is determined that there is **<u>no potential for adverse in-combination effects</u>** on European Site integrity to occur as a result of the implementation of the GTS and the R336 Bearna to Scríb via Ros an Mhíl Road Scheme. This is due to the following reasons: • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* will ensure no adverse effects will arise from the R336 Bearna to Scríb via Ros an Mhíl Road Scheme. This will include the requirement for any development taking place within the county to undergo Screening for Appropriate Assessment and/or Appropriate Assessment where necessary and in doing so to demonstrate that the project will not give rise to any adverse direct, indirect or secondary effects on the integrity of any European Site • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR) Any projects implemented through the GTS must take into account any other plans and/or projects that may act in-combination with it to affect any European Sites, including any damage to the Site since its designation.
	Potential Impact Pathway – Habitat Degradation - Hydrogeology	
	Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment; **Objective DS 9** Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment; **Objective DS** 10 Impacts of Development on Protected Sites; **Objective EQ 4** Compliance with Article 6(3) of the EU Habitats Directive; **Policy NHB 1** Natural Heritage and Biodiversity; **Objective NHB 1** Protected Habitats and Species**;** and, **Objective AFF 5** Compliance with the EU Habitats Directive, **Objective NHB12** Soil/Ground Water Protection; **Objective WS 1** Protection of Ground Waters; **Objective WS 11** Regionally & Locally Important Aquifers; and, **Policy WS 4** Water Quality (Galway County Council, 2014a) **Natural Heritage, Recreation and Amenity Aim**; **Natural Heritage, Recreation and Amenity Strategy**; **Policy 4.1** Green Network; **European Designated sites**; **Policy 4.2** Protected Spaces: Sites of European, **National and Local Ecological Importance**; **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.5.1** Community Spaces: Greenways and Public Rights of Way; **Environment and Infrastructure Aim**; **Environment and Infrastructure Strategy**; **Policy 9.3** Flood Risk Assessment; **Policy 9.5** Sustainable Building Design and Construction; **Policy 9.14** Energy and Associated Infrastructure; **Zoning objective for RA**; **Specific Developments Objectives for RA Zones**; **Specific Development Standard 11.28** Extract Industries/Quarries; **Specific Development Standard 11.31** Natura Impact Assessment (Galway City Council, 2016)	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
Coastal Protection Schemes		
Sáilín to Silverstrand Coastal Protection Scheme	Based on the level of project information available at present, it is possible that the Sáilín to Silverstrand Coastal Protection Scheme in isolation will have adverse effects on European Site integrity Construction and operation stages of the Sáilín to Silverstrand Coastal Protection Scheme will have to adhere to policies and objectives described in the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023*. Based on our professional judgement, the specific policies and objectives relating to all other impact pathways in common with GTS (i.e. aside from habitat loss) will ensure that no adverse effects on site integrity will arise from the Sáilín to Silverstrand Coastal Protection Scheme (i.e. Habitat Degradation – Hydrogeology, Habitat Degradation - Water Quality during construction and operation, Non-native Invasive Species, Displacement/Disturbance and Barrier Effect) (see Section above on *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* for more detail on each policy and objective).	Following on from this strategic level assessment, it is determined that there is **<u>no potential for adverse in-combination effects</u>** on European Site integrity to occur as a result of the implementation of the GTS and the Sáilín to Silverstrand Coastal Protection Scheme. Any projects implemented through the GTS must take into account any other plans and/or projects that may act in-combination with it to affect any European Sites. **Habitat Loss** (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement); and, **Barrier Effect** (i.e. Box 10 GTS – Barrier Effect)
	Potential Impact Pathways – Habitat Loss, Habitat Degradation – Hydrogeology, Habitat Degradation – Water Quality (Construction/Operation), Non-native Invasive Species, Displacement/Disturbance, Barrier Effect	
	Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment; **Objective DS 9** Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment; **Objective DS** 10 Impacts of Development on Protected Sites; **Objective EQ 4** Compliance with Article 6(3) of the EU Habitats Directive; **Policy NHB 1** Natural Heritage and Biodiversity; **Objective NHB 1** Protected Habitats and Species**;** and, **Objective AFF 5** Compliance with the EU Habitats Directive (Galway County Council, 2014a) **Natural Heritage, Recreation and Amenity Aim**; **Natural Heritage, Recreation and Amenity Strategy**; **Policy 4.1** Green Network; **European Designated sites**; **Policy 4.2** Protected Spaces: Sites of European, **National and Local Ecological Importance**; **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.5.1** Community Spaces: Greenways and Public Rights of Way; **Environment and Infrastructure Aim**; **Environment and Infrastructure Strategy**; **Policy 9.3** Flood Risk Assessment; **Policy 9.5** Sustainable Building Design and Construction; **Policy 9.14** Energy and Associated Infrastructure; **Zoning objective for RA**; **Specific Developments Objectives for RA Zones**; **Specific Development Standard 11.28** Extract Industries/Quarries; **Specific Development Standard 11.31** Natura Impact Assessment (Galway City Council, 2016)	
	Potential Impact Pathways – Habitat Degradation - Hydrogeology	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Objective NHB12 Soil/Ground Water Protection; **Objective WS 1** Protection of Ground Waters; **Objective WS 11** Regionally & Locally Important Aquifers; and, **Policy WS 4** Water Quality (Galway County Council, 2014a) **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22** Water Quality (Galway City Council, 2016)	Any projects implemented through the GTS must take into account any other plans and/or projects that may act in-combination with it to affect any European Sites, including any damage to the Site since its designation.
	Potential Impact Pathway – Habitat Degradation – Water Quality (Construction/Operation)	
	Policy WS 4 Water Quality; **Objective WS 2** EU Policies and Directives; **Objective WW 1** EU Policies and Directives; **Objective WW 6** Adherence to Environmental Standards; **Policy NHB 4**; and, **Objective NHB 3** Water Resources (Galway County Council, 2014a) **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.6.2** Open Spaces: Agricultural Lands; Environment and Infrastructure Strategy; **Policy 9.3** Flood Risk Assessment; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.8** Sustainable Urban Drainage Systems (SUDS); **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22 Water Quality** (Galway City Council, 2016)	
	Potential Impact Pathway – Non-native Invasive Species	
	Policy NHB 7 Invasive Species (Galway County Council, 2014a) **Policy 4.2** Protected Spaces: Sites of European, National and Local Ecological Importance (Galway City Council, 2016)	
	Potential Impact Pathway – Displacement/disturbance, Barrier Effect	
	Objective NHB 2 Biodiversity and Ecological Networks; and, **Objective NHB 6** Protection of Bats and Bats Habitats (Galway County Council, 2014a) **Policy 4.2** Protected Spaces: Sites of European, National and Local Ecological Importance; and, **Policy 4.3** Blue Spaces: Coast, Canals and Waterways (Galway City Council, 2016)	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
Salthill Coastal Protection Works (Blackrock to Galway Golf Club)	Based on the level of project information available at present, it is possible that the Salthill Coastal Protection Works (Blackrock to Galway Golf Club) in isolation will have adverse effects on European Site integrity, or other works along the coastline here may have had in the past through habitat loss. Any works will have to adhere to policies and objectives described in the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023*. Based on our professional judgement, the specific policies and objectives will ensure that no adverse effects on site integrity will arise from any coastal protection works here in the future via any of the identified potential impact pathways in common with the GTS, as set out below and outlined in **Table E-1** above (see Section above on *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* for more detail on each policy and objective).	Following on from this strategic level assessment, it is determined that there is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the Salthill Coastal Protection Works (Blackrock to Galway Golf Club) or in relation to any past works here which may have affected Galway Bay Complex SAC and Inner Galway Bay SPA. Any projects implemented through the GTS must take into account any other plans and/or projects that may act in-combination with it to affect any European Sites, including any damage to the Site since its designation. **Habitat Loss** (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments); **Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); **Disturbance/Displacement** (i.e. Box 9 GTS –
	Potential Impact Pathways – Habitat Loss, Habitat Degradation – Hydrogeology, Habitat Degradation – Water Quality (Construction/Operation), Non-native Invasive Species, Displacement/Disturbance, Barrier Effect	
	Objectives DS 6 Natura 2000 Network and Habitats Directive Assessment; **Objective DS 9** Projects/Associated Improvement Works/Infrastructure and Appropriate Assessment; **Objective DS** 10 Impacts of Development on Protected Sites; **Objective EQ 4** Compliance with Article 6(3) of the EU Habitats Directive; **Policy NHB 1** Natural Heritage and Biodiversity; **Objective NHB 1** Protected Habitats and Species**;** and, **Objective AFF 5** Compliance with the EU Habitats Directive (Galway County Council, 2014a) **Natural Heritage, Recreation and Amenity Aim**; **Natural Heritage, Recreation and Amenity Strategy**; **Policy 4.1** Green Network; **European Designated sites**; **Policy 4.2** Protected Spaces: Sites of European, **National and Local Ecological Importance**; **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.5.1** Community Spaces: Greenways and Public Rights of Way; **Environment and Infrastructure Aim**; **Environment and Infrastructure Strategy**; **Policy 9.3** Flood Risk Assessment; **Policy 9.5** Sustainable Building Design and Construction; **Policy 9.14** Energy and Associated Infrastructure; **Zoning objective for RA**; **Specific Developments Objectives for RA Zones**; **Specific Development Standard 11.28** Extract Industries/Quarries; **Specific Development Standard 11.31** Natura Impact Assessment (Galway City Council, 2016)	
	Potential Impact Pathways – Habitat Degradation - Hydrogeology	
	Objective NHB12 Soil/Ground Water Protection; **Objective WS 1** Protection of Ground Waters; **Objective WS 11** Regionally & Locally Important Aquifers; and, **Policy WS 4** Water Quality (Galway County Council, 2014a) **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22** Water Quality (Galway City Council, 2016)	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathway – Habitat Degradation – Water Quality (Construction/Operation)	Disturbance/Displacement); and, **Barrier Effect** (i.e. Box 10 GTS – Barrier Effect)
	Policy WS 4 Water Quality; **Objective WS 2** EU Policies and Directives; **Objective WW 1** EU Policies and Directives; **Objective WW 6** Adherence to Environmental Standards; **Policy NHB 4**; and, **Objective NHB 3** Water Resources (Galway County Council, 2014a) **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.6.2** Open Spaces: Agricultural Lands; Environment and Infrastructure Strategy; **Policy 9.3** Flood Risk Assessment; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.8** Sustainable Urban Drainage Systems (SUDS); **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22 Water Quality** (Galway City Council, 2016)	
	Potential Impact Pathway – Non-native Invasive Species	
	Policy NHB 7 Invasive Species (Galway County Council, 2014a) **Policy 4.2** Protected Spaces: Sites of European, National and Local Ecological Importance (Galway City Council, 2016)	
	Potential Impact Pathway – Displacement/disturbance, Barrier Effect	
	Objective NHB 2 Biodiversity and Ecological Networks (Galway County Council, 2014a) **Policy 4.2** Protected Spaces: Sites of European, National and Local Ecological Importance; and, **Policy 4.3** Blue Spaces: Coast, Canals and Waterways (Galway City Council, 2016)	
Other Infrastructure Projects		
Proposed Galway Harbour Port Extension	According to the conclusions of its Natura Impact Statement (Galway Harbour Company, 2013), the Proposed Galway Harbour Port Extension will have adverse effects on the integrity of Galway Bay Complex SAC, Inner Galway Bay SPA, Lough Corrib SAC and Lough Corrib SPA via the identified impact pathways of Habitat Loss, Displacement/Disturbance (on birds, Otter and Harbour seal) and Barrier effect (on birds). The following mitigation measures (as outlined in the NIS) will ensure no adverse effects will arise via the potential impact pathways of Habitat Degradation – Hydrogeology; Habitat Degradation – Water Quality (Construction/Operation); Habitat Degradation – Non-native Invasive Species; and, Displacement/Disturbance (excluding other Annex II species):	There is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of the GTS and the Proposed Galway Harbour Port Extension. This is due to the following reasons:

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathways – Habitat Loss, Habitat Degradation – Hydrogeology, Habitat Degradation – Water Quality (Construction/Operation), Non-native Invasive Species, Displacement/Disturbance, Barrier Effect	- Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* will further more ensure that this project will comply with the requirements of Article 6(4) of the Habitats Directive (including the provision of compensatory measures) - Despite the fact that the Proposed Galway Harbour Port Extension will have adverse effects on Galway Bay Complex SAC, Inner Galway Bay SPA, Lough Corrib SAC and Lough Corrib SPA via the potential impact pathways of Habitat Loss, Displacement/Disturbance and Barrier Effect, the GTS will not have any adverse effects on these European Sites via the same potential impact pathways due to the mitigation measures outlined in Section 3.2 of this report. There is therefore no potential for in-combination effects to occur. **Habitat Loss** (i.e. Box 1a GTS - Habitat Loss: Cycle Network Greenways; Box 1b GTS – Habitat Loss: Public Transport Network and Non-greenway Cycle Network, and Pedestrian Network; and, Box 1c GTS – Habitat Loss: N6 GCRR); **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments);
	Mitigation by Design - The layout and footprint of the proposed development has evolved over the course of the design processes with a view to minimising the impact on Natura 2000 sites and their qualifying interests. - Rock built sea walls on the eastern side will more than replace existing rock walls to be lost. - The use of textured construction material to enhance settlement by algae and invertebrates.	
	Potential Impact Pathway – Habitat Degradation – Water Quality (Construction/Operation)	
	Mitigation by Design - Storm water treated using control valves on outfall lines with petrol interceptor and silt traps. **Construction Methods and Timing** - The proposed use of geotextiles to minimise escape of silt during construction of lagoons will ensure minimised impact on water quality and associated impacts on qualifying interests of Natura 2000 sites. - Monitoring of suspended solids and dissolved oxygen as part of Environmental Management Plan. - Restricting dredging of sediments within 800m of the mouth of Lough Atalia during ebb tides to avoid the possibility of suspended sediments entering Lough Atalia. - Implementation of Best Practice construction methods and Environmental Management Framework (see Appendix 4.2 of the EIS). - Implementation of Emergency Spill Contingency Plan in the form of Galway Harbour Company's Oil Spill Contingency Plan (see Appendix 4.3 of the EIS). **Mitigation Measures during Operation:** - Water Pollution and Increased Risk of Spillage when Operational - This new system will divert storm water to petrol interceptors fitted with silt traps prior to its discharge to sea. In the event of an oil or other spill entering the storm water system, the discharge of contaminated water will be prevented by the use of control valves. A detailed spill response plan has been prepared. This will limit the negative effects of any spills. In addition, Galway Harbour Company GHC has an Environmental Management policy to ensure that there are no spillages to the sea. - Disposing of Maintenance Dredge Material - Spoil from maintenance dredging will be disposed of to an EPA permitted site located outside Natura 2000 sites.	

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathway – Non-native Invasive Species **Mitigation by Design** • Native species to be used as part of landscaping plan. • Sensitive lighting plan to avoid lighting of water body. ***Potential Impact Pathway – Displacement/disturbance, Barrier Effect*** **Mitigation by Design** • Semi-vertical breakwaters have been proposed to mitigate seal predation on salmonids. **Construction Methods and Timing** • Limit timing of works in line with sensitive months for salmon avoiding April – July inclusive. **Monitoring Programmes** • Marine Mammal Watch Plan including marine observers prior to blasting and use of acoustic deterrent devices if required. • Monitoring of birds and common seal populations prior to, during and after construction as part of the environmental management plan. **Mitigation Measures during Operation:** • Lighting - Mitigation for impacts of lighting during the operational phase has been provided through the use of energy efficient lighting in a configuration designed to provide the minimum lighting level required for safety. The lights used will be of a design that casts light downwards only and the lamp standards will be positioned in such a way that only the newly reclaimed land or new breakwater will be illuminated, not any areas of water. • Predation of Fish by Seals - The design of the proposal with steel sheet pile to act as a toe for the rock armour will create a steep drop into the water and thus mitigate against the possibility of seal haul out areas being created in this area (mitigation by design). • Regulation of vessel speeds - Commercial vessels approach Black Head at ca 12 knots and by the Outer Margaretta Buoy, have reduced this to 6 knots. Pilot transfer takes place at 3.5 /4 knots and vessels enter the docks at a velocity of ca 3 knots.	**Habitat Degradation – Non-native Invasive Species** (i.e. Box 8 GTS – Habitat Degradation – Non-native Invasive Species); **Disturbance/Displacement** (i.e. Box 9 GTS – Disturbance/Displacement); and, **Barrier Effect** (i.e. Box 10 GTS – Barrier Effect). Any projects implemented through the GTS must take into account any other plans and/or projects that may act in-combination with it to affect any European Sites, including any damage to the Site since its designation.
Water supply schemes	It is considered that ***water supply schemes*** **will not have any adverse effects on SAC Qualifying Interest habitats or species, or SPA Special Conservation Interest bird species** via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the fact that any water supply scheme developments located within Co. Galway	Following on from this strategic level assessment, it has been determined that there is **no potential for adverse in-combination effects** on European Site

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	will have to adhere to the following policies and objectives of the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* (as detailed in each plan): ***Potential Impact Pathway – Habitat Degradation – Hydrogeology*** **Objective NHB12** Soil/Ground Water Protection; **Objective WS 1** Protection of Ground Waters; **Objective WS 11** Regionally & Locally Important Aquifers; and, **Policy WS 4** Water Quality (Galway County Council, 2014a) **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22** Water Quality (Galway City Council, 2016) ***Potential Impact Pathway - Habitat Degradation – Water Quality (Construction/Operation)*** **Policy WS 4** Water Quality; **Objective WS 2** EU Policies and Directives; **Objective WW 1** EU Policies and Directives; **Objective WW 6** Adherence to Environmental Standards; **Policy NHB 4**; and, **Objective NHB 3** Water Resources (Galway County Council, 2014a) **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.6.2** Open Spaces: Agricultural Lands; Environment and Infrastructure Strategy; **Policy 9.3** Flood Risk Assessment; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.8** Sustainable Urban Drainage Systems (SUDS); **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22 Water Quality** (Galway City Council, 2016)	integrity to occur as a result of any water supply schemes. This is due to the following reasons: • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* will ensure no adverse effects will occur from any water supply schemes alone. This will include the requirement for any development taking place within the county to undergo Screening for Appropriate Assessment and/or Appropriate Assessment where necessary and in doing so to demonstrate that the project will not give rise to any adverse direct, indirect or secondary effects on the integrity of any European Site • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); and, **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments)
Wastewater Treatment Works	It is considered that ***wastewater treatment works* will not have any adverse effects on SAC Qualifying Interest habitats or species, or SPA Special Conservation Interest bird species** via any of the identified impact pathways set out below and outlined in **Table E-1** above. This is due to the fact that any wastewater treatment developments located within Co. Galway will have to adhere to the following policies and objectives of the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* (as detailed in each plan):	Following on from this strategic level assessment, it has been determined that there is **no potential for adverse in-combination effects** on European Site integrity to occur as a result of the implementation of

Plan or Project	***Potential for Adverse Effects on European Site Integrity Alone?***	***Potential for Adverse Effects on European Site Integrity In-combination?***
	Potential Impact Pathway – Habitat Degradation – Hydrogeology	the GTS and the wastewater treatment works. This is due to the following reasons: • Adherence to the overarching policies and objectives of the *Galway County Development Plan 2015-2021* and the *Galway City Council Draft Development Plan 2017-2023* will ensure no adverse effects will occur from any wastewater treatment development alone. This will include the requirement for any development taking place within the county to undergo Screening for Appropriate Assessment and/or Appropriate Assessment where necessary and in doing so to demonstrate that the project will not give rise to any adverse direct, indirect or secondary effects on the integrity of any European Site • No adverse effects on European Site integrity will arise from the GTS, due to the following mitigation measures outlined in Section 3.2 of this report for: **Habitat Degradation – Hydrogeology** (i.e. Box 2a GTS – Hydrogeology General and Box 2b GTS – Hydrogeology N6 GCRR); and, **Habitat Degradation – Water Quality (Construction/Operation)** (i.e. Box 4 GTS – Habitat Degradation - Water Quality (Construction), Box 5a GTS – Habitat Degradation – Water Quality (Construction) – Park & Ride Facilities; and, Box 5b GTS – Habitat Degradation – Water Quality (Construction) – New Road Developments) Any projects implemented through the GTS must take into account any other plans and/or projects that may act in-combination with it to affect any European Sites, including any damage to the Site since its designation.
	Objective NHB12 Soil/Ground Water Protection; **Objective WS 1** Protection of Ground Waters; **Objective WS 11** Regionally & Locally Important Aquifers; and, **Policy WS 4** Water Quality (Galway County Council, 2014a) **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22** Water Quality (Galway City Council, 2016)	
	Potential Impact Pathway - Habitat Degradation – Water Quality (Construction/Operation)	
	Policy WS 4 Water Quality; **Objective WS 2** EU Policies and Directives; **Objective WW 1** EU Policies and Directives; **Objective WW 6** Adherence to Environmental Standards; **Policy NHB 4**; and, **Objective NHB 3** Water Resources (Galway County Council, 2014a) **Policy 4.3** Blue Spaces: Coast, Canals and Waterways; **Policy 4.6.2** Open Spaces: Agricultural Lands; Environment and Infrastructure Strategy; **Policy 9.3** Flood Risk Assessment; **Policy 9.6** Water Quality; **Policy 9.7** Water Services; **Policy 9.8** Sustainable Urban Drainage Systems (SUDS); **Policy 9.12** Waste Management; and, **Specific Development Standard 11.22 Water Quality** (Galway City Council, 2016)	

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Appendix F

N6 Galway City Ring Road

Lackagh Tunnel Report

Galway County Council

N6 Galway City Ring Road

Lackagh Tunnel Report

GCOB-4.03_03_4.13

Issue 3 | 31 August 2016

This report takes into account the particular
instructions and requirements of our client.
It is not intended for and should not be relied
upon by any third party and no responsibility
is undertaken to any third party.

Job number 233985.00

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Document Verification

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Job title	N6 Galway City Ring Road	**Job number**	233985.00
Document title	Lackagh Tunnel Report	**File reference**	
Document ref	GCOB-4.03_03_4.13		

Revision	**Date**	**Filename**	GCOB_4.03_03_4.13_Lackagh Tunnel Report_I1 .docx		
Issue 1	3 Jun 2016	**Description**	Issue 1		
			Prepared by	Checked by	Approved by
		Name	Les Brown, Juli Crowley, Marie Fleming, Sean Ross & Paul Sweeney	Patrick Casey, Sean Mason, & Mary Hurley	Eileen McCarthy
		Signature			
Issue 2	8 June 2016	**Filename**	GCOB_4.03_03_4.13_Lackagh Tunnel Report_I2 .docx		
		Description	Issue 2		
			Prepared by	Checked by	Approved by
		Name	Les Brown, Juli Crowley, Marie Fleming, Sean Ross & Paul Sweeney	Patrick Casey, Sean Mason, & Mary Hurley	Eileen McCarthy
		Signature	LBrown Juli Crowley Marie Fleming Sean Ross	Sean Mason Mary Hurley	Eileen McCarthy.
Issue 3	31 Aug 2016	**Filename**	GCOB_4.03_03_4.13_Lackagh Tunnel Report_I3.docx		
		Description	Issue 3 - After peer review (Matt Sykes 07/07/16)		
			Prepared by	Checked by	Approved by
		Name	Les Brown, Juli Crowley & Paul Sweeney	Mary Hurley & Matt Sykes (Director UK Tunnels Arup)	Eileen McCarthy
		Signature	LBrown Juli Crowley	Mary Hurley	Eileen McCarthy.
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			

Issue Document Verification with Document ✓

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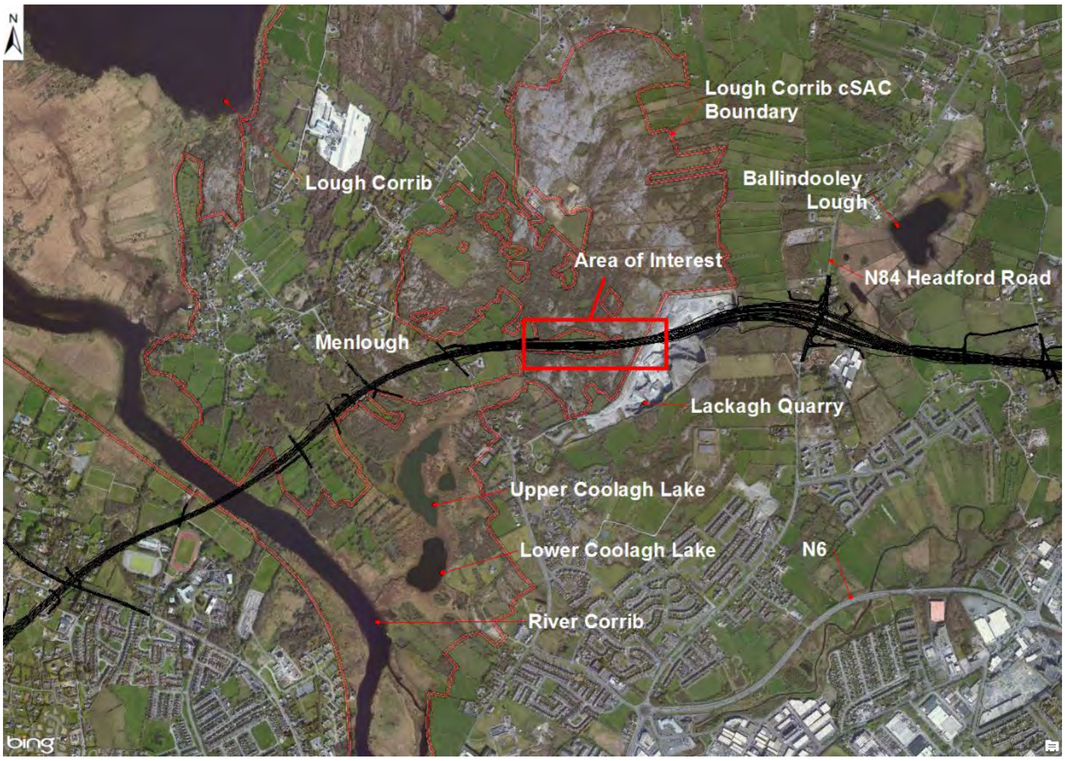
1 Introduction

As part of the N6 Galway City Transport Project, hereafter referred to as the N6 Galway City Ring Road (GCRR) or proposed road development, ground investigations (GI) were undertaken to inform the design and construction of the proposed road development in the vicinity of Lackagh Quarry situated in the north east of Galway City. A section of the N6 GCRR, the Lackagh Tunnel, will pass through this inactive quarry and underneath the Lough Corrib candidate Special Area of Conservation (cSAC) including Qualifying Interest (QI) priority Annex I habitats (Limestone pavement [*8240] and Calcareous grassland [*6210/6210]). The western approach to Lackagh Tunnel is also surrounded by Annex I habitat, located within the Lough Corrib cSAC and between Coolagh Lakes and Ballindooley Lough.

Figure 1.1: Overview of area of interest



The purpose of this report is to appraise the hydrogeological and geotechnical aspects of the design and construction of Lackagh Tunnel and its approaches and to describe the potential impacts to the Annex I habitat, namely Limestone pavement and the groundwater catchment areas within this area. It is acknowledged that there may be other potential environmental impacts, but these are not assessed in this report, as the focus of this report is an assessment of the issues which may have potential to impact on the Annex I habitat in this area. The area of interest is presented in **Figure 1.1**. In addition, this report outlines potential construction approaches to manage these challenges.

Chapter 2 of this report describes the proposed works associated with Lackagh Tunnel. **Chapter 3** includes background information on the hydrogeology and geology of the area. **Chapter 4** outlines the construction methodology, **Chapter 5**

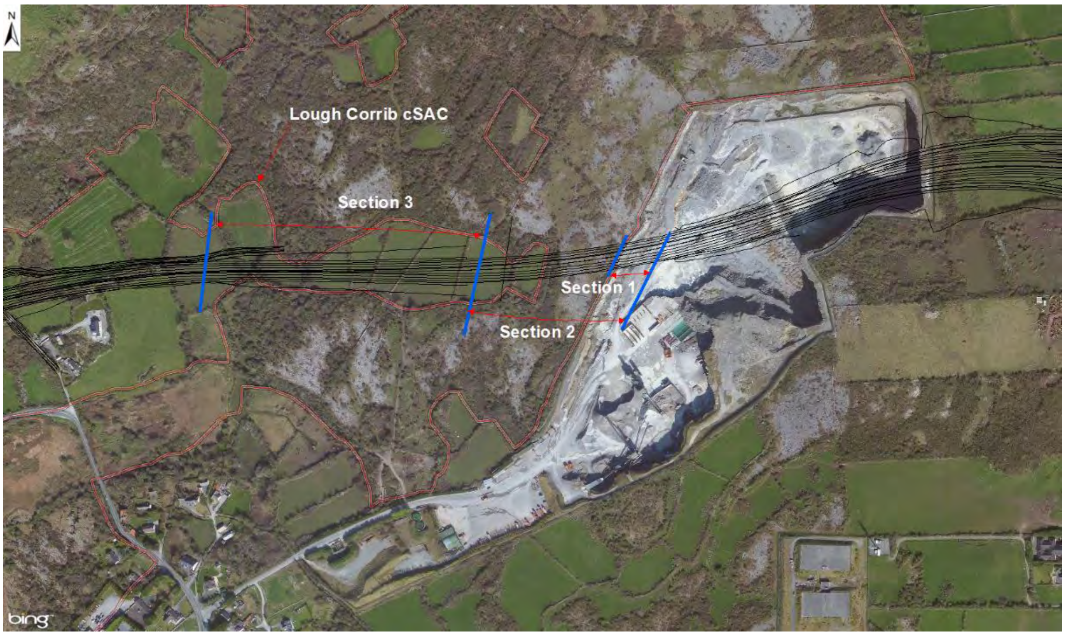
presents the hydrogeological appraisal and **Chapter 6** the geotechnical appraisal of the proposed works. A combined hydrogeological and geotechnical appraisal is outlined in **Chapter 7** and **Chapter 8** summarises the report findings.

This report describes:

- The local hydrogeology along the proposed alignment of the N6 GCRR from the crossing of River Corrib to the N84 Headford Road
- The soils and geology of Lackagh Quarry and an area extending approximately 1km west of Lackagh Quarry
- The envisaged construction sequence of the proposed works
- The potential hydrogeological and geological impact from the proposed road development
- The potential construction and operation risks to the Limestone pavement
- Required mitigation measures

For the purpose of this report the assessment is split into three areas, namely Section 1 (Lackagh Quarry Face), Section 2 (Lackagh Tunnel) and Section 3 (Western Approach), hereafter referred to as Sections 1, 2 and 3 and are shown in **Figure 1.2** below. Note, Section 1 is encompassed in Section 2 as it includes the tunnel enabling works.

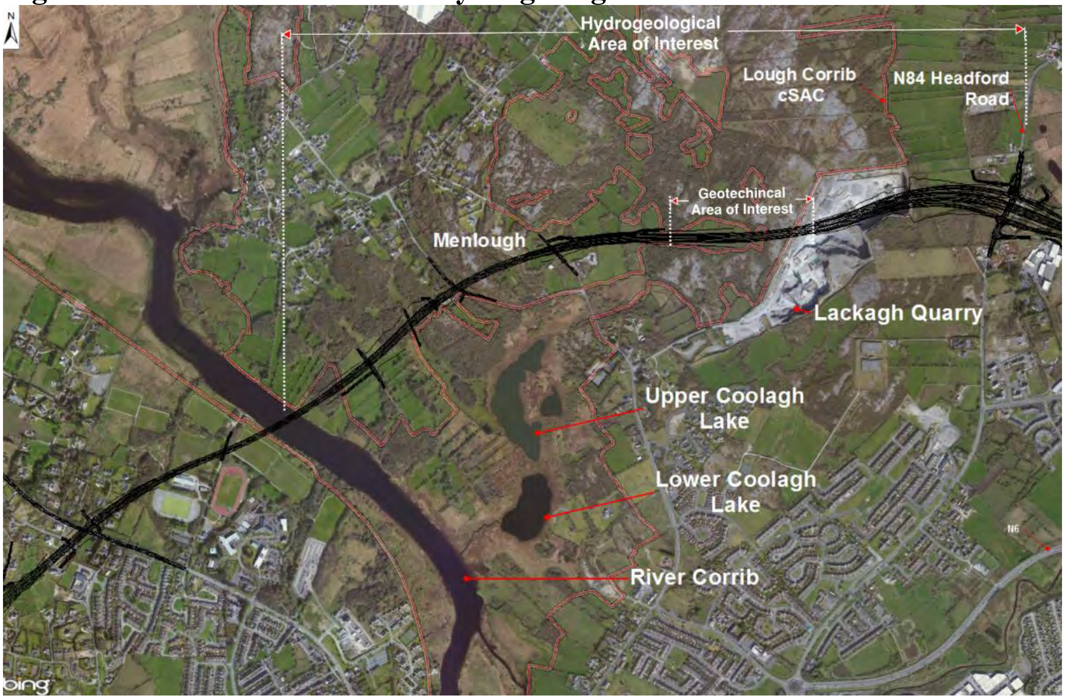
Figure 1.2: Aerial view of the area of interest



2 Proposed works

The proposed works assessed in this report comprise of the construction of Lackagh Tunnel and the area considered is shown in **Figure 2.1** below. Whilst the geotechnical appraisal of Lackagh Tunnel concentrates on the area of interest in Sections 1, 2 and 3, the hydrogeological appraisal assesses the groundwater catchment area encompassing Lackagh Tunnel, extending from the River Corrib to the N84 Headford Road.

Figure 2.1: Geotechnical and hydrogeological areas of interest



The proposed N6 GCRR alignment within the groundwater catchment area comprises (from east to west):

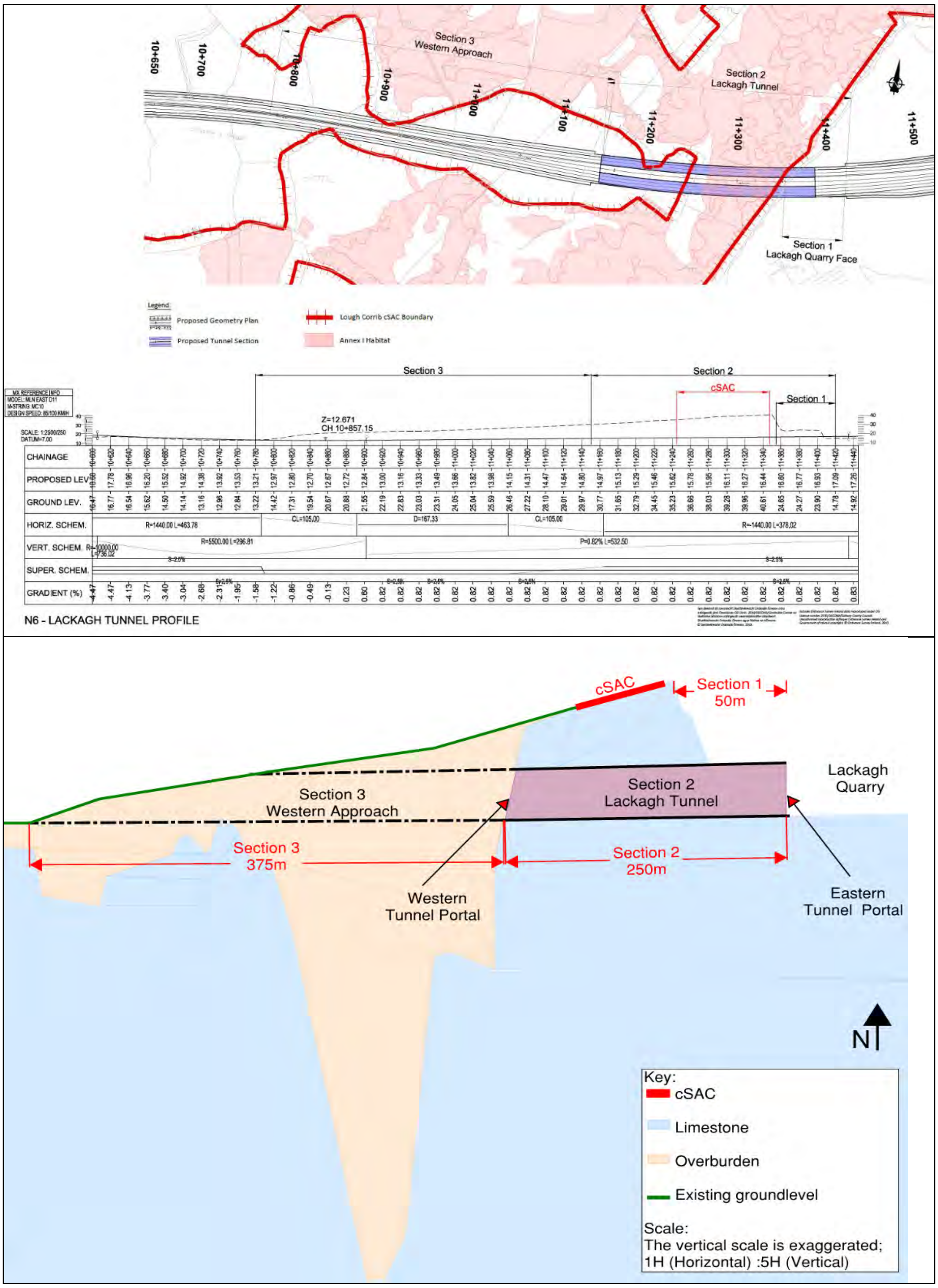
- A bridge over the N84 Headford Road
- A cutting to enter Lackagh Quarry
- An embankment through the quarry
- A twin tunnel under the Lough Corrib cSAC (Section 2), approximately 250m in length
- A cutting on exiting the tunnel
- An embankment to cross Sean Bothar and Bóthar Nua at Menlough
- Between Menlough and the River Corrib the proposed road is elevated comprising of:
  - A viaduct over Limestone pavement at Menlough;
  - Two sections of embankment over the surrounding low-lying ground; and
  - A bridge over the River Corrib.

The geotechnical area of interest comprises Lackagh Quarry rock face, the twin tunnel and the cutting on exiting the tunnel, extending from chainages (Ch.) 10+775 to 11+400 at the time of writing this report, refer to **Table 2.1** and **Figure 2.2**. Section 1 concentrates on the stabilisation of Lackagh Quarry western rock face. Section 2 focuses on Lackagh Tunnel. There is a cross over between Sections 1 and 2 as the tunnel extends into Lackagh Quarry. On exiting Lackagh Tunnel at the western end, the proposed road development remains in close proximity to the QI Annex I habitat, and the appraisal for Section 3 discusses suitable retaining systems that can be employed so that this receptor will not be impacted.

Table 2.1: Section Summary

Section	Chainage		Approximate Section Length	Proposed finished road level (range in mOD)	
	From	To		Minimum	Maximum
1	11 +350	11 +400	50	+16.5	+17.0
2	11 +150	11 +400	250	+14.8	+17.0
3	10 +775	11 +150	375	+12.7	+14.8

Figure 2.2: Plan, profile and schematic cross section of Sections 1- 3



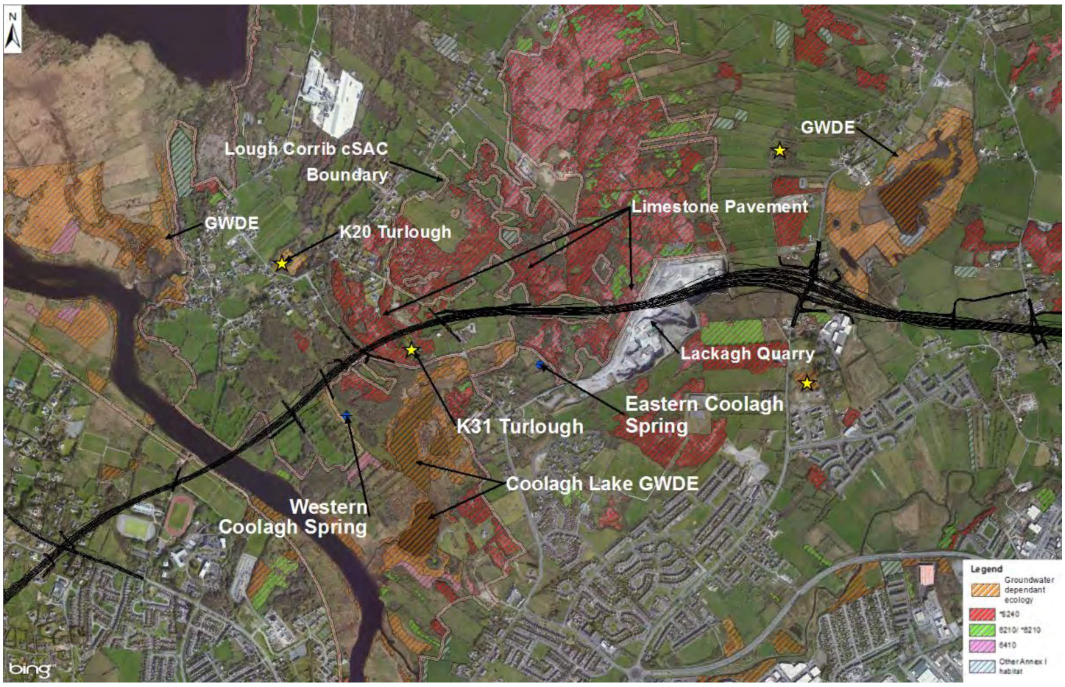
3 Background

3.1 Lough Corrib cSAC and QI Annex I habitats

There are a number of QI Annex I habitats in the Lough Corrib cSAC along and adjacent to the proposed road development in the vicinity of Lackagh Tunnel and its western approach (Refer to **Figure 1.1**). Habitats that have the potential to be affected by environmental impacts include ecology that is dependent on groundwater (Groundwater Dependent Ecology – GWDE) as well as flora and fauna associated with those habitats (refer to **Figure 3.1**). GWDE within the Lough Corrib cSAC are located at Coolagh Lakes which lie to the south of the proposed road development between Lackagh Quarry and the River Corrib. There are two Turloughs [*3180] adjacent to this section of the proposed road at Menlough which are GWDE priority Annex 1 habitat outside of the Lough Corrib cSAC. There is one main area of Limestone pavement within the Lough Corrib cSAC, which extends north and west from Lackagh Quarry (refer to **Figure 2.1**). Associated with this are also areas of Calcareous grassland both of the priority and non-priority Annex I variants. There is a second area of Limestone pavement at Menlough that is outside of the Lough Corrib cSAC.

GWDE and Limestone pavement are sensitive to changes in hydrogeology but are dependent on different aspects of the water environment. Whilst, GWDE is dependent on the groundwater table and its interaction with surface water, Limestone pavement habitat is dependent on exposed, free draining and unsaturated limestone with clints and grykes.

Figure 3.1: Groundwater dependent habitat and Limestone pavement habitat adjacent to Lackagh Quarry



3.1.1 Coolagh Lakes

Coolagh Lakes comprise of an upper and lower lake that are perennial with a 70cm seasonal fluctuation in water level. Coolagh Lakes also includes a smaller third lake but in this report the third lake is included as part of the upper lake. The combined area of the lakes ranges from 0.08km^2 (2.2km perimeter) in the summer to 0.22km^2 (3.5km perimeter) in the winter.

The lakes themselves correspond with the QI Annex I habitat type Hard water lakes [3140] which support a wetland habitat mosaic including the QI priority Annex I habitat Cladium fen [*7210] and the QI Annex I habitat Alkaline fen [7230].

The upper lake receives flow from the Western Coolagh Spring and Eastern Coolagh Spring, with the Western Coolagh Spring being the main inflow (Refer **Figure 3.1** for location of springs). The flow rate from the Western Coolagh Spring has been estimated to range from 0 to 100 l/s with the flow being greatest in the winter and flow ceasing during the summer. Flow from the Eastern Coolagh Spring has remained too low to measure throughout the year (estimated flow <1l/s) and is considered to be a minor groundwater inflow to Coolagh Lakes.

Water level instrumentation was installed at Coolagh Lakes in July 2015 to record the seasonal water levels between the upper and lower lake as well as springs. In September 2015 the surface water instrumentation was supplemented with monitoring of groundwater levels from monitoring boreholes in the area. These data sources indicate that the groundwater contribution to the lake water is mainly during the autumn, winter and spring and that the groundwater input to the lakes ceases during the summer months. During the summer, the water level in the lakes lowers to the level in the River Corrib. During the winter months the lake levels rise and remain slightly higher than the River Corrib.

3.1.2 Turloughs

Two turloughs were identified in the Menlough area, with both being located outside of the Lough Corrib cSAC (Refer to **Figure 3.1**). Turlough K31 lies adjacent to the proposed road development and turlough K20 is located just to the north of Menlough Village. The winter flooding of the turloughs is due to the seasonal groundwater rise.

Although outside of the Lough Corrib cSAC, turloughs are priority Annex I habitats and sensitive to hydrogeological impacts.

3.1.3 Limestone pavement

Limestone pavement is not groundwater dependent *per se* as the terrain forms above the water table in the unsaturated zone of the aquifer. However, the pavement does form part of the recharge pathway from rainfall to groundwater and as such the habitat is susceptible to different impacts to those impacts affecting groundwater dependent ecosystems which are dependent on groundwater level. Limestone pavement habitat is mainly dependent on climate and the free draining nature of the aquifer.

Limestone pavement is unsaturated and formation of the pavement clints and grykes are water worn by a combination of chemical and physical weathering by recharge over time. Rainfall is mildly corrosive to limestone and hence weathering is enhanced over other rock types. Where a soil is present then the rainfall can be further enhanced by humic acids to become more aggressive to limestone.

There are multiple areas of Limestone pavement in the region with two main areas adjacent to the proposed road development, these are at Menlough (Bothar Nua) and immediately west of Lackagh Quarry (**refer to Figure 3.1**).

Potential hydrogeological risk to the Limestone pavement comes from changes to the shallow pathways in the unsaturated zone of the aquifer or from reduction in recharge draining to ground.

3.2 Existing hydrogeological environment

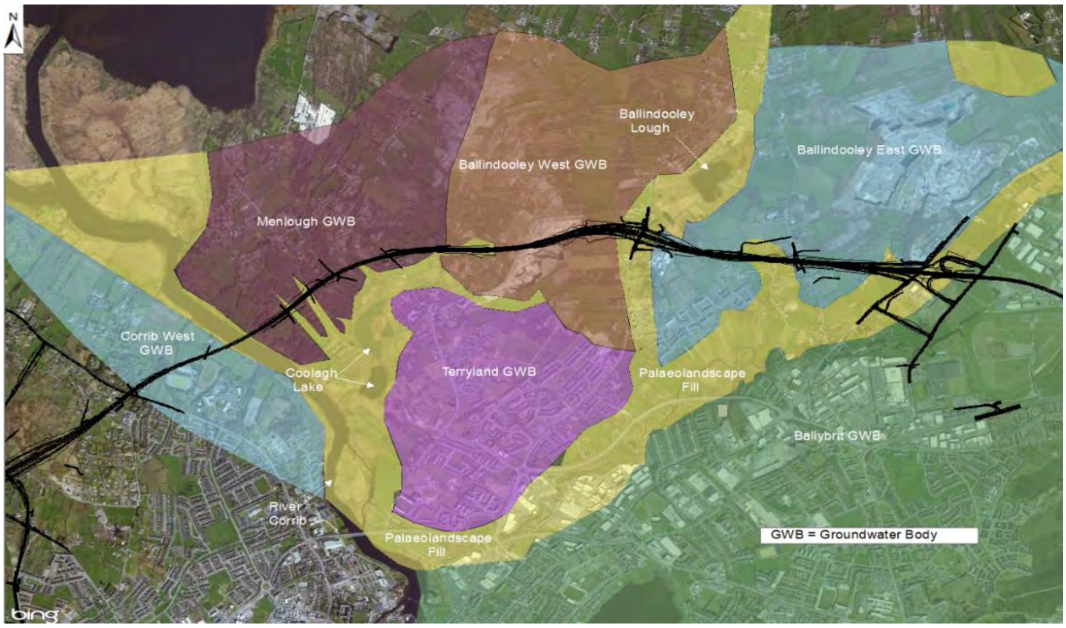
3.2.1 Introduction

The karst survey undertaken for the constraints study for N6 GCTP included a site walkover including Coolough, Menlough and Lackagh Quarry. The survey identified several karst features in the area including the Western and Eastern Coolagh Springs, as well as two turloughs in Menlough (K20 and K31). The ground in the area is almost entirely limestone, but in a number of areas there is no rock outcrop and thick clayey soils and subsoils dominate. This includes areas at Terryland, where the Terryland River flows along a wide flat valley floor of clayey subsoils and at Coolough where the lakes lie on a wide flat low lying area with clayey soils and subsoils.

As part of the ground investigation (GI), undertaken for the proposed road development, these areas with clay subsoils have been examined by ground investigations including geophysics (resistivity) surveying and borehole drilling. In a number of these areas, such as the western approach to Lackagh Tunnel, these clayey areas have been proven to be deep buried landscape features that have been in filled by sediment deposition. These palaeolandscapes can be particularly deep, with the feature at the western approach to Lackagh Tunnel particularly so having a depth of 104.95m deep (to -78.69mOD) being a steep sided enclosed depression or karst doline. Adjacent features at Lackagh Quarry have been proven by geophysics to be greater than 30m deep (to>-20mOD) and are also considered to be palaeolandscape features.

These deep palaeolandscape features and their clay dominated fills separate the hydrogeology of the area into a number of limestone blocks that form groundwater bodies, refer to **Figure 3.2**. These features also alter the recharge characteristics with all effective rainfall on the limestone areas recharging to ground and all effective rainfall on valley fill running off to surface water.

Figure 3.2: Groundwater bodies in the Coolagh Lakes and Ballindooley area



3.2.2 Groundwater data collection

Groundwater level data has been gathered from a number of monitoring boreholes in the area of Lackagh Quarry and Coolagh lakes. These include monitoring boreholes as shown in **Figure 3.3**, **Figure 3.5** and **Table 3.1**.

Figure 3.3: Groundwater and surface water monitoring locations

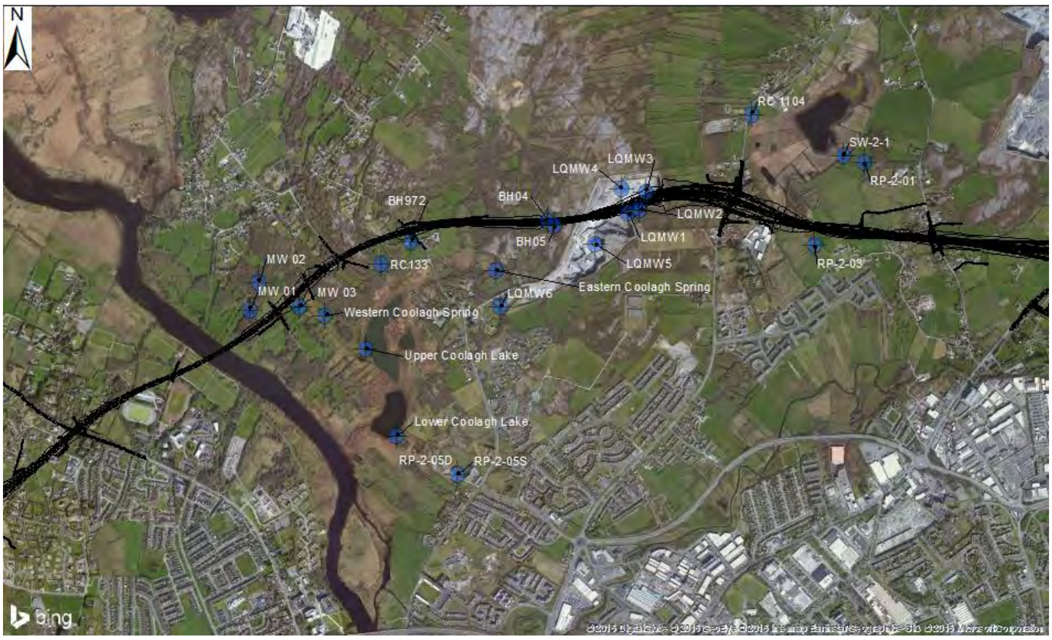
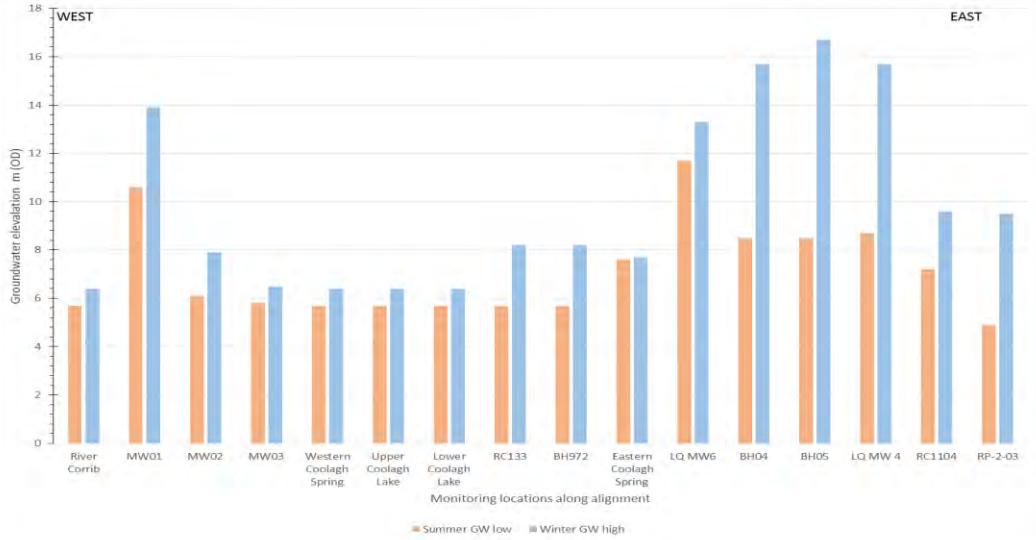


Table 3.1: Surface water and Groundwater data recorded in monitoring wells (2015-2016)



Menlough Groundwater Catchment

Monitoring Location	Ground Elevation (mOD)	Summer GW low (mOD)	Winter GW high (mOD)	Seasonal change (m)
Upper Coolagh Lake	-	+5.7	+6.4	0.7
Lower Coolagh Lake	-	+5.7	+6.4	0.7
Western Coolagh Spring	-	+5.7	+6.4	0.7
Eastern Coolagh Spring	-	+7.6	+7.7	0.1
RP-2-05S	+20.2	+8.8	+12.7	3.9
RP-2-05D	+20.0	+6.1	+8.4	2.3
MW01	+16.1	+10.6	+13.9	3.3
MW02	+13.4	+6.1	+7.9	1.8
MW03	+6.7	+5.8	+6.5	0.7
BH972	+12.3	+5.7	+8.2	2.5
RC133	+11.7	+5.7	+8.2	2.5
LQ MW6	+15.4	+11.7	+13.3	1.6

Ballindooley West Groundwater Catchment

Monitoring Location	Ground Elevation (mOD)	Summer low (mOD)	Winter high (mOD)	Seasonal change (m)
BH04	+32.2	+8.5	+15.7	7.2
BH05	+34.1	+8.5	+16.7	8.2
LQ MW 4 (1, 2 and 3 near identical)	+16.8	+8.7	+15.7	7.0
RC1104	+9.6	+7.2	+9.6	2.4
RP-2-03	+22.4	+4.9	+9.5	4.6
LQ MW5[Note 2}	+25.4	+10.7	+19.4	8.7

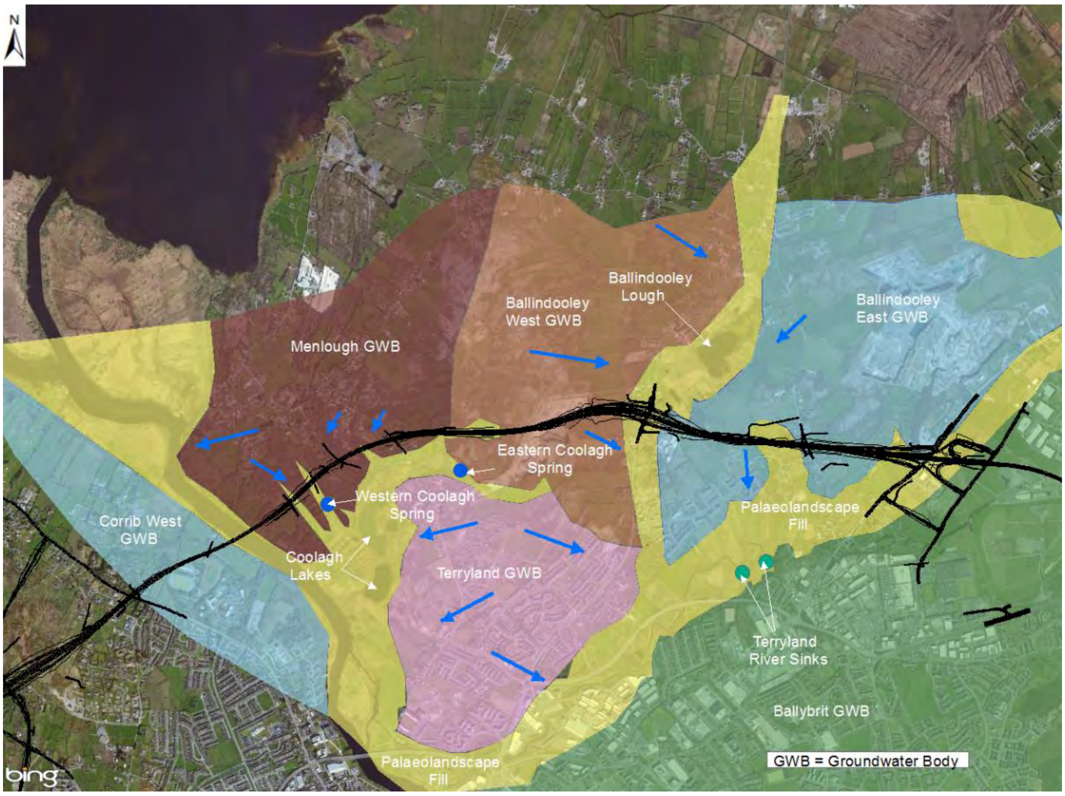
[Note 1]: The groundwater level data plotted in the chart only includes the data from wells along the proposed road alignment. Additional wells are included within the above table which are not plotted.

[Note 2]: Monitoring well LQ MW5 was installed by the operators of Lackagh Quarry in 2006, as part of a hydrogeological study as part of planning conditions. It is the only well of the Lackagh Quarry monitoring wells to intersect with the clay wayboard and as such the response zone is mixed between both the main aquifer and the perched groundwater table but representative of neither. In this regard the data from LQ MW5 is presented in this report for completeness but discounted for use as a representative water level.

3.2.3 Interpretation of groundwater data

The groundwater levels shown in **Table 3.1** indicate a groundwater divide between Lackagh Quarry and Coolagh lakes, with the watershed located near monitoring well BH05. On the basis of this divide then groundwater at Lackagh Quarry will drain south-eastwards away from Coolagh Lakes and groundwater near Menlough will drain south-westwards towards Coolagh Lakes **(Figure 3.4)**. On this basis Lackagh Quarry is in a separate groundwater catchment to Coolagh Lakes.

Figure 3.4: Groundwater bodies with arrows showing direction of groundwater flow



The limestone aquifer is classified as being a regionally important karst aquifer by the GSI based upon the high number of high yielding wells in the formation but also due to the low density of ditches and streams locally. The higher conductivities represent where test boreholes have intersected fractures and the lower conductivities represent where test boreholes encountered few or narrow discontinuities.

Based on the groundwater level data, the regional groundwater regime discharges to the Coolagh Lakes, the River Corrib, and Galway Bay (refer to **Figure 3.4)**. There are divides that split the groundwater into a number of bodies. In the area of

Lackagh Quarry the aquifer is divided into the Menlough groundwater body (GWB), which drains to Coolagh Lakes and the Ballindooley West GWB, which drains south-eastwards. Groundwater in the Ballindooley West GWB and Ballindooley East GWB likely drains through the aquifer southwards at depth towards the Terryland River sinks and from there to Galway Bay.

Of note is that the divide between Menlough GWB and Ballindooley West GWB is a groundwater ridge that extends through the current road alignment of the proposed road development at the western approach to Lackagh Tunnel. The buried palaeolandscape feature located below the western approach is part of the groundwater divide.

3.3 Existing geotechnical environment

3.3.1 General

Lackagh Tunnel is located within an area of Lower Carboniferous Limestone. Rockhead level of the limestone generally exists quite close to ground level with large areas of limestone bedrock outcrops. The ground investigation demonstrated that the depth to bedrock varies from surface outcrop to 104.95m below ground level (mbgl) within the study area. Where bedrock is not exposed at ground level it is generally overlain with topsoil, glacial till (sandy gravelly CLAY) and silt deposits where rock is at depth.

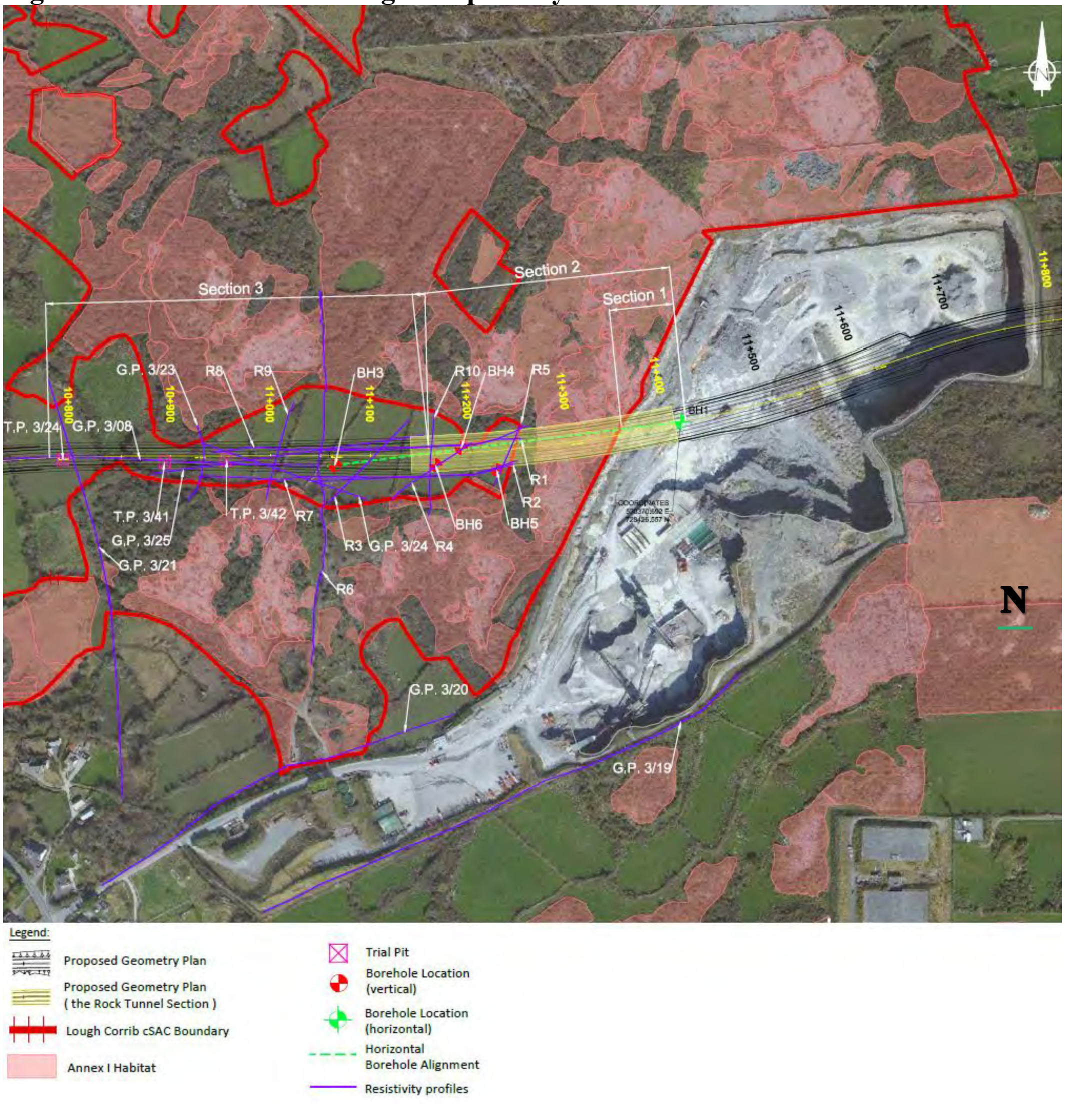
3.3.2 Site specific ground investigation

A site specific ground investigation (GI) was undertaken in 2015 and 2016 to understand the ground conditions at Lackagh Tunnel comprising:

- Desk study and site walkover
- One horizontal borehole in Section 1 and Section 2
- Four vertical boreholes in Sections 2 and 3
- Geophysical Survey (surface and downhole)

A plan layout of the ground investigation is presented in **Figure 3.5**, outlining each survey location with the exception of the microgravity geophysical survey stations (118 stations across Sections 1, 2 and 3). During the ground investigation factual data was recorded and is included in **Appendix A**.

Figure 3.5 Ground investigation plan layout



In total five boreholes (BH1, 3, 4, 5 and 6), were drilled both in Lackagh Quarry and in the adjacent fields west of the quarry (Refer to **Table 3.2** and **Figure 3.5**. One horizontal rotary core borehole (BH1) (**Figure 3.6**), was drilled at an inclination of ~12° off horizontal, through the western quarry face, at the location of the proposed eastern tunnel portal and four vertical rotary core boreholes were drilled in the fields adjacent to the quarry on the west, above the proposed tunnel alignment.

Figure 3.6: BH01 Horizontal borehole at the eastern tunnel portal

Table 3.2: Summary of Lackagh Tunnel borehole data.

Name	Type	End Depth / Horizontal Length	Depth at which limestone rock was encountered
BH01 (Sections 1 and 2)	Horizontal rotary corehole (61mm triple barrel HQ [3HQ]) along the length of the alignment for a length of 300m with an incline of 12° to the horizontal, includes rock core recovery and discontinuity logs	278m from quarry face	Immediately
BH03 (Section 3)	Vertical rotary corehole (82mm 3PQ), tricone open hole drilling from 85m	109.9mbgl (-83.6mOD)	104.95.5mbgl (-78.692mOD)
BH04 (Section 2)	Vertical rotary corehole (82mm 3PQ)	35mbgl (-2.8mOD)	4mbgl (+28.2mOD)
BH05 (Section 2)	Vertical rotary corehole (82mm 3PQ)	50mbgl (-15.9mOD)	0.4mbgl (+33.7mOD)
BH06 (Section 3)	Vertical rotary corehole (82mm 3PQ)	45mbgl (-14.2mOD)	Not encountered

Lab testing of the recovered soil samples and rock core was completed in order to attain parameters to aid in tunnel design. In-situ hydrogeological testing was also carried out in two of the four vertical boreholes.

Geophysics in the form of microgravity was carried out at Lackagh Quarry. Electrical resistivity tomography (ERT) and seismic refraction was carried out in the agricultural fields adjacent to the quarry. Details of geophysics survey is presented below in **Table 3.3** below.

Table 3.3: Summary of the geophysical survey data.

Location	Type of GI	Details	Date
Section 1, 2 and 3, along the upper bench of Lackagh Quarry and within the 3 fields immediately to the west of the quarry	Microgravity Survey	118 stations along the centre line and 15m either side of the proposed alignment and on the upper bench	27 October – 3 November 2015
ERT 1-5 located in Sections 2 and 3 in fields to west of quarry	Electrical Resistivity Tomography (ERT)	682m's of line, depth range 25-30m	27 October – 3 November 2015
ERT 6, Section 3, perpendicular to the proposed alignment (North to South)	Electrical Resistivity Tomography (ERT)	381m's of line, depth range 50-60m	25 November 2015
ERT 7-10, Sections 2 and 3, along and perpendicular the proposed alignment	Electrical Resistivity Tomography (ERT)	834m's of line, depth range of 25-50m	13 – 15 January 2015
G.P. 3/23 – G.P. 3/25, Section 3	Electrical Resistivity Tomography (ERT) and Seismic Refraction	540m's of line, depth range 25-30m	March – April 2016
G.P. 3/19, 3/20 and 3/21. East of Lackagh Quarry and west of the study area (completed as part of the hydrogeology survey)	Electrical Resistivity Tomography (ERT) and Seismic Refraction	1365m's of line, depth range 15 -30m	March – April 2016

Downhole geophysics was also carried out in BH04 and BH05 to understand the rock mass. Geophysical logging methods undertaken comprise:

- Acoustic/Optical Televiewer surveys to identify the nature and orientation of discontinuities in the bedrock
- Fluid Temperature and Conductivity, Natural Gamma, Calliper logging to determine any flow pattern within the borehole and to identify flow zones; to

identify different zones of water quality; to detect the clays that contain potassium K40 and to measure the mean diameter of the borehole, respectively

- Impeller Flow meter to determine flow patterns and identify flow zones
- Focused Resistivity to aid in the identification of strata and quality of the pore water
- Full Wave Sonic, again to aid in the identification of strata

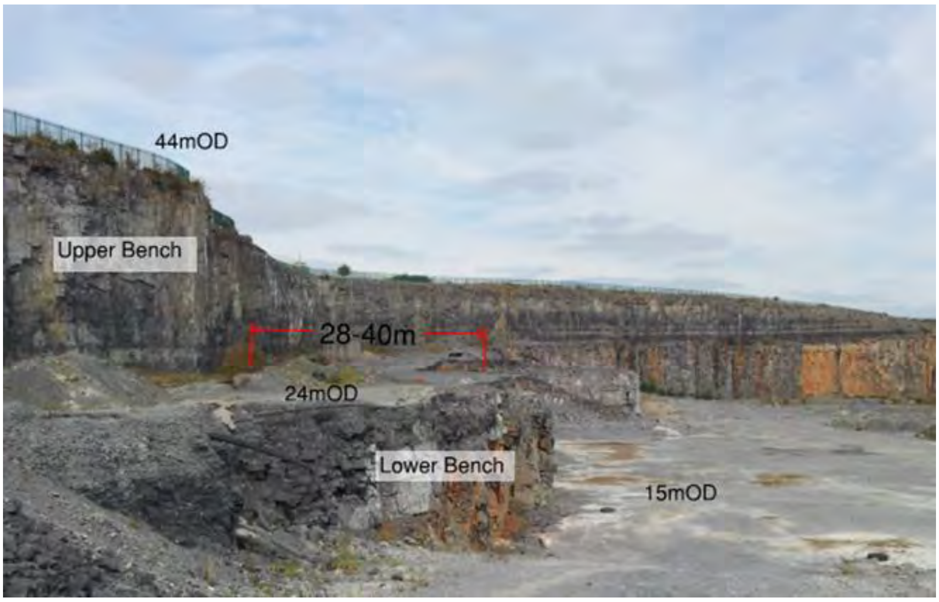
3.3.3 Topography

3.3.3.1 Section 1

The proposed eastern tunnel entry portal is located within the now inactive Lackagh Quarry, on the western quarry wall. The western quarry wall comprises of a lower and upper bench. The lower bench floor level is at +15mOD which rises steeply to +24mOD at the upper bench with a slope angle ranging from 75 degrees to sub-vertical in places with an uneven surface, (**Figure 3.7**). The distance between the top of the lower bench to the base of the upper bench ranges in width from 28m to 40m around the proposed tunnel portal area, (**Figure 3.8**). The upper bench ranges in height from 18m to 20m with a slope angle ranging from 70 degrees to sub-vertical. The maximum elevation of the quarry wall in this location is +44mOD.

Figure 3.7: Section 1 showing Lackagh Quarry and tunnel portal

Figure 3.8: Photograph of Lackagh Quarry in the vicinity of the tunnel portal



The quarry boundary is defined by a steel fence on a concrete plinth, which borders the Limestone pavement within the Lough Corrib cSAC. There is an average distance of approximately 1m between the edge of the fenceline plinth and the top of the upper quarry bench. **Figure 3.9** below shows a view of the western quarry wall from a distance, outlining the lower and upper bench and boundary fence.

Figure 3.9: Features of the tunnel portal area, with extent of tunnel portal marked

Some instability in the rock face is evident predominantly from blast damage during the operation of the quarry, with open discontinuities (joints and fractures), loose rock and the accumulation of debris resulting from spalling and failures present at the base of the lower and upper benches, see **Figure 3.10** below.

Figure 3.10 Face instability on the lower and upper bench

3.3.3.2 Section 2

Section 2 focuses on Lackagh Tunnel which overlaps with Sections 1 as the tunnel extends into Lackagh Quarry, **Figure 3.11.** The proposed tunnel lies beneath the Limestone pavement within the Lough Corrib cSAC and agricultural fields. The ground levels of the exposed Limestone pavement, **Figure 3.12**, range from 36.4 to +40.5mOD along the proposed alignment, falling from east to west. The tunnel extends west beyond the Limestone pavement boundary approximately 110m, overlain by agricultural land where the ground level reduces to +30.7mOD in the west from +36.4mOD in the east.

Figure 3.11: Section 2 showing Lackagh Tunnel footprint

Figure 3.12: Photographs of Limestone pavement located in Section 2

3.3.3.3 Section 3

Section 3 is bounded on the north and south by Limestone pavement. The proposed road development is located in in an area made up of agricultural fields and stone boundary walls**, Figure 3.13**. The existing ground levels fall from east to west from +30.7 to +13.41mOD.

Figure 3.13: Section 3 footprint

Figure 3.14: Photographs of the agricultural fields located in Section 3

3.4 Ground Model

As discussed in **Section 3.3.2** a site specific ground investigation was undertaken which is the basis of this ground model. Several stratigraphy were encountered varying in depth along the proposed tunnel alignment. Surface geophysics highlighted a large karst feature, possibly a doline beneath the agricultural fields adjacent to Lackagh Quarry. Overburden from this feature was recovered in BH03 and BH06. The stratigraphy encountered within Sections 1, 2 and 3 include topsoil, glacial till, silt, clay/organic clay, cobbles and boulders, weathered rock and limestone bedrock. A plan and profile of the proposed alignment and a schematic profile of Sections 1, 2 and 3 is presented in **Chapter 2, Figure 2.1**

Section 1 and Section 2 are appraised in a combined section as they examine the same limestone lithology and lab testing confirmed that the limestone from these sections have similar geotechnical properties. Section 3 is discussed independently as the overburden thickens and the ground conditions vary.

3.4.1 Engineering Geology

3.4.1.1 Section 1 and Section 2

Ground conditions at the western face of Lackagh Quarry comprise a cyclical sequence of carboniferous limestones, **Figure 3.15.** Each cycle is between 10m and 15m thick and is characterised by thinly bedded, dark mud-rich (argillaceous) limestones which pass upward into thicker bedded, paler non-argillaceous limestones. The darker limestone marks the beginning of the upper bench at the western face, and is generally considered to be stronger than the paler limestones.

Figure 3.15: Cyclical sequence of limestones at Lackagh Quarry

The stratigraphy of Section 1 and 2 was investigated by a 280m horizontal borehole (BH01) drilled sub-horizontally along at a 12° off horizontal incline along the alignment of the proposed road development beginning at the eastern tunnel portal location. The ground conditions in Section 2 were also determined using vertical boreholes BH04 and BH05 which reached depths of 35m and 40m, respectively. The bedrock is described as strong to very strong, thickly bedded, pale grey, fine to medium grained slightly fossiliferous limestone. Argillaceous limestones found in the quarry face were not found during investigation of Section 2, suggesting that these beds are not present moving west. A thin 20cm band of laminated mudstone was encountered in BH04, however it is unknown whether this is a continuous layer or a cavity infill. BH04 and BH05 encountered several cavities, some not filled, and some infilled with clay.

Geophysical surveying included, electrical resistivity tomography (ERT) and microgravity surveying. These survey lines highlighted high resistivity limestones in the east (in Section 2) which give way to a lower resistivity zone to the west. BH06 and BH03 located within Section 3 respectively, penetrated this low resistivity zone proving thick overburden consisting of glacial tills and silts.

Both the geophysics and horizontal borehole showed the presence of karst features within the limestone rock mass in Section 2, with several cavities discovered at depth, below the proposed road alignment, as well as a large karst landform which underlies the agricultural fields adjacent to the quarry on the west. The boreholes cored along the proposed line of the tunnel encountered a number of cavities in the bedrock that were generally less than 0.5m in size, with some infilled cohesive material. The microgravity survey data showed a similar finding to the ERT, dense limestones in the east giving way to a less dense zone in the west. Low density readings were found at the edges of the quarry face in Section 1, resulting from historic blast damage which extends 2 to 3m into the quarry face and is further discussed below.

Rock core recovered from BH01 indicates that:

- The Limestone is laterally and stratigraphically homogenous, it is described as pale grey to grey, fine to medium grained, strong to very strong fossiliferous (slightly) weathered (slightly) to fresh massive limestone
- Historic quarry blasting has affected a zone of the quarry face extending on average 1.5 to 3.0m into the rock mass. Beyond the blast affected zone, the discontinuities become more widely spaced, and show less alteration, indicating a more stable rock mass

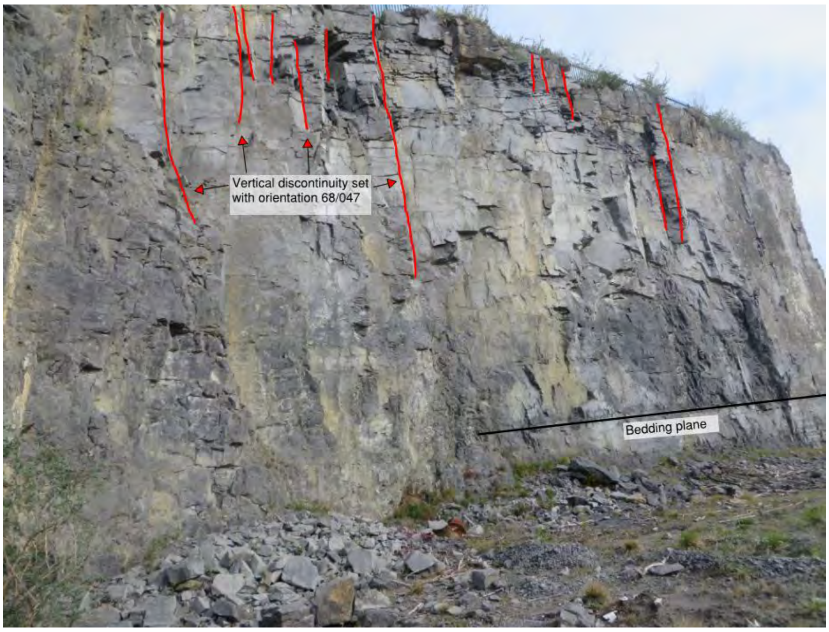
It is important to know the rock mass discontinuities, orientation and state as they can act as failure planes, impacting the Limestone pavement in Sections 1 and 2. A discontinuity is a plane of weakness in the rock mass which has a lower tensile weakness than that of the surrounding rock. It also marks a change in physical or chemical characteristics of the rock mass. Examples include bedding and jointing, both of which are evident in Lackagh Quarry. Through visual inspection, borehole logging and downhole geophysics, four discontinuity sets have been highlighted in the rock mass (**Table 3.4** and **Figure 3.16**). From these parameters an analysis of kinematic stability can be conducted.

Table 3.4 Discontinuity summary

Discontinuity Set	Dip/Dip Direction	Nature of Discontinuity
1	02/288	Bedding
2	68/047	Joint
3	54/008	Joint
4	53/204	Joint

The rock mass discontinuities provide the main flow path for groundwater. In this case the main pathway is flow along joints and bedding planes. Groundwater flow is generally from the north-west and accordingly the north-western faces of the quarry have most groundwater inflows. The main seepage zones occur where prominent bedding planes and joints intersect.

Figure 3.16: Exposed discontinuities on the upper bench



The vertical and horizontal discontinuities are visible on the exposed quarry face and are more evident in the upper bench wall, as the lower bench wall has been heavily affected by blast induced fractures.

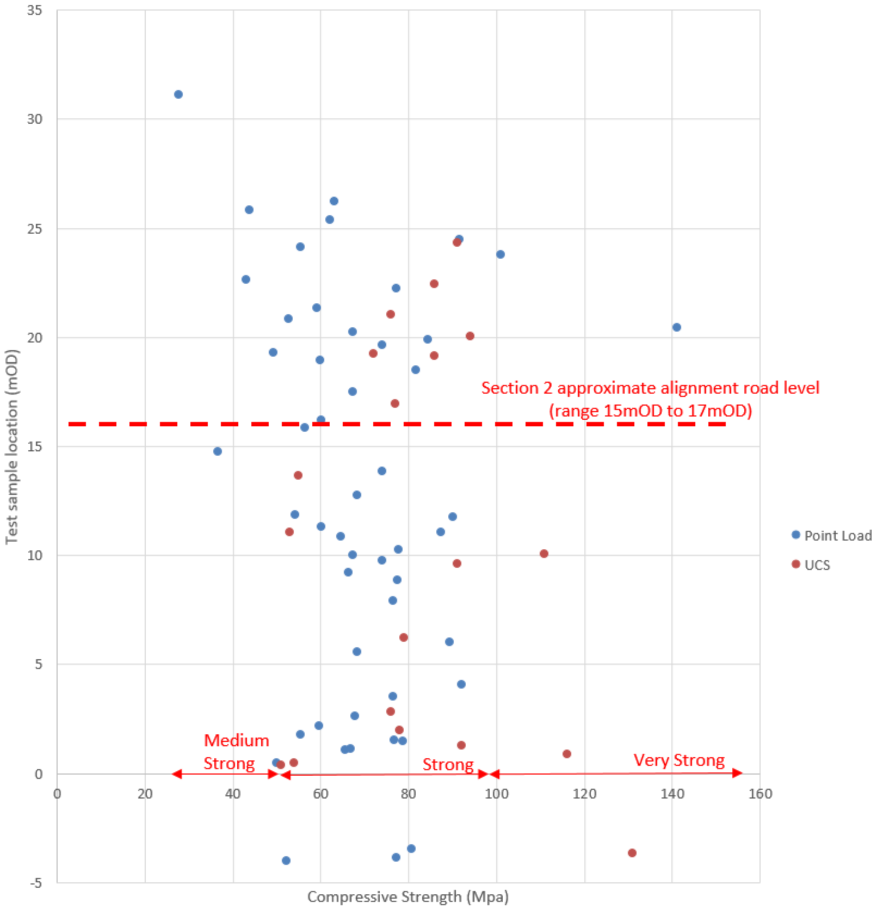
The western face has been left unprotected since the closure of the quarry in 2010 and has gradually deteriorated over time. Previous quarry workings have resulted in a heavily fractured rock face, both natural and blast induced (**Figure 3.17**), and unsafe overhangs and loose rock are present in the area of the proposed tunnel portal.

Given the nature of the fracturing and the evidence of failures, the angle at which the current rock face stands is too steep in parts, suggesting that this unprotected face, if left in its present state will continue to erode and may potentially impact the overlying Limestone pavement if a deep seated slope failure was to occur.

Figure 3.17: Blast damage on quarry face

The geotechnical laboratory test results, which consisted of Point Load testing and Uniaxial Compressive Strength (UCS) tests, from rock core samples from BH01, BH04 and BH05, confirmed that the limestone is in the strength range of strong to very strong, **Figure 3.18.**

Figure 3.18: Compressive Strength of limestone V's Depth (mOD)



Groundwater levels in Section 1 (Lackagh Quarry Face), and Section 2 (Lackagh Tunnel) have been recorded from summer 2015 to summer of 2016. This data is presented in **Table 3.1** and shows that groundwater levels in Section 2 were recorded between 8.7m and 16.7mOD. Water filled conduits were encountered during the drilling of inclined borehole BH01. Although no conduits have been observed in Lackagh Quarry they are present within the aquifer locally.

3.4.1.2 Section 3

Surface geophysics and boreholes BH03 and BH06 are used to establish the ground conditions in the agricultural fields in Section 3.

The geophysical survey picked up a zone of low density, low resistivity material beneath the agricultural fields in Section 3. A large karst feature underlies the agricultural fields, with a stepped bedrock profile and deep overburden deposits. BH03 and BH06 confirmed the geophysics findings, bedrock was encountered in BH03 at 101.5mbgl, -75.2mOD and was not confirmed in BH06 as drilling terminated prior to hitting rock. BH03 and BH06 terminated 109.9 and 45m below ground level (-83.6 and -14.2mOD) respectively.

Overburden comprises topsoil, glacial till (boulder clay), silt, organic clay, and a transition zone consisting of cobbles and boulders which is likely to be weathered bedrock. In summary the overburden in Section 3 comprises:

- Topsoil is present throughout Section 3, although it was not recovered from the boreholes.
- Glacial till was present in vertical boreholes BH03 and BH06 with the top surface occurring at 1.2m -1.05mbgl. Glacial Till found is described as *firm to very stiff brown and grey (slightly) sandy gravelly (slightly) CLAY with occasional to some cobbles and boulders.* Cobbles and Boulders are generally described *as sub-rounded to sub-angular and of limestone*, and occasional granites.
- Silt was found in just one borehole, BH03, which is located west of BH06. It is described as *very soft to firm greenish (slightly) grey SILT.* Locally its shows faint laminae. In BH03 it occurs below Glacial Till with a top surface at 13.65mbgl and a thickness of 23m.
- Clay/Organic Clay was found in both BH03 and BH06. It is generally described as *soft to stiff greyish (slightly) brown to dark brown CLAY*. In BH03 it is found beneath the silt stratum with a top surface at 38.38mbgl and a thickness of 12m. It is described as *very stiff dark brown grey (slightly) organic clay* towards the end of the strata with some small fibres, possible lignite. It was found again with a top surface of 61mbgl and a thickness of 10m beneath *gravelly CLAY with occasional cobbles and boulders*, but is described as *firm to stiff locally laminated fine sandy CLAY.*
- A transitional layer of gravels, cobbles and boulders, which represents the weathered rock horizon, was encountered, above slightly weathered to fresh limestone. This transition zone was encountered in both boreholes ranged in thickness from 20 to 25m. Where present it is generally described as *GRAVELS, COBBLES and BOULDERS with sandy gravelly CLAY* or *loose, coarse gravelly COBBLES and BOULDERS with some clay.* In BH03 the top surface of the cobbles and boulders was found at 80.10m BGL, with bedrock eventually being encountered at a depth of 101.5m. The stratigraphy of the weathered bedrock unit is unclear as the drilling was undertaken with a tricone bit with no recovery. In BH06 the cobbles and boulders were encountered at 22m, and have a thickness at least 20m. Its stratigraphy varies greatly over the course of the unit, as can be seen from the following generalised descriptions. It is described *as soft to firm grey sandy clay with coarse grained angular GRAVELS and COBBLES, angular to sub-angular with occasional boulders*. The clay content decreases with depth and is almost completely absent close to fresh bedrock.

In BH06, it was thought that drilling was close to the margin of a deeply buried rock topography and that the significant thickness of transition zone before bedrock was encountered may represent a wall or side to the feature.

Table 3.6 below summarises the findings of BH03 and BH06 completed in Section 3 (Western Approach).

Table 3.6 Section 3 stratigraphy summary

Stratum	Depth to top of stratum			
	BH03		BH06	
	(mbgl)	(mOD)	(mbgl)	(mOD)
Glacial Till	1.5	+24.8	1.5	+29.3
Silt	13.7	+12.7	Not present	
Clay	38.4	-12.1	15.9	+14.9
Cobbles/Boulders (Transition zone)	80.1	-53.8	26.6	+4.2
Limestone bedrock	101.5	-75.2	Not reached	

Section 3 is set within fill of the palaeokarst feature filled by fine grained sediment. The fine grained nature of the sediment indicates low hydraulic conductivity and storage and as such it is unlikely to be significantly water bearing. The bedrock surrounding the palaeokarst is water bearing and will have a water table that reduces from the groundwater high at BH04 westwards to BH972 and RC133 (refer to **Figure 3.3** for location) to the west of Section 3. On the basis of the data presented in **Table 3.1**, the groundwater level in Section 3 is estimated to range between 8.5-15.7m OD at the western tunnel portal (eastern extent of Section 3) to an estimated 6.5-10m OD at the western extent of Section 3.

4 Construction and operation

This chapter presents an overview of the construction activities within Sections 1, 2 and 3 and presents the envisaged construction sequence. The chapter forms an introduction to **Chapters 5, 6** and **7** outlining the potential areas of impact which are described in their relevant section**s** of this report.

4.1 Construction

4.1.1 Overview of construction activities and methodology

The construction activities for each section include:

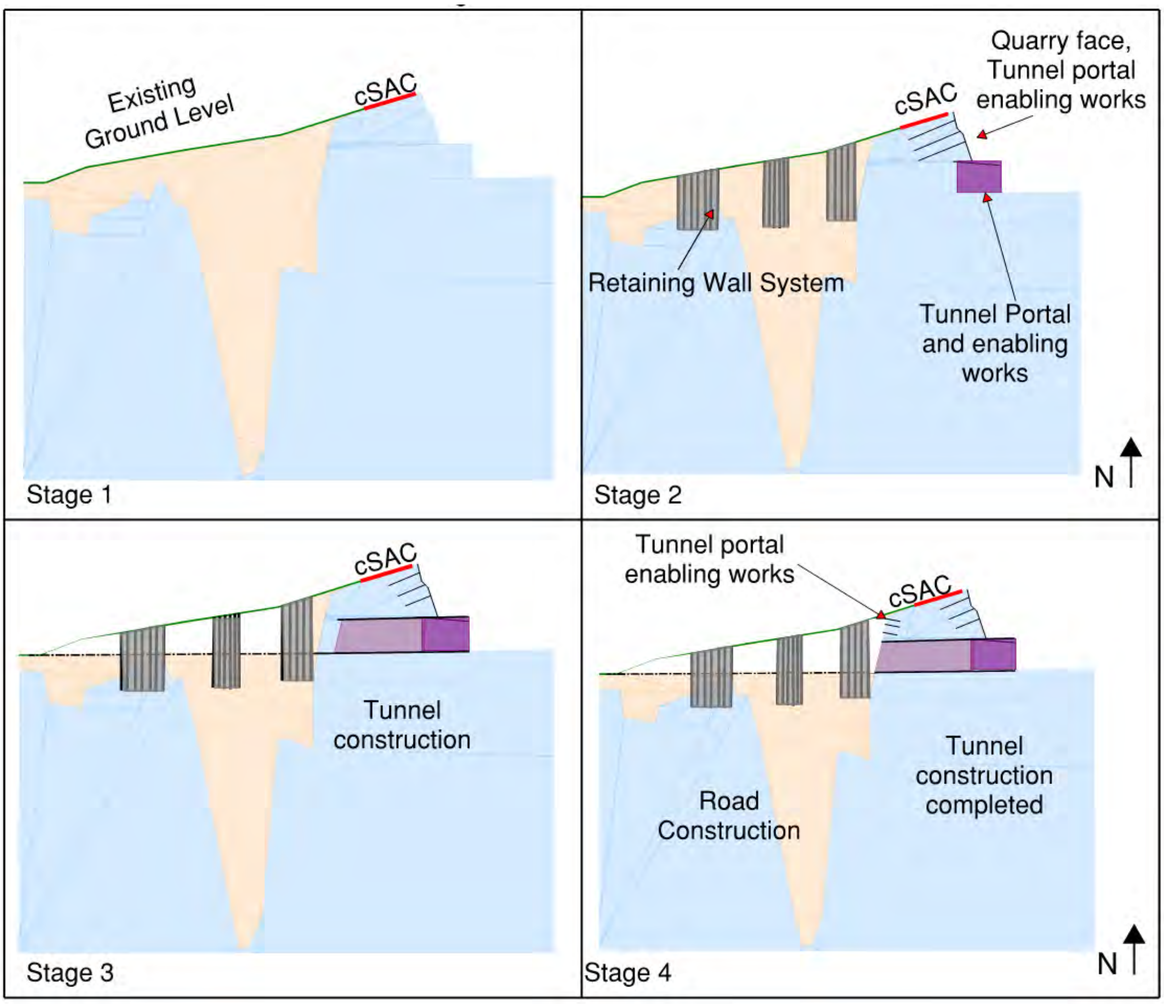
Section 1:	Stabilisation of the Lackagh Quarry face
Section 2:	Construction of the eastern entry portal
	Construction of tunnel (from east to west) – Drill and Blast
	Stabilisation of the connection to Section 3 (Western Approach)
Section 3:	Installation of retaining wall structures where required
	Excavation of overburden
	Installation of retaining wall temporary/permanent support
	Construction of western approach road

The following construction sequence is envisaged, (refer to **Figure 4.1)**. It is possible for Section 3 to be constructed in parallel with the construction of Sections 1 and 2.

1. Stage 1:
   - Site enabling and preparation works
2. Stage 2:
   - Stabilisation of the Lackagh Quarry western face (Section 1)
   - Construction of the tunnel entry portal (Sections 1 and 2)
   - Installation of a retaining wall from existing ground level in Section 3
3. Stage 3:
   - Construction of the proposed tunnel (Section 2)
   - Ongoing installation of retaining wall from existing ground level in Section 3 and commencement of the excavation works (Section 3)
4. Stage 4:
   - Excavation ongoing for Section 3
   - Stabilisation of the rock along the Section 2-Section 3 boundary (if/where required)

- Completion of the proposed tunnel (Section 2)
- Construction of the proposed road (Section 3)

Figure 4.1: Notional sequence of works (Schematic)



4.1.2 Overview of potential construction impacts to Annex I habitat from a hydrogeological and geological perspective

The potential hydrogeological and geotechnical construction impacts are discussed in Chapters 5, 6 and 7. The principle construction impacts include:

1. Connectivity of the eastern and western groundwater catchment areas
2. Changes to the groundwater recharge pattern
3. Intercepting the groundwater table
3. Polluting the groundwater
5. Removal of the Limestone pavement habitat

6. Causing instability of the Limestone pavement above the tunnel entry portal, Section 1, during tunnel construction in Section 2 or along the Western Approach, Section 3

4.2 Operation

4.2.1 Overview of operation activities

During the operational phase of the proposed road development, Sections 1, 2 and 3 form part of the N6 Galway City Ring Road.

4.2.2 Overview of potential operational impacts to Annex I habitat

The potential hydrogeological and geotechnical operational impacts are discussed in **Chapters 5**, **6** and **7**. The principle operational impacts include:

1. Connectivity of the eastern and western groundwater catchment areas
2. Polluting of the groundwater
3. Long term instability of the Limestone pavement in Sections 1, 2 and 3.

5 Hydrogeological appraisal of Lackagh Tunnel

5.1 Introduction

Hydrogeological mapping undertaken for this project (**Chapter 3**) has identified that Lackagh Tunnel and the Western Approach crosses two groundwater bodies in the limestone aquifer east of the River Corrib. The groundwater bodies are referred to as Western and Eastern Groundwater Bodies in this report (refer to **Figure 3.1**).

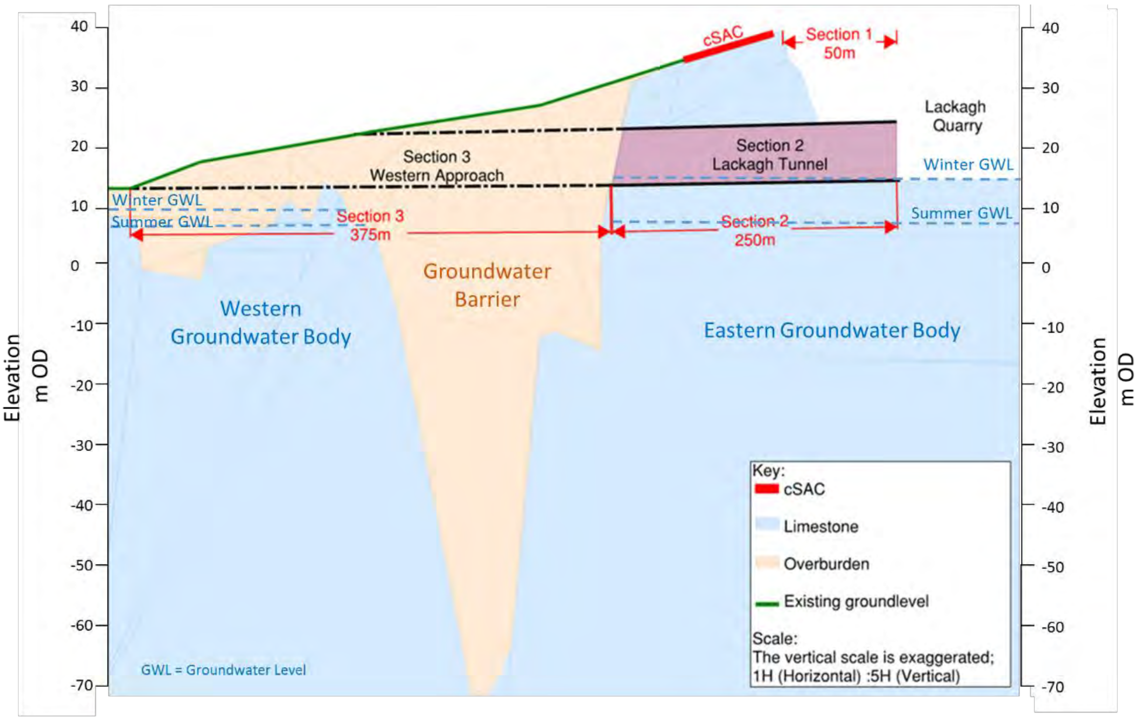
Parts of the Western and Eastern Groundwater Bodies lie with the area of the Lough Corrib cSAC. As presented in **Chapter 3**, ecological mapping for the proposed scheme has identified GWDE and Limestone pavement/Calcareous grassland habitat within both the Western and Eastern Groundwater Bodies.

The proposed road at Lackagh Quarry is divided into three sections:

- Section 1 – Lackagh Quarry Face
- Section 2 – Lackagh Tunnel
- Section 3 – Western Approach

This chapter assesses the design of the three sections of the proposed road development at Lackagh Quarry from a hydrogeological perspective. The design includes controls to prevent dewatering of the bedrock aquifer during construction and operation so that there is no reduction in groundwater flow through the aquifer to sensitive habitats.

Figure 5.1: Schematic profile along the proposed alignment from Western Approach through the tunnel to Lackagh Quarry.



5.2 Section 1- Lackagh Quarry Face

The groundwater levels in Lackagh Quarry have been recorded since autumn 2015 and will be ongoing to autumn 2016 using a combination of water level loggers and manual measurements of existing wells within the quarry. This data shows that the groundwater level in the floor of the quarry has a range of +8.7mOD (summer) to +15.7mOD (winter). At the peak groundwater levels the Lower bench quarry floor (+15.0mOD) was flooded (by c.0.7m depth water).

The cut at the eastern wall of Lackagh Quarry will set the road at +25.8mOD, which is c.10m higher than the extreme flood level of +15.7mOD recorded at the quarry. On this basis the road cutting will not intercept the groundwater table. Recharge may be intercepted in the cutting, which can be infiltrated to ground.

The lowest level of the proposed road surface in Lackagh Quarry is +16.9mOD which is approximately 1.2m higher than the groundwater flooding recorded during the extreme winter of 2015/16. On this basis the proposed road development as currently designed would not have flooded during the extreme groundwater high observed during the winter 2015/16.

In addition, bund walls will be placed at the tunnel eastern portal as a safety measure to seal the proposed road development against groundwater ingress from the quarry.

The proposed design of the drainage network for the proposed road within Lackagh Quarry will collect all surface water from both carriageways on the eastern approach to the tunnel.

The road drainage will be sealed and directed to a hydrocarbon interceptor and then to a containment pond. Following containment all water would enter an infiltration pond with a 1m constructed subsoil bed that would allow the treated water to recharge to ground. The pond is designed to accommodate a 100-year storm event, with 50% of volume to infiltrate to ground within 24 hours. The floor of Lackagh Quarry floods during peak groundwater levels and this will continue to be the case following road construction. When the quarry floods, the water level will also rise in the infiltration pond but all road water will continue to infiltrate either through the base or sides of the pond. After the winter peak groundwater levels the pond operation will drain and return to normal operation.

5.2.1 Construction phase

The proposed finished level of the proposed road will lie above the groundwater table, however, the embankment starter layer would, in part, be submerged during high groundwater. In this regard cross drains or culverts should be constructed so as not to dam groundwater in parts of the quarry floor. The cutting on the eastern wall of the quarry will not intersect the groundwater table. All works including starter layers and embankments on the quarry floor should be completed when groundwater levels are low to prevent working in groundwater. All work in Section 1 can be constructed without a requirement for dewatering.

During the construction phase groundwater may be at risk from pollution during site storm water runoff or infiltration without containment and treatment. In this regard any runoff or discharges will be managed so as to not discharge without being first treated for hydrocarbons and suspended solids.

In order to maintain low risk for accidental spills and leaks of fuel, lubricants or chemicals all machinery will be in good working condition. Any fuel or chemicals stored on site that have the potential to pollute will be bunded within in an area of sufficient capacity in order to contain 110% capacity.

5.2.2 Operation phase

There will be no dewatering required during the operation phase of the proposed road development. Recharge inflows and seepages may occur in the cutting on the eastern wall of the quarry but these will be managed using an interception trench to prevent groundwater entering the proposed road drainage network. Recharge inflows and seepages will occur in the quarry walls but these will be left to infiltrate to ground as they currently do.

The rock bolting and concrete covering to be installed at the eastern tunnel portal will cease or reduce seepage and inflows in the area of the tunnel portal. However, these flows will still infiltrate to the groundwater table without any net loss in volume.

Impacts to recharge mainly have implications for the operation phase of the proposed road development.

In the existing environment incident rainfall will recharge the ground. In the operational setting incident rainfall will be intercepted by the proposed road

carriageway and directed towards a sealed drainage system that is routed through an interceptor, containment area and infiltration pond prior to infiltration to ground.

The proposed design of the drainage network for the proposed road within Lackagh Quarry will match the natural groundwater catchments in so far as reasonably possible and will not modify the quantities of recharge to ground.

Due to the nature of rainfall infiltrating to the quarry floor in the existing environment there will be no change to the water balance due to the proposed road development.

5.3 Section 2 – Lackagh Tunnel

The proposed finished road level for the tunnel section has a range in elevation from +14.8mOD at the western portal to +17.0mOD at the eastern portal. Groundwater monitoring along Section 2 of the tunnel has shown that the natural water level fluctuation has a seasonal low of +8.5mOD during the summer and may rise to a seasonal high of +16.7mOD, as recorded during the particularly high groundwater levels of winter 2015/16.

Construction of the tunnel will be controlled with works being restricted to above the groundwater table at all times. Winter works could include advancing the heading of the tunnel above the water table provided that no dewatering takes place.

5.3.1 Construction phase

The hydrogeological study of Lackagh Quarry area has identified a local perched water table and flow path along a clay wayboard in the limestone sequence. The clay wayboard will be intersected by the tunnel and there may be localised inflows. These inflows will be managed during construction and be allowed to infiltrate to ground. On sealing of the tunnel these inflows will be transferred laterally around the outside of lining and to the groundwater table below.

The lower sections of the tunnel will be worked only during the seasonal groundwater low to ensure that all construction remains above the water table for the duration of the project. The construction schedule will be tailored so that the excavation of the lower section will occur only during the groundwater low when the water table is below the construction level. Construction will be managed in the upper part of the tunnel during the winter without requiring dewatering. The proposed road development can be completed without requiring dewatering and thereby reducing the risk of impact to groundwater.

Berms installed to stop ingress of water from either portal will keep groundwater in the tunnel separate from runoff. It is likely that recharge will enter the tunnel during construction and this will be controlled during construction by allowing it to recharge to ground in the tunnel section.

During the construction phase groundwater may be at risk from pollution during site storm water runoff or infiltration without containment and treatment. In this regard any runoff or discharges will be managed as per the Preliminary Sediment

Control Plan so as to not discharge without being first treated for hydrocarbons and suspended solids.

In order to maintain low risk for accidental spills and leaks of fuel, lubricants or chemicals, all machinery will be in good working condition. Any fuel or chemicals stored on site that have the potential to pollute will be bunded within in an area of sufficient capacity in order to contain 110% capacity.

5.3.2 Operation phase

The groundwater table has the potential to rise above the tunnel level in the western part of the tunnel but as the tunnel will be sealed there will be no dewatering required. There will be no impact to the recharge occurring to the Limestone pavement above the tunnel nor prevention of recharge draining to the water table as recharge will flow around the tunnel construction.

All wash water entering the tunnel drainage system from vehicles will be collected in a sealed drainage system and pumped to foul sewer for treatment at a municipal facility.

5.4 Section 3 - Western Approach

The elevation of the Western Approach reduces as proceed from east to west to a low point at its western extents and increases again as proceed west. The Western Approach is in subsoil fill of a karst landform identified by the ground investigations outlined in **Chapter 3** of this report.

The cutting ranges from being predominately in rock at the western area of Section 3 to entirely in subsoil fill in the central and eastern area of Section 3. The eastern extent of the buried landform is encountered at the western tunnel portal.

Section 3, the Western Approach of Lackagh Tunnel, straddles the groundwater divide between the Eastern and Western Groundwater Bodies. The western portal and potentially bedrock to the north of the section are part of the Ballindooley West Groundwater Body, whilst the western end of the approach and southern part of the section are in the Menlough Groundwater Body.

The winter of 2015/16 had higher groundwater levels in the limestone aquifers of Galway than a normal winter. Groundwater levels reported in **Table 3.1** show a manually measured groundwater high of +8.2mOD at monitoring well BH972, which is located in the Menlough Groundwater Body and 300m west of Section 3. This groundwater level data (which is similar to nearby well RC133) was recorded monthly during 2015 and 2016.

The western tunnel portal is in the Ballindooley West Groundwater Body and as such will have a range in the groundwater level of +8.5mOD (summer) to +15.7mOD (winter). As Section 3 includes both part of the eastern and western groundwater catchment it is important that the road construction retains the groundwater divide between these catchments so that neither groundwater bodies are intersected nor the catchment boundaries modified.

The network of buried landforms west and south of Lackagh Quarry forms a barrier between the Ballindooley West and East Groundwater Bodies. This is seen in the different water levels between the two groundwater bodies, especially during the winter.

The peak groundwater levels in Section 1 and Section 2 were recorded at a maximum of +15.7mOD during the winter of 2015/2016. However, peak groundwater levels in BH972 (300m west of the Section 3) were recorded with a winter high of +8.2mOD. This data indicates a significantly lower groundwater level to the west of Section 3 at BH972, which supports the conceptual model of a groundwater divide between Menlough GWB and Ballindooley West GWB.

As the groundwater levels in BH972 were recorded manually rather than automatically, the more conservative value of +10mOD is used to estimate the winter peak winter peak in BH972 for the winter of 2015/16.

5.4.1 Construction Phase

Due to the proximity to Coolagh Lakes no dewatering will be permitted during the construction of Section 3. Peak groundwater levels of +15.7mOD were recorded during the winter of 2015/16 at Lackagh Quarry (January, 2016) and 16.7m OD was recorded in Borehole BH04 located in Section 2 (Lackagh Tunnel) (January, 2016). Groundwater levels in Section 3 are estimated to range from 8.5mOD at the western end to 15.7m OD at the tunnel portal.

During the construction phase groundwater may be at risk from pollution during site storm water runoff or infiltration without containment and treatment. In this regard any runoff or discharges will be managed as per the Preliminary Sediment Control Plan so as to not discharge without being first treated for hydrocarbons and suspended solids.

In order to maintain low risk for accidental spills and leaks of fuel, lubricants or chemicals all machinery will be in good working condition. Any fuel or chemicals stored on site that have the potential to pollute will be bunded within in an area of sufficient capacity in order to contain 110% capacity.

5.4.2 Operation phase

Section 3 will be permanently sealed below the proposed road level to a minimum level of +17.7mOD in the cutting sides. This level equates to the winter water level high of +15.7mOD plus 2m. This seal will ensure that winter groundwater levels will not impact on road operations.

Runoff in Section 3 will be collected by a sealed drainage system and discharged to ground by infiltration ponds to the west.

5.5 Hydrogeological summary

The assessments for Sections 1, 2 and 3 have identified that the risk of hydrogeological impact can be mitigated against by restricting construction in sensitive areas to times when the groundwater levels are low. As such, for Section 2 and the eastern part of Section 3 the construction works will be restricted to above the groundwater table at all times.

During construction/operation of the proposed tunnel at Lackagh Quarry there is a risk of groundwater impacts which could affect habitats within Lough Corrib cSAC. The following mitigation measures will be implemented to ensure that the proposed Lackagh Tunnel, and construction of western and quarry approaches to same, will not adversely affect the integrity of Lough Corrib cSAC from impacts:

Section 1

A composite support system of rock bolts, steel mesh and sprayed concrete will be used to stabilise the quarry face. In the event that sprayed concrete is used, groundwater seepage from the quarry face will be facilitated by installing weep holes. The frequency of weep holes will be based on the expected groundwater seepage from the quarry face to reduce any water build-up behind the shotcrete layer.

The drainage network for the proposed road within Lackagh Quarry will collect all surface water from both carriageways on the eastern approach to the tunnel. The road drainage will be sealed and directed to a hydrocarbon interceptor and then to a containment pond. Following containment all water will enter an infiltration pond with a 1m constructed subsoil bed that will allow the treated water to recharge to ground. The pond is designed to accommodate a 100-year storm event, with 50% of volume to infiltrate to ground within 24 hours.

The proposed finished level of the proposed road will lie above the groundwater table, however, the embankment starter layer would, in part, be submerged during the winter groundwater high. In this regard the starter layer will be constructed so as not to dam groundwater in parts of the quarry floor. Similarly, the drainage network will not be installed during the seasonal groundwater high so as to avoid the need for dewatering and groundwater lowering.

Section 2

No groundwater dewatering of the bedrock aquifer will be permitted during construction works. No construction works will be permitted during periods of high groundwater periods where groundwater dewatering would be required to facilitate works. When the groundwater rise occurs all construction activities within the zone below the high winter groundwater level for the tunnel will cease and the operation made safe until groundwater levels drop, which may include the installation of berms to prevent groundwater entering or exiting the tunnel from the tunnel portal.

The hydrogeological study of Lackagh Quarry area has identified a potential perched water table and flow path along a clay wayboard in the limestone sequence. The clay wayboard will be intersected by the tunnel and there may be inflows along

it. These inflows will be managed during construction and allowed to infiltrate to ground along the tunnel section.

On sealing of the tunnel these inflows will be transferred laterally around the outside of the tunnel box section and to the groundwater table below.

To facilitate groundwater flow around the completed tunnel a drainage blanket up to the winter groundwater level (+16.7mOD), will be incorporated during construction. It is envisaged that this will take the form of a drainage layer, drainage pipes or similar placed outside the permanent cast in-situ reinforced concrete tunnel lining and waterproof membrane.

Section 3

No dewatering of the bedrock aquifer will be permitted due to the sensitive nature at the groundwater dependent habitat at nearby Coolagh Lakes.

Where excavation into subsoils below the winter groundwater level is required, an additional geotechnical investigation to establish the overburden permeability will be required to determine if inflows to the excavation will occur from the bedrock aquifer. In the case that inflow is likely below the winter groundwater level then construction below the winter groundwater level will not be permitted. The additional geotechnical investigation will calculate groundwater seepage based on an assessment of permeability, thickness of overburden between the excavation and the bedrock aquifer and geotechnical stability.

A watertight seal will be installed on the underside of the road base and the cutting sides to protect against groundwater inflow. This area will be sealed during construction (and permanently) to +17.7mOD; which is derived from the groundwater high (+15.7mOD) plus 2m free board. Slope or retaining structures will be utilised from +17.7mOD to existing ground level where required.

Runoff will be collected by a sealed drainage system and discharged to ground by infiltration ponds to the west.

Operation of the tunnel

All wash water entering the tunnel on vehicles will be collected in a sealed drainage system and pumped to foul sewer for treatment at a municipal facility.

In summary the proposed design of Lackagh Tunnel and the Western Approach is unlikely to impact on hydrogeology.

6 Geotechnical appraisal of Lackagh Tunnel

6.1 Introduction

This chapter of the report follows on from **Chapter 4** outlining the construction activities within Sections 1, 2 and 3. It looks at the potential risks to the priority Annex I habitats, Limestone pavement and Calcareous grassland within the Lough Corrib cSAC and the construction methodology to be implemented, based on scientific data, to ensure no impacts to the stability of the Limestone pavement.

6.2 Section 1 - Lackagh Quarry Face

The potential impacts and proposed mitigation measures during the construction phase are described in **Section 6.2.2** and the potential impacts during the operational phase in **Section 6.3.3**.

6.2.1 Construction phase

This geotechnical appraisal considers the potential impacts that construction of the tunnel will have on the overlying Limestone pavement/Calcareous grassland and outlines the control measures.

6.2.1.1 Potential impacts

The potential impact in Section 1 is on the adjacent Limestone pavement and Calcareous grassland during the construction of the tunnel entry portal. This will be as a result of rock mass instability and subsequent slope failures on the quarry face encroaching into the overlying cSAC.

In order to protect this overlying Limestone pavement, proposed works within the quarry include stabilisation of the existing quarry face prior to any excavation taking place to control any rock slope failure occurring which may impact the overlying Limestone pavement.

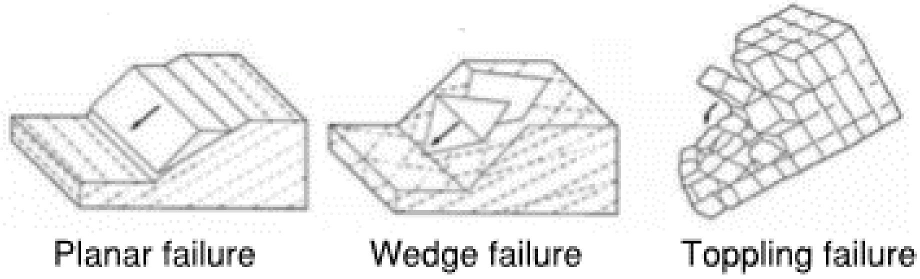
6.2.1.2 Sources of instability

The three principle failure mechanisms which occur in a rock mass are discussed below and illustrated as schematics in **Figure 6.7**. The principle rock mass failure mechanisms are:

- Planar Failure
    - In order for a rock mass to undergo planar failure, the dip of the rock face must exceed the dip of the potential slip plane
    - The potential slip plane must be visible on the rock face

- Wedge Failure
  - Occurs when the dip of the rock face exceeds the dip of the line of intersection between two discontinuity planes
  - The line of intersection of the two discontinuity planes must daylight on the rock face
- Toppling Failure (Direct toppling)
  - Two sets of discontinuity planes whose intersections must dip into the rock face
  - Another set of discontinuity planes which daylight on the rock face and dip at a shallow angle.

Figure 6.1: Schematic of potential failure mechanisms, Planar, Wedge and Toppling after Matheson (1983).



The discontinuity data, presented in **Table 3.4** in **Chapter 3**, indicates that the failure most likely to occur within the rock mass and impact upon the Limestone pavement is wedge failure and toppling. Wedge failures are seen in the upper section of the upper bench illustrated in **Figure 6.2** below.

Figure 6.2: Wedge failure in the upper bench

6.2.1.3 Quarry face support measures

Mined tunnelling has been outlined as the method for the twin tunnel excavation. This method could potentially mobilise the rock mass along any of its discontinuity planes, causing movement of the quarry face and potentially impact upon the Lough Corrib cSAC and the Limestone pavement/Calcareous grassland above. In order to protect the overlying Limestone pavement/Calcareous grassland during the works, a series of quarry face support works will be undertaken to ensure stability at the quarry face prior to and during excavation.

Prior to excavation of the portal, rock face stabilisation preparatory works will be carried out to clean off any loose rocks on the quarry face which overhangs the tunnel portal and on either side until a safe distance is reached. This will be designed based on detailed analysis of the face during the initial works. Upon completion, a composite system is proposed to be put in place prior to any excavation for the tunnel portal. The extent of the work required may include the following:

1. Rock bolts
2. Rock dowels
3. Steel mesh
4. Sprayed concrete

As the support measures for the quarry face are permanent, they should be designed to the relevant design standards (Eurocode 7, BS8081) for the 120 year life span.

Rock Bolts

There are several types of rock bolts, which generally consist of plain steel rods with a mechanical or chemical anchor at one end and a face plate and nut at the other. The rock bolt anchor (steel rod) is inserted into a borehole that has been drilled through the rock face. The anchor is tensioned after installation and grouted. They work by 'knitting' the rock mass together sufficiently prohibiting movement to loosen and fail the rock slope. Rock bolts are anchored into the stronger rock mass, i.e. beyond the blast affected zone, therefore >2m in length for Lackagh Quarry. Rock bolts are generally installed in patterns with the exact length, spacing and tension strength depending on several factors. The rock bolts may extend in length up to 10m.

Rock Dowels

Rock dowels generally comprise deformed steel bars which are grouted into the rock. Unlike rock bolts, tensioning is not possible and the load in the dowels is generated by movements in the rock mass. In order to be effective, dowels have to be installed before significant movement in the rock mass has taken place. In the case of Lackagh Quarry most of the support will result from rock bolting, however the rock dowels are an added safety measure. Like rock bolts, they are inserted into a borehole drilled into the quarry face, however they are inserted after grouting of the hole, and will be up to 3m in length.

Steel Mesh

Following the installation of the rock bolts and dowels, an added safety measure of a steel mesh is proposed on the Lackagh Quarry face.

This steel mesh will cover the quarry face above the tunnel portals and 30m either side will be held in place by the rock bolts. This will act as a cover on the rock face, protecting against the movement of any failures, which may affect the Limestone pavement.

Sprayed concrete

An additional safety measure is using a sprayed concrete, shotcrete, coating which covers the rock bolts, dowels and steel mesh. Shotcrete is usually used in conjunction with a steel reinforcement, and in this instance the steel mesh will provide sufficient support. Shotcrete is sprayed onto the rock face surface pneumatically via a shotcrete machine. Where shotcrete is utilised weep holes will be installed to allow the groundwater drain.

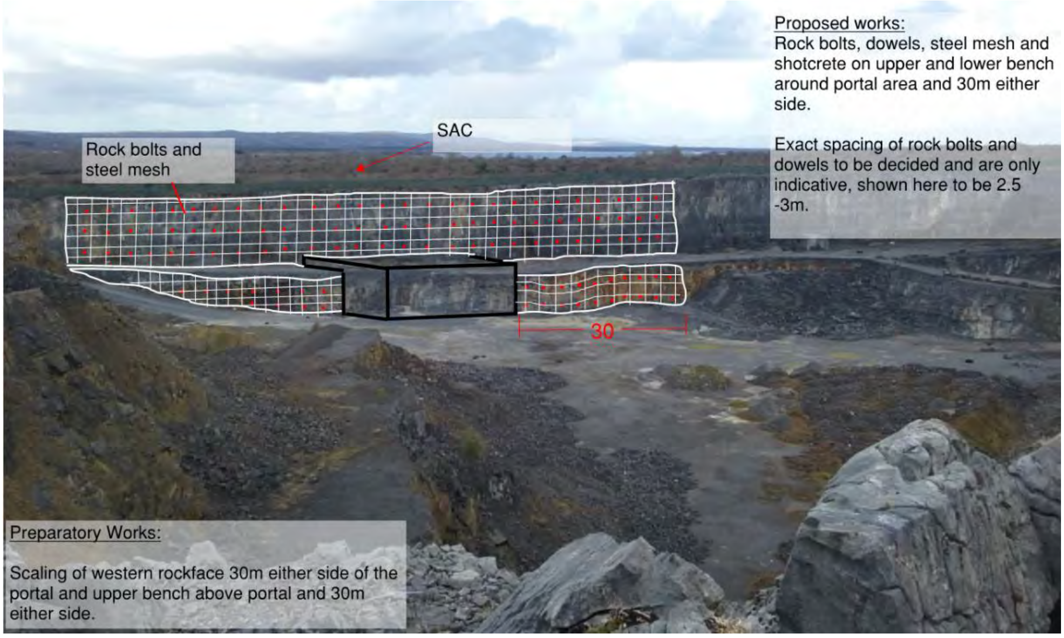
It is proposed that works on the upper bench wall will consist of rock bolts and rock dowels with steel mesh and shotcrete. Works on the lower bench wall will consist of rock dowels and steel mesh with shotcrete. Three cross sections are included in **Appendix B**, showing various levels of support in relation to the tunnel portal.

6.2.1.4 Summary for construction phase

A composite support system of rock bolts, steel mesh and sprayed concrete will be used, **Figure 6.3**. The proposed works will be completed prior to the tunnel excavation and be limited to the quarry face. These rock face protective measures will limit movement within the rock mass resulting in no impact to the Limestone pavement.

During the construction of the tunnel the Lackagh Quarry stabilised face will be monitored for movement and cracks to ensure no impact to the Limestone pavement. In the unforeseen event that movement is observed additional support systems will be installed.

Figure 6.3: Extent of proposed works at tunnel portal



6.2.2 Operational phase

During operational phase of the tunnel continued monitoring will take place to ensure that further stabilisation measures are implemented to protect against any further movement or instability within the rock mass surrounding the tunnel portal. During the operational stage of the tunnel there will be no impact on the Limestone pavement.

6.3 Section 2 - Lackagh Tunnel

A description of the tunnel and its potential impacts is provided in **Section 6.3.1**, the potential impacts and proposed mitigation measures during the construction phase are described in **Section 6.3.2** and the potential impacts during the operational phase in **Section 6.3.3**

6.3.1 Construction phase

This geotechnical appraisal considers the potential impacts that construction of the tunnel will have on the overlying Limestone pavement and outlines the control measures. Lackagh Tunnel comprises a twin mined tunnel through approximately 250m of competent limestone under approximately 100m length of the Lough Corrib cSAC.

6.3.1.1 Potential impacts

The tunnelling works have the potential to impact the Lough Corrib cSAC if the appropriate support measures are not implemented. Potential impact to the Lough Corrib cSAC include collapse of the tunnel, significant ground settlement, instability of quarry face, blast damage and impact to the hydrogeological conditions, discussed in **Chapter 6** of this report.

6.3.1.2 Tunnel design control measures

The size, separation and minimum rock cover to the tunnels is designed based upon the available geological information and the sensitivity of the habitats present above in Lough Corrib cSAC.

Each individual tunnel will maintain at least 8m of clear rock above the crown to the top of rock/ground level. This 8m allows a sufficiently stable rock arch to develop around the tunnel which will ensure the stability of the tunnel in the temporary case. The calculation showing the effect of the rock arch is shown in **Appendix C**.

Where karst features are present in the tunnel zone there is potential impact to the stability of the tunnel. The construction of the tunnel will occur above the water table and as such any karst features intercepted will be filled with water when groundwater is locally perched. The presence of these karst features (cavities) in the tunnel arch may cause instability and therefore it is critical that probing ahead of the tunnel face is carried out. This probing will identify these cavities. If encountered these karst features will be investigated and backfilled or bridged.

The combined effect needs to be assessed as there are two tunnels in close proximity to each other. The critical element is the pillar of rock that will remain between the two tunnel bores. If this pillar is too thin or too weak it could lead to a collapse or partial collapse of both tunnels. This pillar will see a notable stress increase as it acts as the support for the arch around both tunnels.

The quality and unconfined compressive strength of the rock has been determined in the site investigation and used in the rock pillar calculation, which can be found in **Appendix D**. The calculation demonstrates that the minimum clear distance between the tunnels should be 7m.

A preliminary baseline vibration assessment of the Limestone pavement was carried out with a limit of 25mm/sec and maximum instantaneous charge weights are shown in **Appendix E**. Vibrations at this limit will not impact the Limestone pavement environment. During the blasting period the Limestone pavement will be monitored to establish if vibration in excess of 25mm/sec are feasible.

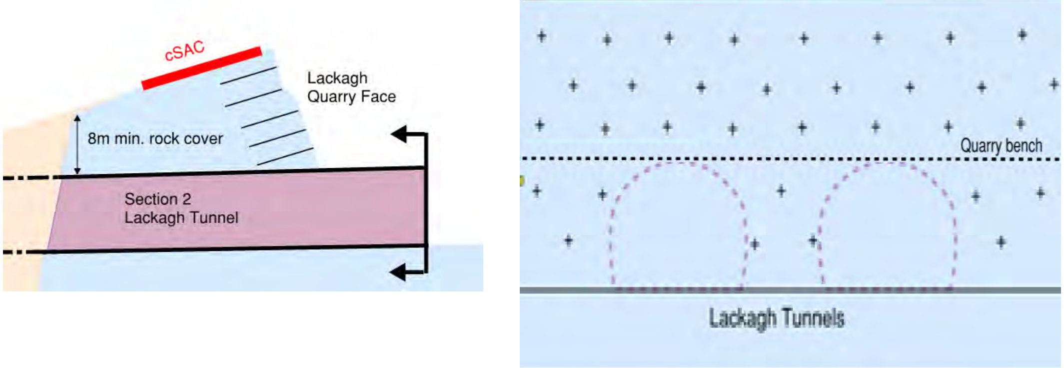
6.3.1.3 Excavation and construction methodology

The tunnel excavation will be carried out by mined tunnel methods (drill and blast or road header), which are commonly used for tunnels through hard rock. Prior to excavation the quarry face will be stabilised as discussed for Section 1 (Stage 1), then in the vicinity of the tunnel portals the lower bench will be cut back in line with the upper quarry bench (Stage 2), **Figure 6.4**, Stages 1 and 2.

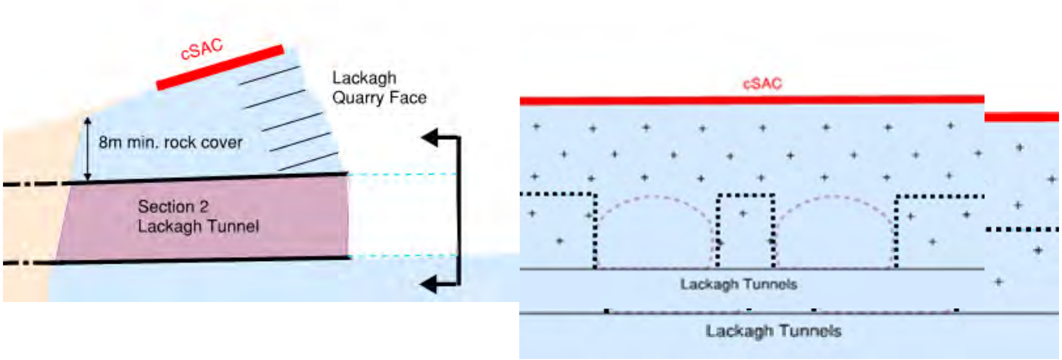
Works will be completed using drill and blast methods where rock thickness above the crown of the tunnel excavation is greater than 8m at the minimum location.

Figure 6.4: Tunnel construction sequence stage 1 and 2.

Stage 1:
Stabilise quarry face prior to tunnel excavation works using rock bolts, steel mesh and sprayed concrete



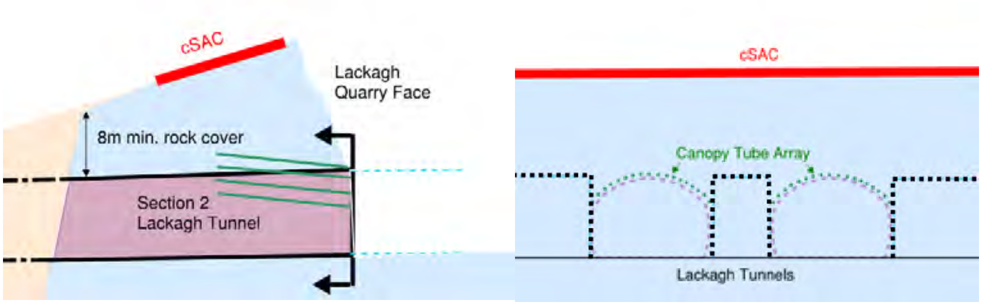
Stage 2:
Removal of quarry bench



Temporary support measures (Stage 3) for the tunnel portal will then be installed around the arch of the tunnel through the quarry rock face in the form of 10-12m length sub-horizontal canopy tubes, **Figure 6.5.** Canopy tubes are steel tubes that are drilled into the ground around the tunnel arch. These tubes extend a maximum of 2m above the tunnel crown, which leaves 17m clear distance between the proposed works and the Lough Corrib cSAC boundary. These pre-support measures form a canopy of support and allow the portal to be excavated without causing risk of collapse to the quarry face.

Figure 6.5: Tunnel construction sequence Stage 3.

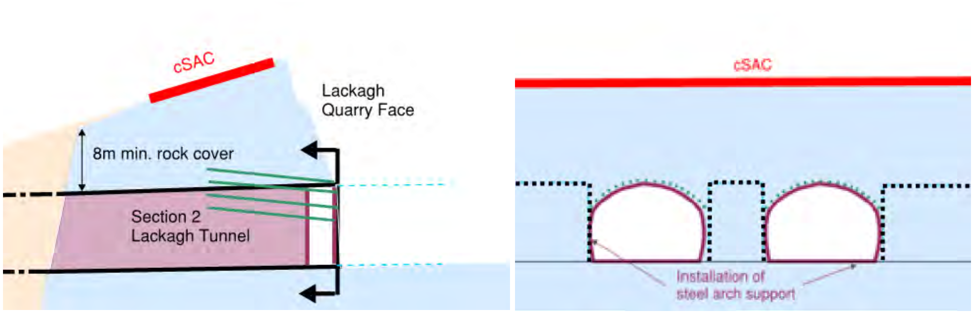
Stage 3:
Installation of tunnel pre-support (canopy tubes)



Once installed the first two metres of tunnel is excavated (Stage 4)**, Figure 6.6.** A portal support structure in the form of a steel arch will then be installed to provide support to the pre-support and the ground above.

Figure 6.6: Tunnel construction sequence Stage 4.

Stage 4:
First advance of tunnel



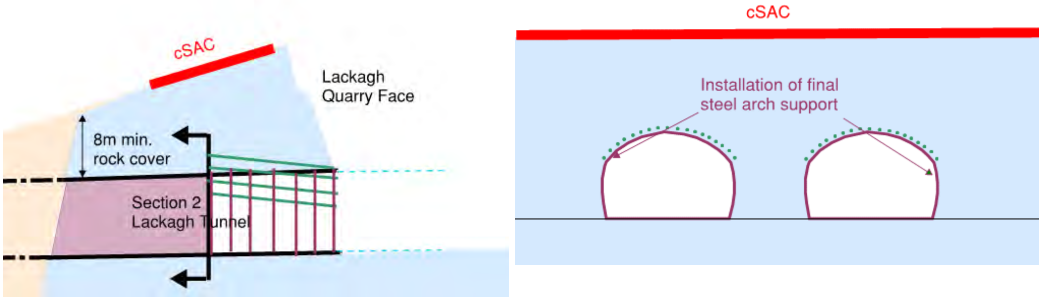
Excavation will be then progressed for the tunnel in a cyclic manner with drilling, blasting, rock face mapping, mucking out, installation of support measures and then preparing for the next advance of the tunnel (Stages 5 and 6), **Figure 6.8**. The excavation will be in short advances with steel arches and sprayed concrete implemented until the end of the pre-support zone.

Following each blast and as the tunnel advances the rock face will be mapped for discontinuities so that any potential instabilities are identified.

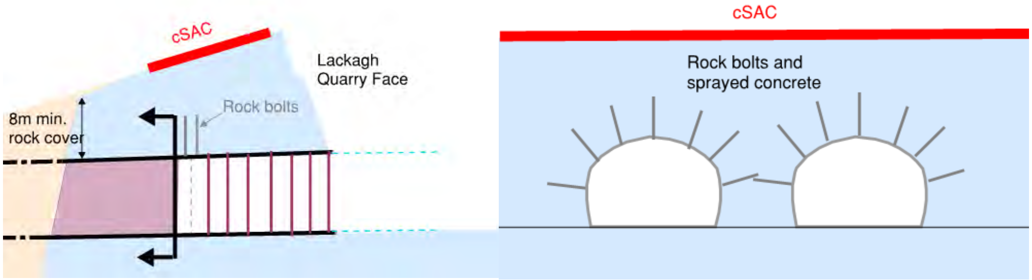
Once this mapping is complete, the loose rock will be removed and any rock that was not successfully blasted will be manually broken out and then temporary support measures where required will be installed. These support measures are based on the results of the mapped rock face. The most common support system is the use of radial rock bolts (discussed for Section 1) with sprayed concrete (shotcrete) which are used to develop a reinforced rock arch. The maximum length of rock bolt will be 5m from the excavated tunnel face. This methodology will continue while the rock cover is 8m or greater above the tunnel crown, after this the tunnelling works will cease.

Figure 6.8: Tunnel construction sequence Stage 5 and 6.

Stage 5:
Excavation until end of pre-support zone



Stage 6:
Switch to conventional drill and blast tunnelling



The blast pattern will drilled using a rock hammer through the tunnel excavation face, the blast holes will then be loaded with detonators and explosives as per the blast design. These will be set to explode at set time intervals so that the instantaneous intensity of the blast is reduced and vibration levels are kept to an acceptable level. The blast is designed to only break out the required rock to form the tunnel.

The charge weights used for drill and blast excavation will be limited to cater for the proximity of a sensitive receiver (a close structure or feature that may be affected by vibrations) which includes the Limestone pavement within the Lough Corrib cSAC. As part of the blasting assessment, vibration limits will be assigned to all sensitive receivers and an appropriately low charge weight will be used.

Blast vibration monitoring will be carried out during the works to verify the proposed charge weights and demonstrate that vibration will not affect the structural integrity of the Limestone pavement. As discussed a preliminary assessment of the

blasting has been carried out and is presented in **Appendix E**. Vibrations of 25mm/sec will not impact the Limestone pavement environment. During the construction and blasting phase it is recommended that the Limestone pavement is monitored to evaluate if vibration in excess of 25mm/sec are feasible.

Standard rock tunnelling works will cease once the rock cover is 8m based on the available ground investigation (GI) data and preliminary modelling of the tunnel. In the event that there is less than 8m cover then pre-support measures in the form of sub-horizontal spiles, similar to canopy tubes, will be implemented which provide a stiffer support. Spiles will be used in addition to the rock bolts and sprayed concrete. These additional measures provide an extra level of safety to the temporary works ensuring tunnel stability and no impact to the Limestone pavement environment. Rock cover less than 8m between the tunnel crown and the Limestone pavement ground level is not anticipated.

Permanent tunnel support will then be installed in the form of a cast in-situ reinforced concrete lining.

In order to facilitate groundwater flow around the concrete lining, the completed tunnel will have a drainage blanket up to the winter groundwater level (+15.7mOD) that will be incorporated during the construction. It is envisaged that this will take the form of a drainage layer or drainage pipes or similar placed outside the waterproof membrane.

6.3.1.4 Design and construction summary

Works will be completed using drill and blast methods. The potential impact on the Limestone pavement due to the tunnel works and proposed mitigation measures are outlined below:

- Each individual tunnel will maintain at least 8m of clear rock above the tunnel crown to the ground level of the Lough Corrib cSAC. This 8m allows a sufficiently stable rock arch to develop around the tunnel which will ensure the stability of the tunnel in the temporary case.

- The minimum clear distance of 7m will be maintained between the tunnels based on the strength of the rock and expected size of the tunnels.

- Pre-support measures will be installed at the quarry face around the proposed tunnel portal to prevent collapse into the quarry.

- The blasting charge weights used for excavation will be limited to cater for the proximity of a sensitive receiver. Following a preliminary assessment, vibrations of 25mm/sec will not impact the Limestone pavement environment. During the blasting period the Limestone pavement will be monitored to establish if vibration in excess of 25mm/sec are feasible.

- In the event that there is less than 8m cover then pre-support measures in the form of sub-horizontal spiles will be implemented which provide a stiffer support in addition to the rock bolts and sprayed concrete. These additional measures provide an extra level of safety to the temporary works ensuring there is no impact.

- Temporary works in the tunnel in the form of steel arch supports, rock bolts and sprayed concrete will be installed to form a reinforced rock arch support allowing the tunnel to be excavated without causing risk of collapse.

6.3.2 Operational phase

Permanent tunnel stability will be provided by a cast in-situ reinforced concrete lining and permanent waterproofing of the tunnel will be provided by the application of a water proof membrane.

During the operation phase of the tunnel and for the entire design life, minimal settlement or deformation of the tunnel lining is expected. Any slight movement that does occur will not impact to the structural integrity of the Limestone pavement.

6.4 Section 3 - Western Approach

A description of the Western Approach is provided in **Section 6.4.1**, the potential impacts and proposed mitigation measures during the construction phase are described in **Section 6.4.2** and the potential impacts during the operational phase in **Section 6.4.3**

6.4.1 Construction phase

The ‘Western Approach’ to Lackagh Tunnel is set within thick subsoils that are bound to the north and south by the Lough Corrib cSAC and Annex I habitat, namely Limestone pavement and Calcareous grassland. Due to the close proximity of the Limestone pavement/Calcareous grassland to the horizontal alignment of the proposed road development an unsupported open cut excavation may not be viable as the landtake required for such works would include areas of Limestone pavement and Calcareous grassland.

6.4.1.1 Potential impact

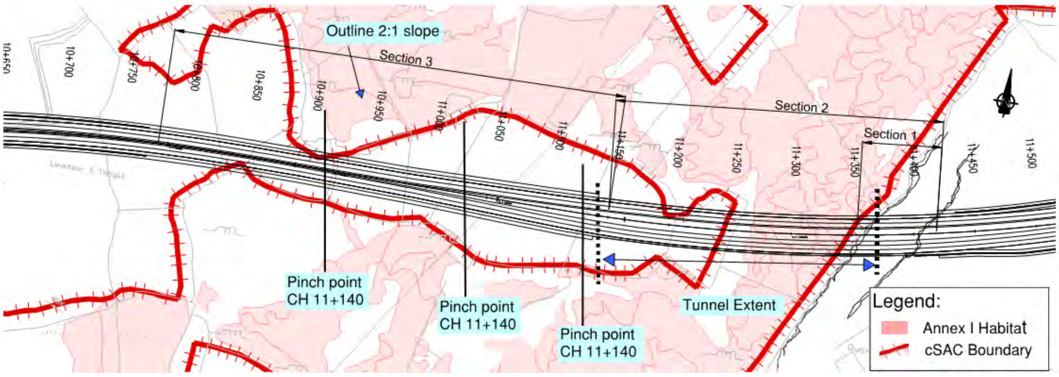
Potential impacts to the Limestone pavement and Calcareous grassland in close proximity to the proposed road development include significant ground settlement, slope instability and impact to the hydrogeological conditions which is discussed in **Chapter 5**.

6.4.1.2 Section 3 design and construction control measures

A retaining system will be installed to retain the Annex I habitat where required, this is generally where there is insufficient area (footprint) for the ground slope to be self-supporting between the existing ground level and the proposed road level. The overburden ground conditions encountered in Section 3, between existing and proposed alignment levels, would allow an unsupported 2 horizontal in 1 vertical slope however within Section 3 there are three pinch point locations where the footprint is too narrow for unsupported slopes to be viable, **Figure 6.8.** At these locations retaining systems will be installed to protect the Limestone pavement.

The retaining system is dependent on the ground conditions, overburden only, rock only and a combination of overburden and rock. As discussed in **Chapter 3** the rock head level changes significantly in Section 3. From the ground investigation data, the ground conditions ground at the pinch point locations where retaining systems are required vary from overburden only, rock only and a combination of overburden and rock ground conditions.

Figure 6.8: Plan Section outlining slope pinch points



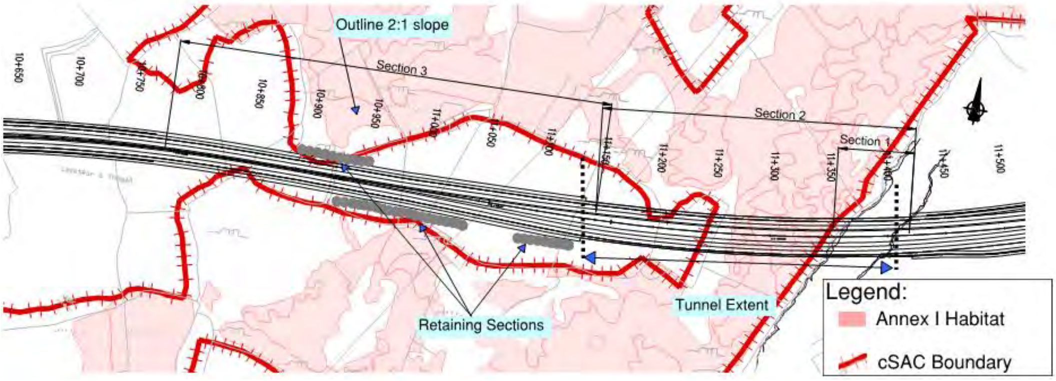
6.4.2 Slope retaining systems

The retaining systems that will be in Section 3 to control these impacts are shown in **Figure 6.9** and include:

1. Rock bolts, rock dowels, steel mesh, and sprayed concrete in areas of rock only
2. Piled retaining walls, supported with ground anchors in areas of overburden only and in areas with a combination of overburden and rock

Other support options include reinforced concrete retaining walls or gabion baskets filled with stone. It is also possible for a combination solution to be employed where one method is used to support the overburden by means such as gabion baskets and rock bolts/ rock dowels/ steel mesh / sprayed concrete are employed to support the exposed rock face. A combination solution will be implemented where shallow overburden is present which is located on the western extent of Section 3.

Figure 6.9: Plan Section illustrating the retained locations



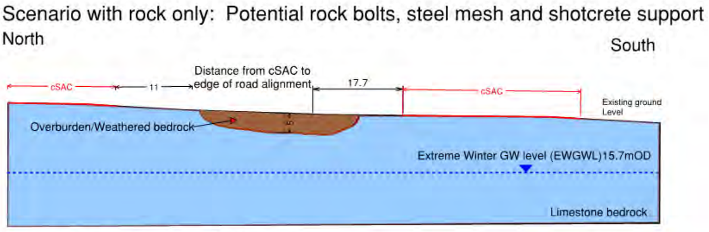
6.4.2.1 Rock retained slopes

Where rock only is present for the depth of the excavation, rock face stability composite control system will be implemented where required. This will include rock bolts, rock dowels, steel mesh and sprayed concrete as discussed in **Section 6.2.2.3**. It is envisaged that rock will be excavated predominately using drill and blasting methods. Similar to tunnelling, blast charge weights will be limited to cater for the proximity of a sensitive receiver which includes the Limestone pavement within the Lough Corrib cSAC.

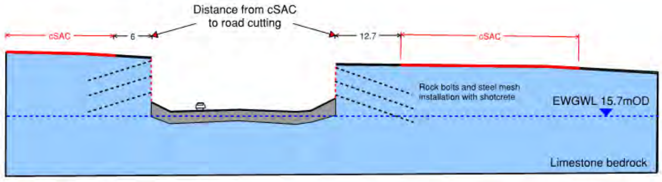
As part of the blasting assessment, a trial blast will be completed in a controlled environment in an area that will pose no risk to the Limestone pavement. This blast will determine the appropriate charge weight to be used, verifying and demonstrating that vibration will not affect the integrity of the Limestone pavement. In the event that blasting in not viable the rock will be excavated slowly using hydraulic hammers.

Rock mapping assessments will be completed in stages following the excavation 2-four metres of rock where the exposed rock face is mapped. A composite support system will be designed, implemented and installed for the rock face prior to excavation of the next stage (2-4m depending on the rock quality). Stability control measures in the form of rock bolts, steel mesh and sprayed concrete will be implemented where required. **Figure 6. 10** presents a schematic of the ground condition at one of the pinch points in Section 3 in rock only.

Figure 6.10: Schematic cSAC Pinch Point at CH10+930



CH 10+930 Existing Ground Conditions

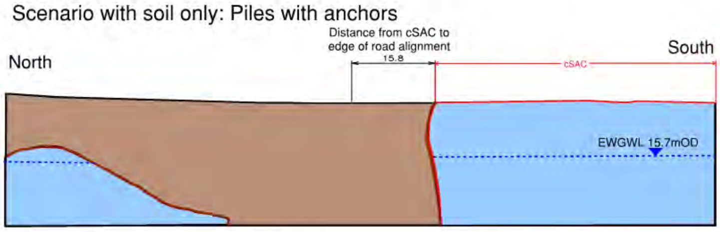


CH 10+930 Finished Road

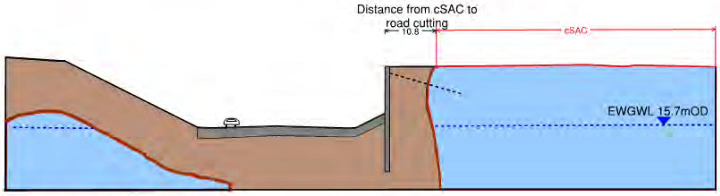
6.4.2.2 Piled retained slopes

In the central area of Section 3 (Western Approach) it is envisages that overburden only is present for the depth of the road excavation. In these locations a piled retaining wall solution will be installed, **Figure 6.11.** This retaining system is installed from the existing ground level prior to the alignment being excavated. The retaining structure may require permanent and/or temporary support in the form of ground anchors which are installed in the same way as rock bolts, through the retaining wall under the Limestone pavement. Ground anchors limit the temporary and long term deflection of the retaining wall and control the risk of settlement of the Limestone pavement. Horizontal deflections of the retaining walls will be monitored during construction to minimise movements of the ground.

Figure 6.11: Schematic Lough Corrib cSAC Pinch Point at CH. 11+030



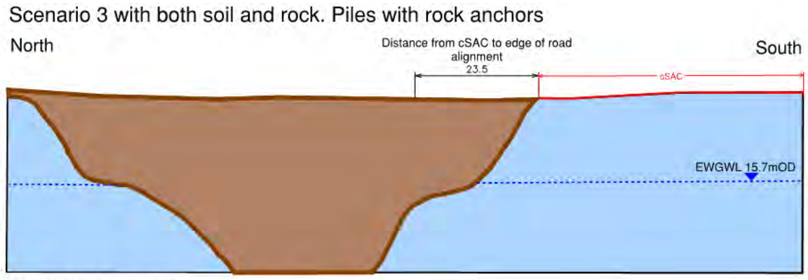
CH 11+030 Existing Ground Conditions



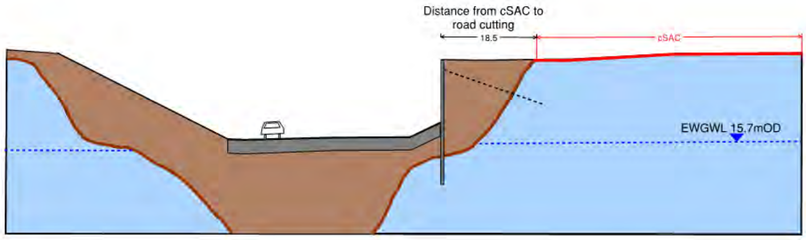
CH 11+030 Finished Road

Where a combination of overburden and rock is present for the depth of the road excavation, a piled retaining wall solution will be installed, **Figure 6.12.**

Figure 6.12: Schematic Lough Corrib cSAC Pinch Point at CH. 11+140



CH 11+140 Existing Ground Conditions

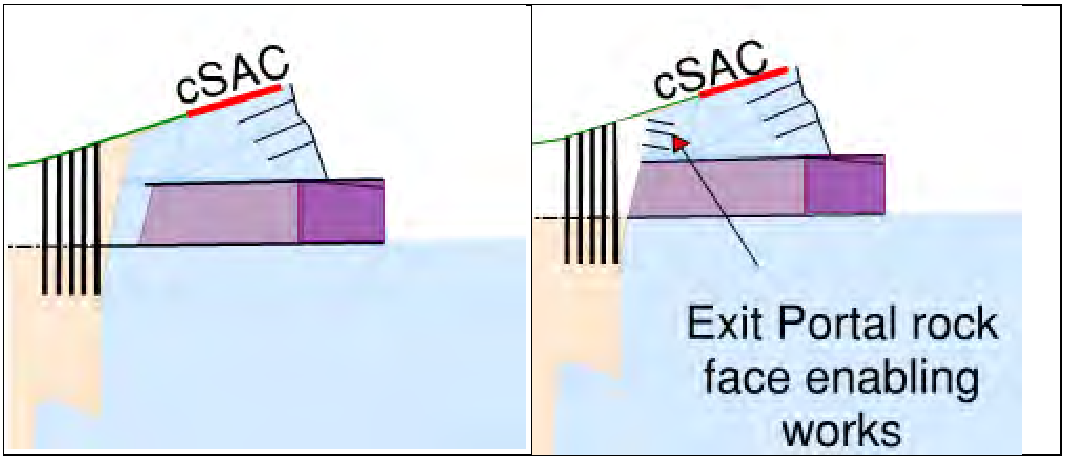


CH 11+140 Finished Road

6.4.3 Western tunnel portal

During the excavation of Section 3 the rock face at and above the western tunnel portal will be exposed. This rock face is c.110m from the Limestone pavement therefore there is no instability risk to the Annex I habitat. However there is a rock stability concern during the exiting of the portal and during the operation of the proposed road development. During excavation this rock face will be assessed as described for Section 1 for Lackagh Quarry rock face and enabling works will be installed where required. Stability works as described for the eastern tunnel entry portal and tunnelling works as described for Section 2 shall be utilised if required.

Figure 6.13: Schematic of the exit portal rock face enabling works



6.4.4 Operational phase

During the operational phase the excavated slopes will be monitored. In the unforeseen event that movement is recorded further stabilisation measures will be implemented to protect against any further movement or instability within the slopes.

There will be no impacts during the operational phase to the Lough Corrib cSAC from a geotechnical perspective.

6.5 Geotechnical summary

6.5.1 Potential construction and operational impacts to Limestone pavement from a geological perspective

The potential construction impacts introduced in **Chapter 4** and discussed in **Chapter 6** include:

1. Removal of the Limestone pavement habitat
4. Causing instability of the Limestone pavement above the tunnel entry portal, Section 1 or along the Western Approach, Section 3
5. Long-term instability of the Limestone pavement in Sections 1, 2 and 3

6.5.2 Design impact control measures

Section 1

In Section 1 the geotechnical appraisal considers the impacts that construction of the tunnel will have on the quarry face and the potential impact to the overlying Limestone pavement.

The discontinuity data indicates that the failure most likely to occur within the rock mass and impact upon the Limestone pavement is wedge failure and toppling.

A composite support system of rock bolts, steel mesh and sprayed concrete will be employed in Section 1. These proposed works will be completed prior to the tunnel excavation and be limited to the quarry face. These rock face protective measures will ensure that there will be no movement within the rock mass and therefore no impact to the Limestone pavement.

During the construction of the tunnel the Lackagh Quarry stabilised face will be monitored for movement and cracks to ensure no impact to the Limestone pavement. In the unforeseen event that movement is observed additional support systems will be installed.

During operational phase of the tunnel continued monitoring will take place to ensure that further stabilisation measures are implemented to protect against any further movement or instability within the rock mass surrounding the tunnel portal. During the operational stage of the tunnel there will be no impact on the Limestone pavement.

Section 2

In Section 2 the geotechnical appraisal considers the impacts that construction of the tunnel will have on the overlying Limestone pavement.

Lackagh Tunnel comprises a twin mined tunnel through approximately 250m of competent limestone under approximately 100 metre length of the Lough Corrib cSAC.

To reduce the risk of impact to the Lough Corrib cSAC the size, separation and minimum rock cover to the tunnels is specified based upon geological information.

Directly under the Lough Corrib cSAC a minimum of 8m clear rock will be maintained above the tunnel crown to ground level (top of rock). This 8m allows a sufficiently stable rock arch to develop around the tunnel which will ensure the stability of the tunnel in the temporary case.

Having two tunnels in close proximity to each other a minimum pillar width of 7m of rock will be maintained. This is designed to acts as the support for the arch around both tunnels. To reduce the risk caused by the potential presence of karst features probing ahead of the tunnel face will be carried out. This probing will identify any cavities, where encountered they will be investigated and backfilled/bridged.

Excavation of the tunnel is in a cyclic manner with drilling, blasting, rock face mapping, mucking out, and installation of support measures. Temporary support works in the tunnel in the form of steel arch supports, rock bolts and sprayed concrete will be installed to form a reinforced rock arch support allowing the tunnel to be excavated without causing risk of collapse.

Permanent tunnel stability will be provided by a cast in-situ reinforced concrete lining.

Section 3

In Section 3 the geotechnical appraisal considers the impacts that construction of the Western Approach will have on the neighbouring Limestone pavement.

Retaining systems will be installed to retain the Annex I habitat where required, this is generally where there is insufficient area (footprint) for the ground slope to be self-supporting between the existing ground level and the proposed road level. These locations area known as ‘pinch points’.

Retaining systems are dependent on the ground conditions in the pinch point locations. The retaining systems that will be in Section 3 to control these impacts include:

1. Rock bolts, rock dowels, steel mesh, sprayed concrete in areas of rock only
2. Piled retaining walls, supported with ground anchors in areas of overburden only and in areas with a combination of overburden and rock

The exposed rock face surrounding the western tunnel portal will be continuously assessed during excavation. Where required stability control measures will be implemented in the form of rock bolts, steel mesh and sprayed concrete.

7 Combined hydrogeological and geotechnical appraisal

Following the independent hydrogeological and geotechnical appraisal of Sections 1, 2 and 3 in **Chapters 5 and 6** this chapter outlines the combined requirements of the proposed works.

7.1 Section 1

In Section 1 it is envisaged that a composite support system of rock bolts, steel mesh and sprayed concrete will be used. In the event that sprayed concrete is used groundwater seepage from the quarry face will be facilitated by installing weep holes. A weep hole is a small opening that will allow water to drain from the rock mass, the frequency of weep holes will be based on the expected groundwater seepage from the quarry face. Allowing water to escape will reduce any water build-up behind the shotcrete layer.

7.2 Section 2

The proposed finished road level within the tunnel ranges from +14.8 to +17.0mOD. To facilitate groundwater flow around the completed tunnel a drainage blanket up to the winter groundwater level (+15.7mOD) will be incorporated during construction. It is envisaged that this will take the form of a drainage layer, drainage pipes or similar placed outside the permanent cast in-situ reinforced concrete tunnel lining and waterproof membrane.

7.3 Section 3

As discussed, the recorded winter groundwater level in the Ballindooley West Groundwater Body (+15.7mOD) is above the proposed road level in Section 3 where the proposed finished road level ranges from +12.7 to +14.8mOD. The following construction control measures are recommended for Section 3:

- No dewatering of the bedrock aquifer due to the sensitive nature at the groundwater dependent habitat at nearby Coolagh Lakes
- Where excavation into subsoils below the winter groundwater level is required, an additional geotechnical investigation to establish the overburden permeability will be required to determine if inflows to the excavation will occur from the bedrock aquifer. In the case that inflow is likely (high permeability subsoil), construction below the groundwater level is not permitted. The additional geotechnical investigation will calculate groundwater seepage based on an assessment of permeability, thickness of overburden between the excavation and the bedrock aquifer and geotechnical stability.
- A watertight seal to be installed on the underside of the road base and the cutting sides to protect against groundwater inflow. This area will be sealed during construction (and permanently) to +17.7mOD; groundwater high (+15.7mOD) plus 2m free board.

8 Summary

There are a number of Annex I habitats adjacent to the proposed road development in the area which is the subject of this report, some of which are located within or immediately adjacent to the Lough Corrib cSAC and some of which are groundwater dependent.

The proposed road development tunnels beneath the Lough Corrib cSAC from the western face of Lackagh Quarry in a westerly direction and then enters a cutting which runs adjacent to the Lough Corrib cSAC boundary towards Coolagh, Menlough and before crossing over the River Corrib.

Construction and operation of Lackagh Tunnel and the Western Approach, and associated hydrogeological changes as a result of the proposed road development to the local environment has the potential to directly and indirectly impact these sensitive habitats. This report provides a geotechnical and hydrogeological assessment and scientific data of the potential impacts to inform the design of the proposed road in this area and fully understand the potential effects on the integrity of the Lough Corrib cSAC as a result of Lackagh Tunnel.

From the geological and hydrogeological characterisation in the area of interest it is apparent that the modern undulating landscape masks an ancient landscape of deep karst landforms and valleys up to 100m in depth but now buried by thick subsoils. The rock topography and sediment fill is an integral part of the hydrogeology of the region, which along with the Lough Corrib, River Corrib and Galway Bay allows the groundwater bodies and catchments to be delineated and flow paths identified.

The design of the proposed road development in this area has incorporated characterisation of the geology and hydrogeology so as to identify where potential impacts are likely and to mitigate against them accordingly to reduce risk.

From the assessment, the main areas of geological and hydrogeological risks to the QI Annex I habitats have been identified and are summarised below:

- Impact on groundwater recharge from runoff on sealed drainage over the operation of the lifetime of the proposed road development
- The potential impact from operation of the proposed road development on groundwater dependent habitats at Coolagh Lakes by interception of the groundwater table and modification of the extents of the groundwater catchment
- Potential pollution of groundwater from construction and operation
- Instability of Lackagh Quarry rock face during construction of the tunnel and operation of the proposed road development
- Instability of Lackagh Tunnel during construction and operation
- Instability of Lackagh Tunnel due to karstic features

- Instability where the road excavation requires an excavation slope steeper than a 2 (horizontal) in 1 (vertical) due to the proximity of the Limestone pavement during construction and operation.

Impact on recharge will impact on the groundwater level responses in the aquifer to storm events. Worst case scenario is a reduction in recharge from the proposed road development that would lead to a reduction in groundwater levels and create risk for groundwater dependent habitats during the summer when groundwater inflow is reduced. As the design of the proposed road development captures, treats and infiltrates all runoff to the ground then there will be no net loss in recharge to the groundwater catchments and potential impacts from reduction in groundwater quantity are mitigated.

Interception of groundwater and the modification of groundwater bodies or catchments has the potential to reduce flow to groundwater dependent habitats. The assessment includes the delineation of groundwater bodies and catchments. In doing so particular attention has been applied to the area of the catchment boundaries so that the proposed design will not modify the extent of the groundwater body. As such, particular attention has been applied to the groundwater catchment divide to ensure that these are not modified by the proposed works. This includes replacement of natural barriers where required so as to maintain the groundwater regime of the existing environment. This is particularly the case in the Lackagh Tunnel were the tunnel and Western Approach is sealed to prevent groundwater ingress.

In order to reduce potential impacts from pollutants the design of the proposed road development incorporates control measures including zero dewatering in bedrock where there is sensitive GWDE as well as mitigation by good working practice and having spill kits onsite for rapid response in the case of an accident. The design for the operational phase of the proposed road development includes treatment of all road runoff with infiltration of discharges to ground via an infiltration pond.

The potential impacts from the instability of Section 1 (Lackagh Quarry Face), the construction of Section 2 (Lackagh Tunnel) and operation and slope stability of the Section 3 (Western Approach) can be mitigated by engineered solutions. Section 1 will be supported where required by an engineered composite support system of rock bolts, steel mesh and sprayed concrete. Tunnel excavation and construction will be supported by Canopy Tubes, sub horizontal spiles, a portal steel structure and rock bolts. Bridging and backfilling of karstic features identified by probing will resolve the risk due to karst. The blast charge will be designed considering the sensitive receptor limits. In the permanent and operating condition the tunnel will be supported by a cast in-situ reinforced lining. Where steepened embankments are required due to the proximity to the Annex I habitat a suitable retaining system will be installed depending on the ground conditions. Retaining systems in rock will include rock bolts, rock dowels, steel mesh, and sprayed concrete. In areas of overburden only and a combination of overburden and rock piled retaining walls with ground anchors are recommended.

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Appendix A

Ground Investigation Factual Report

A1

R15-16

N6 Galway City Transport Project

Phase 3 Ground Investigation

Contract No. 2 - Factual Report

Galway County Council

Prepared by BRG Ltd. on behalf of Priority Drilling Ltd.

Dave Blaney

Project Number:	**R15/16**
Author(s):	Dave Blaney P. Geo
BRG Ltd.	Galway County Council
Date of Report:	May 2016

R15/16
N6 Galway City Transport Project - Phase 3 Ground Investigation Contract No. 2 - Factual Report
Dave Blaney P.Geo
May 2016

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1. Purpose and Scope of Works

Galway County Council, on its own behalf and on behalf of Galway City Council, are committed to developing a solution to the existing transportation issues in Galway City and its environs, which are having a negative impact upon the local, regional and national road network. As part of this work it is necessary to undertake ground investigation works prior to the commencement of detailed design work.

The Menlough region, within and to the immediate west of Lackagh Quarry, has been selected as a possible route for the N6 road development (Figure 1).

Figure 1: Lackagh Quarry Ground Investigation Site - Yellow Polygon (Google 2015)

The site consists of a non-active quarry with associated derelict, buildings, plant, structures and poor quality agricultural land used for the grazing of cattle (Figure 2).

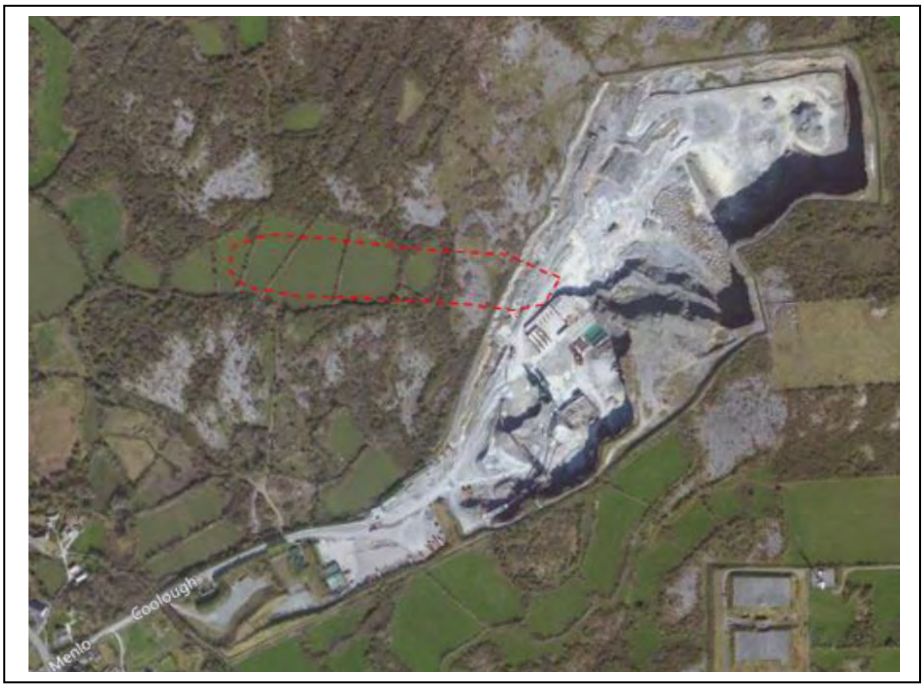

Figure 2: Site Area - Dashed Red Line (Bing 2015)

This area is in an environmentally sensitive region, with the Lough Corrib, SAC No. 000297 (Special Area of Conservation), located immediately west and north of the Lackagh Quarry site (Figure 3).

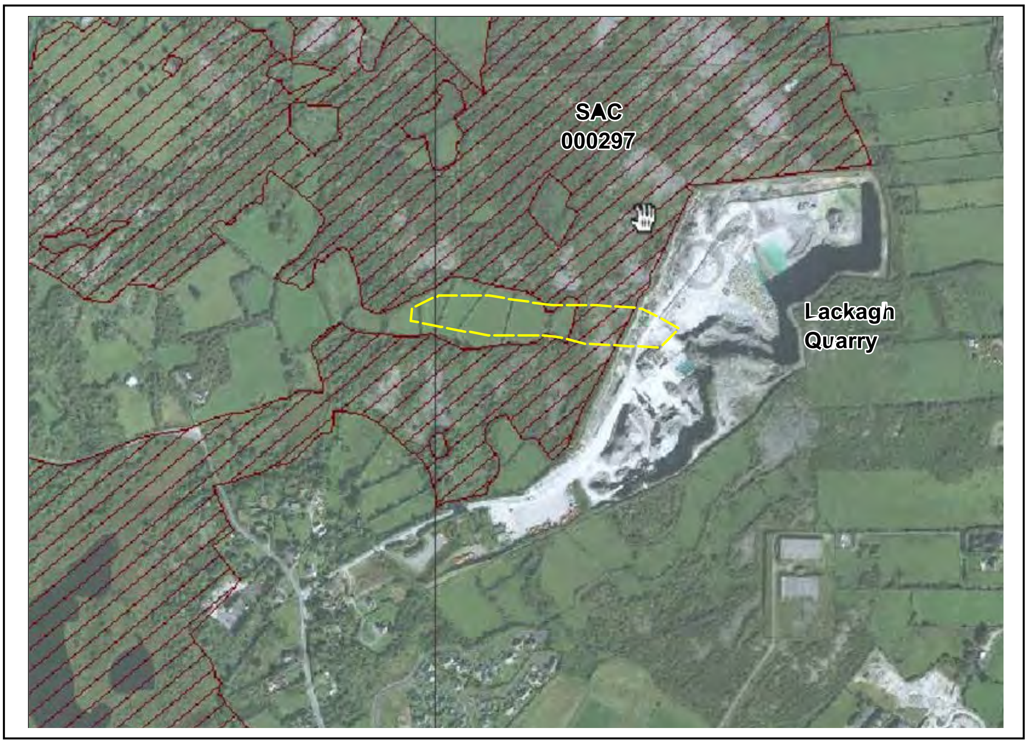

Figure 3: SAC Location (Red Hashed Area) (NPWS 2015)

The objective of the ground investigation is as follows:

- Characterise the nature of the rockmass for tunnel design;
- Characterise the hydrogeology for tunnel design and the existing groundwater conditions;
- Indentify any existing karst features and potential for karstic conditions with the rockmass
- Carryout in-situ and laboratory testing to provide geotechnical and hydrological parameters for tunnel design

In order to accomplish the stated objectives the following ground investigation was proposed:

- 1 No. Sub-horizontal rotary cored drillhole along the proposed tunnel alignment for a length of approximately 300m
- 3 No. Vertical Rotary cored drillholes to depths of 32.5m, 35.0m and 40.0m
- 3 No. Monitoring Installations (piezometers) with raised steel covers
- Geotechnical Laboratory Testing

- Downhole Geophysics
- Surface Geophysics
- Factual Reporting

2. Geological Setting and Ground Conditions

The site is underlain by Lower Carboniferous (Visean) Limestone located approximately 2km to the northeast of the contact with the Galway granitic intrusive complex (Figure 4). There is little published data for this region and Geological Survey of Ireland (GSI) 1:100,000 scale Bedrock Map series record this area as Undifferentiated Visean Shelf Limestones.

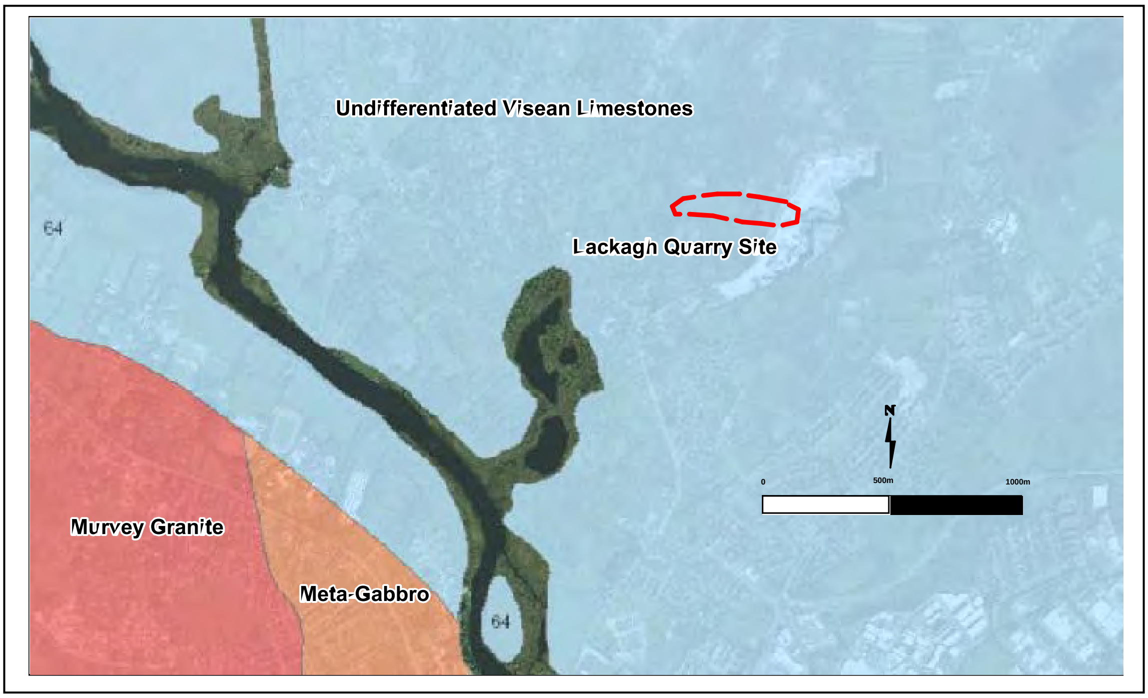

Figure 4: Simplified Geology Map of the Memlo Region (GSI 1:100,000 series)

The bedrock geology is dominated by light grey / grey, massively bedded, fine to medium grained pellety to weakly oolitic grainstones. Discrete, metric scale, beds of dark grey / black limestones are developed within the sequence. The black limestone beds are dominated by synsedimentary breccias with intraclastic clasts of grainstone supported in a black fine grained micritic matrix. There is evidence of burrowing and the brecciation may have been caused by bioturbation. Minor bioclastic debris is disseminated throughout, dominated by unrecognisable small shell fragments. Locally occurring coarse bioclastic fragments consist of thick shelled brachiopods and solitary corals. The fauna and well sorted nature of the rock are indicative of a shallow water, relatively high energy depositional environment. Thin (centimetric scale), horizons of grey / green to black mudstone form semi-continuous marker horizons within the geological sequence. The mudstone horizons (often known as clay wayboards) can be weakly tuffaceous, often containing a significant proportion of finely disseminated pyrite. The pyrite in these thin bands oxidises strongly and is responsible for the surficial iron staining present on parts of the lower benches at Lackagh Quarry.

The unconsolidated Quaternary geology of this region has been proven by the recent drilling to be much more complex than originally anticipated. A deep buried channel /

trough is located to the west orientated along an east-west axis. Unconsolidated material deposited within this feature ranges from lacustrine, laminated (possibly varved) dark brown, organic clays to sands / gravels of a possibly fluviatile origin, all overlain by very stiff, glacial boulder clays.

Extensive areas of limestone pavement are developed to the north and west of the quarry site and there are numerous glacial erratics scattered throughout, many of which are granitic.

3. Ground Investigations

3.1 Setting Out / Surveying

Drawings and coordinates were provided by ARUP and were used to locate and position each borehole and geophysical station. The drillhole collar locations were positioned using a Trimble GeoExplorer 6000 RTK GPS system corrected to a differential base station through a phone modem link. Locations were measured relative to Irish Transverse Mercator.

The low angle borehole, BH01, was set out using the Trimble GeoExplorer 6000 RTK GPS system. The hole / working platform was orientated using a prismatic compass, accurate to +/- 0.5°. The rig was then set up using a Reflex TN14 Gyrocompass to measure the exact dip and azimuth of the hole before coring commenced.

Downhole surveying of drillhole BH01 was carried out at 3m intervals using a Reflex EZ-TRAC digital downhole survey instrument. Owing to ground conditions (cavities and localised broken ground from 186m) the hole could only be surveyed from 175m back to surface. A core orientation tool had been used throughout the drilling that provided information about the dip of the hole, the driller noted no significant variation in dip from 175m. Refer to Appendix I for all surveying data.

3.2 Rotary Borehole Investigation

Five rotary boreholes were drilled during this phase of the investigation. Four vertical and one low angle borehole drilled from the quarry floor (Figures 5 & 6).

DHID	East	North	Elevation	Dip	Azimuth	Length (m)
BH01	530370.592	728426.557	16.712	-11.5°	268.3°	276.7
BH03	530023.824	728382.566	26.256	-90°	360°	109.9
BH04	530150.783	728400.125	32.167	-90°	360°	35
BH05	530186.649	728378.105	34.138	-90°	360°	40.3
BH06	530125.143	728383.081	30.799	-90°	360°	45

Table 1: Borehole Collar Locations

The low angle borehole, BH01, was drilled using a Dura Lite rig producing HQ diameter core (63.5mm). This borehole was drilled using a 3m hexagonal core barrel in order to minimise droop and deflection away from the planned section. The borehole was collared at an azimuth of 268.3° N_{mag} and a dip of -11.5° to the horizontal. BH01 was located within the boundary of the quarry and was designed to drill into the quarry face. The hole was located at the base of the second bench and rig was stepped back approximately 6m from the quarry face. The face was scaled back before the rig was moved onto site using an excavator to remove loose, unstable rock material that was at risk of collapse. A concrete plinth was constructed between the borehole collar and the quarry face to support the rods whilst drilling and accordingly the first 6m cored from BH01 consists of concrete.

BH01 was drilled to a final depth of 276.7m. It was scheduled to drill to approximately 300m. However, poor quality and unconsolidated / cavernous ground intersected from 272.4m to the end of hole at 276.7m meant that the hole could not be continued.

After drilling was completed borehole BH01 was sealed at a depth of 175m using a Vann Ruth plug and was then backfilled with a cement / bentonite grout from 175m back to surface. The cavities in the lower part of the hole (175.0 - 276.7m) contributed to localised unstable ground conditions and it was considered a significant possibility that they may act as conduits to draw the cement / bentonite grout away from the hole, therefore, a plug was installed at 175m to seal the lower part of the hole.

The vertical boreholes (BH03, BH04, BH05 & BH06) were all drilled using a top drive Hang Seng drilling rig producing PQ diameter drill core (85mm). The holes were collared along the line of the proposed tunnel route to the west of the quarry. BH03 was scheduled to drill to a depth of 32.5m, however, it drilled through a deep overburden feature with very challenging, poorly consolidated ground, intersecting rock at a depth of 104.95m and stopping at a depth of 109.9m. The hole was cored to 85.55m in PQ and subsequently cased to 85m with PW casing. It was then open hole drilled using a HQ tricone until competent ground was intersected at 104.95m and continued to the end of hole with HQ core. Due to the instability of hole BH03 the planned piezometer could not be installed or the downhole geophysical survey carried out. It was backfilled with a cement / bentonite grout upon completion.

BH04 and BH05 were drilled to scheduled depths and intersected the expected geological succession of shallow overburden overlying competent, massively bedded limestones. Piezometers were installed in both of these holes. BH06 was an additional hole added to the ground investigation to test a zone of transition from competent to poorly consolidated rock / overburden that had been detected by the ground geophysical survey. This hole was drilled to a final depth of 45m in unconsolidated clay, sand and gravel it was backfilled with a cement grout from the end of hole back to a depth of 11.0m. A stand pipe was installed in the top of the hole.

The core from the rotary drilling was logged in accordance with the BS5930:1999 specification. A detailed geological description of the rock was generated and a quantitative description of the fracture state of the rock core was provided for each borehole, including:

- Total Core Recovery (TCR)
- Solid Core Recovery (SCR)
- Fracture Index (FI)
- Fracture Number (FNo.)

- Rock Quality Designation (RQD)

The logs were generated using HoleBase AGS software (Hard copies - Appendix II).

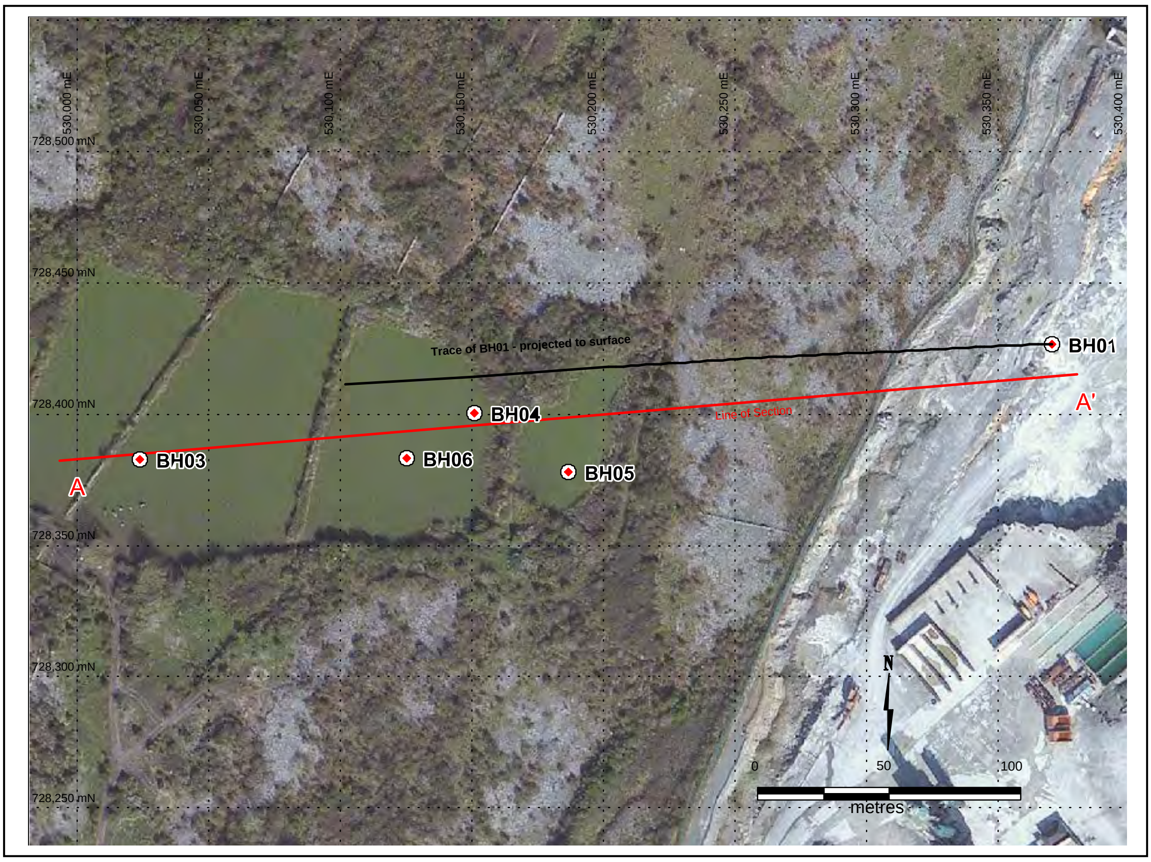

Figure 5: Borehole Collar Locations, Traces and Line of Section

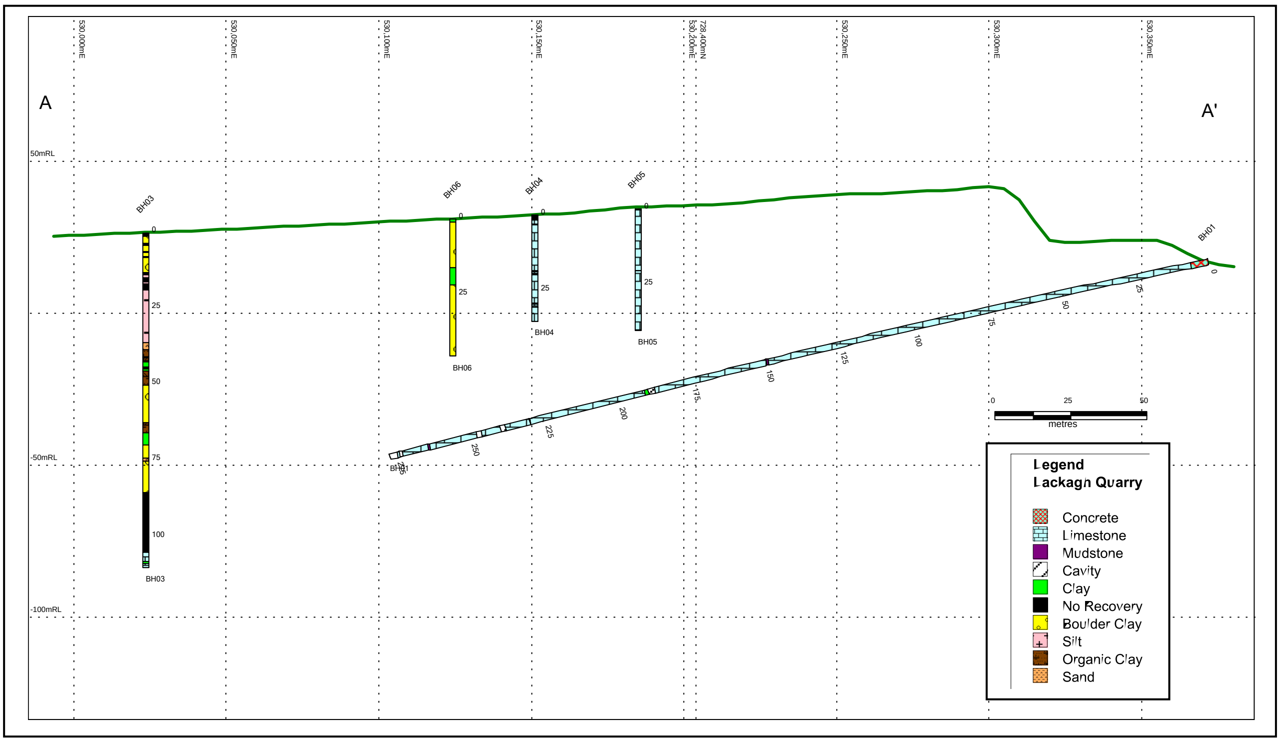

Figure 6: A - A' Drill Section (looking North) through the Lackagh Quarry GI Site

3.3 Discontinuity Logging

Discontinuity logging of rock cores was carried out using the ARUP "Rock Core Discontinuity Log" template for holes BH01, BH04 and BH05. The following headings were used:

- Orientation
- Spacing
- Roughness
- Weathering
- Infilling
- Number of Discontinuity Sets

The core from BH01 was orientated using a core orientation system mounted on the core barrel. and the discontinuities were measured relative to the invert of the core.

See Appendix III for the discontinuity logs.

3.4 Piezometer Installations

Three piezometers were installed in the vertical boreholes located to the west of the quarry. They were installed in boreholes BH04, BH05 and BH06. A summary of the installation design can be seen in Tables 2 - 4.

From (m)	To (m)	Installation
0.00	28.00	Blank 19mm PVC Pipe
28.00	34.00	Slotted 19mm PVC Pipe
34.00		End Cap
0.00	21.00	Cement Grout
21.00	23.00	Bentonite Pellets
23.00	24.00	Sand
24.00	34.00	Pea Gravel
34.00	35.00	Gravel Base

Table 2: BH04 Piezometer Installation Details

From (m)	To (m)	Installation
0.00	33.00	Blank 19mm PVC Pipe
33.00	39.00	Slotted 19mm PVC Pipe
39.00		End Cap
0.00	19.00	Cement Grout
19.00	23.00	Bentonite Pellets
23.00	24.00	Sand
24.00	39.00	Pea Gravel
39.00	40.30	Gravel Base

Table 3: BH05 Piezometer Installation Details

From (m)	To (m)	Installation
0.00	4.00	Blank 19mm PVC Pipe
4.00	10.00	Slotted 19mm PVC Pipe
10.00		End Cap
0.00	1.00	Cement Grout
1.00	2.00	Bentonite Pellets
2.00	3.00	Sand
3.00	11.00	Pea Gravel
11.00	45.00	Cement Grout

Table 4: BH05 Piezometer Installation Details

3.5 Ground Geophysical Surveying

Ground geophysical surveying was specified for the Lackagh Quarry Ground Investigation. BRG Ltd were sub-contracted by Priority Drilling Ltd. to carry out the surveying. The geophysical surveys consisted of 2D Electrical Resistivity Tomography (ERT) and Microgravity across an initial area of roughly 300x30m, this area was subsequently extended to define the lateral and depth extent of a zone of deep overburden. The surveys were designed to test for subsurface heterogeneity and bedrock depths in advance of follow up rotary core drilling. Information on potential karst features were of particular interest to the client.

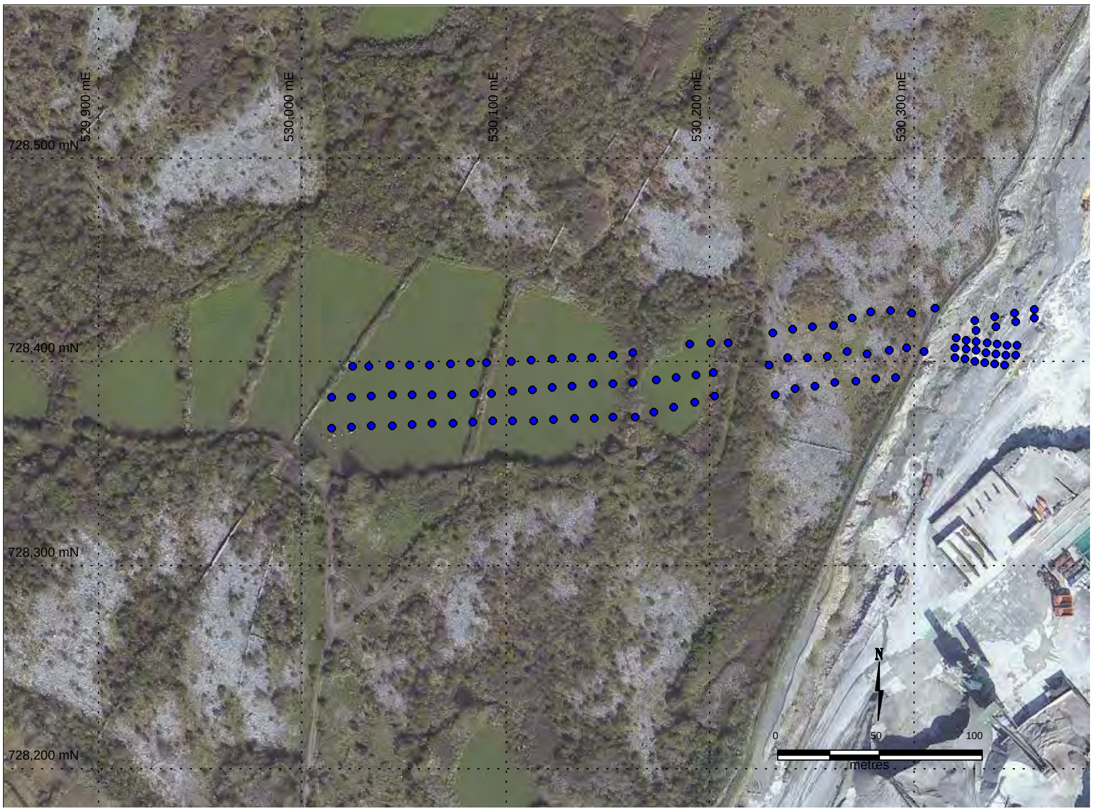

Figure 7: Microgravity Station Locations

Microgravity data was acquired with measured sites along the centre line and 15m either side of the proposed tunnel section. These lines were measured with nominal station spacing of 10m, with gaps where scrub hawthorn was too thick. Extra stations were measured within the quarry on the first bench at 5-10m intervals. Measurements were taken using a Lacoste & Romberg model G gravity meter. Instrument drift was monitored by returning to a locally established base station at hourly intervals.

Stations were topographically surveyed using a Trimble GeoExplorer 6000 RTK GPS system corrected through phone modem link for both the ERT and the gravity surveys. The drift corrected gravity data was corrected for elevation, latitude, and reduced to Bouguer 2.67g/cm^3 to allow for local average rock densities. It was then gridded and exported for display and interpretation in the MapInfo GIS system (Figure 7).

Figure 8: 2D Electrical Resistivity Tomography (ERT) Line / Station Locations

The depth mapping potential with the ERT is limited by the length of each spread. The variability of line lengths meant that the ERT surveying was capable of surveying to a minimum depth of 22m bgl on Line 5 to a maximum depth of 60m bgl on Line 6. Equipment used was an Allied Associates Tigre system which has the potential for up to 128 electrode takeouts. 2m station spacing was initially used to get the required detail along the chosen lines, with 3m intervals on the long lines (6, 7 & 8). Data was

measured using a Wenner array, controlled by an Imager2006 programme with a laptop computer. Saved data was inverted using the Geotomo Res2Dinv programme and exported as an image file displaying a cross section of the inverted Resistivities with elevation data. The resultant resistivity sections were subsequently interpreted and an interpreted geological model developed.

Resistivity sections from the 2D ERT and the microgravity data show a marked contrast from high resistivity bedrock in the east with a sharp contact into very low resistivity zones to the west. The western region has a low gravity response coincident with the low resistivity. The base of the initial ERT lines did not penetrate below 30m, however, the low resistivity zone developed to the west suggests that this area was dominated by a significant deep overburden feature. Subsequent 2D ERT surveying, particularly line 6 defined a channel / basin shaped feature developed along a roughly east - west axis with sharp contacts to the north and south. The northern side of the feature seems to be step down into the core of the channel, which is roughly coincident with BH03.

The surface geophysical report is appended as Appendix V.

3.6 Borehole Geophysical Surveying

Ground geophysical surveying was specified for the Lackagh Quarry Ground Investigation. European Geophysical Services Ltd were sub-contracted by Priority Drilling Ltd. to carry out this surveying. It was originally intended to survey three boreholes, however, the poor ground conditions encountered in BH03 meant that only BH04 and BH05 were surveyed.

The geophysical surveys consisted of:

- Optical Televiewer
- Acoustic Televiewer
- Fluid Temperature and Conductivity, Natural Gamma Calliper
- Impeller Flowmeter
- Focused Resistivity
- Full Wave Sonic Velocity
- Pumped Temperature and Conductivity

Report attached as Appendix VI

3.7 Rock / Soil / Water - Laboratory Testing

Core samples were taken from the rock / soil recovered during the drilling operations and forwarded to two accredited laboratories for a testing. The Celtest Laboratory near Bangor in North Wales was selected to carry out the rock testing. The Priority Geotechnical Soil testing Laboratory was selected to carry out the soil testing.

Test	BH01 (No.)	BH04 (No.)	BH05 (No.)	Total Number of Tests
Deformability in Uniaxial Compression	10	5	5	20
Indirect Tensile Strength by Brazilian Test	3	1	1	5
Natural Water Content	40	10	9	59
Oxidisable Sulphate	5	1	1	7
pH Value	5	1	1	7
Point Load	58	25	25	108
Porosity / Density using Saturation & Buoyancy	15	2	3	20
Porosity / Density using Saturation & Calliper	15	2	3	20
Thin Section Petrography	2	1	1	4
Total Sulphur	6	1	1	8
Uniaxial Compressive Strength	36	10	10	56
Total	**195**	**59**	**60**	**314**

Table 5: Scheduled Rock Tests

Test	BH03 (No.)	BH06 (No.)	Total Number of Tests
Atterberg Limits	9	3	12
Moisture Content	19	3	22
Oedometer	4	3	7
Organic Matter Content	9	3	12
Particle Size Distribution	9	0	9
pH Value	5	0	5
Triaxial Test (Unconsolidated / Undrained)	5	3	8
Total	**60**	**15**	**75**

Table 6: Scheduled Soil Tests

A suite of aggregate tests had been scheduled in the Bill of Quantities, including:

- Slake Durability Index
- Los Angeles Coefficient
- Aggregate Crushing Value
- Ten Percent Fines
- Aggregate Impact Value
- Aggregate Abrasion Value
- Polished Stone Value
- Aggregate Frost Heave

The volume of material required to carry out these tests was excessive (e.g. the Aggregate Frost Heave test needs a minimum of 75kg of rock) and would have taken the bulk of the available drill core. Given the relatively homogenous nature of the limestone intersected it was agreed that a representative bulk sample would be acquired from the quarry and sent for the specified aggregate testing. Accordingly, a composite, 275kg, representative sample was obtained from the quarry and sent to Celtest.

Water samples were obtained from the piezometers in boreholes BH04, BH05 and BH06 and sent to the IAS Laboratory in Bagenalstown, Co Carlow for testing for major cations and anions.

Test results are summarised in Tables 7 - 10 certificates are attached as Appendix VII

Location ID	Sample ID	Depth Top	Depth Base	Test	Result
BH01	**48861**	6.70	6.80	Moisture Content	**1.20%**
BH01	**48862**	10.36	10.46	Point Load	**79.3MPa**
BH01	**48863**	10.46	10.69	Uniaxial Compressive Strength	**97MPa**
BH01	**48864**	10.69	10.76	Point Load	**78MPa**
BH01	**48865**	10.89	10.97	Porosity / Density using Saturation and Buoyancy	**0.5 / 2.63**
BH01	**48866**	10.97	11.07	Porosity / Density using Saturation and Calliper	**0.47/2.69**
BH01	**48867**	11.57	11.94	Deformability in Uniaxial Compression	**99.8MPa**
BH01	**48868**	13.26	13.35	Moisture Content	**1.60%**
BH01	**48869**	13.35	13.45	Point Load	**82.9MPa**
BH01	**48870**	13.45	13.70	Uniaxial Compressive Strength	**59MPa**
BH01	**48871**	13.70	13.80	Point Load	**71.9MPa**
BH01	**48872**	16.30	16.40	Point Load	**67.7MPa**
BH01	**48873**	16.40	16.66	Uniaxial Compressive Strength	**73MPa**
BH01	**48874**	16.66	16.80	Point Load	**76.5MPa**
BH01	**48875**	22.40	22.50	Porosity / Density using Saturation and Calliper	**0.58/2.65**
BH01	**48876**	22.50	22.60	Porosity / Density using Saturation and Buoyancy	**1.2 / 2.70**
BH01	**48877**	26.20	26.36	Point Load	**47.1MPa**
BH01	**48878**	26.36	26.61	Uniaxial Compressive Strength	**100MPa**
BH01	**48879**	26.61	26.70	Point Load	**60.5MPa**
BH01	**48880**	27.85	28.15	Deformability in Uniaxial Compression	**112.4MPa**
BH01	**48881**	32.65	32.72	Moisture Content	**1.40%**
BH01	**48882**	34.44	34.48	Point Load	**88.8MPa**
BH01	**48883**	34.48	34.73	Uniaxial Compressive Strength	**69MPa**
BH01	**48884**	34.73	34.83	Point Load	**62.2MPa**

BH01	**48885**	44.35	44.40	Porosity / Density using Saturation and Calliper	**0.54/2.70**
BH01	**48886**	44.45	44.54	Point Load	**84.8MPa**
BH01	**48887**	44.54	44.79	Uniaxial Compressive Strength	**83MPa**
BH01	**48888**	44.79	44.90	Point Load	**53.0MPa**
BH01	**48889**	45.65	45.74	Porosity / Density using Saturation and Buoyancy	**0.5/2.68**
BH01	**48890**	48.90	49.16	Deformability in Uniaxial Compression	**187.5MPa**
BH01	**48891**	53.80	53.93	Total Sulphur	**<0.1%**
BH01	**48892**	55.30	55.40	Oxidisable Sulphate	**<0.01%**
BH01	**48893**	55.84	55.92	pH Value	**9.1**
BH01	**48894**	56.50	56.60	Point Load	**64.4MPa**
BH01	**48895**	56.60	56.85	Uniaxial Compressive Strength	**138MPa**
BH01	**48896**	56.85	56.93	Point Load	**63.9MPa**
BH01	**48897**	57.30	57.40	Moisture Content	**1.10%**
BH01	**48898**	61.65	61.75	Moisture Content	**1.20%**
BH01	**48899**	62.76	62.86	Point Load	**83.4MPa**
BH01	**48900**	62.86	63.05	Uniaxial Compressive Strength	**65MPa**
BH01	**50857**	63.05	63.16	Point Load	**49.6MPa**
BH01	**50858**	64.20	64.50	Indirect Tensile Strength by Brazilian Test	**7.8MPa**
BH01	**50859**	65.40	65.50	Total Sulphur	**<0.1%**
BH01	**50860**	65.66	65.75	Porosity / Density using Saturation and Buoyancy	**0.2/2.72**
BH01	**50861**	65.75	65.92	Porosity / Density using Saturation and Calliper	**0.64/2.69**
BH01	**50862**	66.00	66.10	Point Load	**69.6MPa**
BH01	**50863**	66.10	66.34	Uniaxial Compressive Strength	**104MPa**
BH01	**50864**	66.34	66.45	Point Load	**62.6MPa**
BH01	**50865**	67.07	67.20	Moisture Content	**1.10%**
BH01	**50866**	67.20	67.28	Porosity / Density using Saturation and Calliper	**0.57/2.71**
BH01	**50867**	68.50	68.59	Porosity / Density using Saturation and Buoyancy	**0.2/2.63**
BH01	**50868**	70.10	70.20	Moisture Content	**1.30%**
BH01	**50869**	72.10	72.30	Deformability in Uniaxial Compression	**136.3MPa**
BH01	**50870**	73.03	73.10	Moisture Content	**1.60%**
BH01	**50871**	76.00	76.09	Moisture Content	**1.20%**
BH01	**50872**	79.10	79.18	Point Load	**51.8MPa**
BH01	**50873**	79.18	79.40	Uniaxial Compressive Strength	**62MPa**
BH01	**50874**	79.40	79.52	Point Load	**48.0MPa**
BH01	**50875**	80.04	80.12	Moisture Content	**1.20%**
BH01	**50876**	81.70	81.78	Moisture Content	**1.60%**
BH01	**50877**	87.50	87.57	Moisture Content	**1.80%**
BH01	**50878**	39.70	39.80	Moisture Content	**1.30%**
BH01	**50879**	91.10	91.20	Total Sulphur	**<0.1%**
BH01	**50880**	91.34	91.42	Porosity / Density using Saturation and Calliper	**0.49/2.71**

BH01	**50881**	91.42	91.51	Porosity / Density using Saturation and Buoyancy	**1.0/2.70**
BH01	**50882**	91.63	91.71	Moisture Content	**1.80%**
BH01	**50883**	92.35	92.47	Point Load	**73.3MPa**
BH01	**50884**	92.47	92.70	Uniaxial Compressive Strength	**76MPa**
BH01	**50885**	92.70	92.79	Point Load	**71.1**
BH01	**50886**	93.00	93.10	Moisture Content	**1.50%**
BH01	**50887**	94.90	94.96	Oxidisable Sulphate	**<0.01%**
BH01	**50888**	94.96	95.05	pH Value	**9.2**
BH01	**50889**	97.34	97.43	Moisture Content	**1.30%**
BH01	**50890**	97.95	98.23	Deformability in Uniaxial Compression	**110.0MPa**
BH01	**50891**	101.36	101.45	Moisture Content	**1.60%**
BH01	**50892**	102.90	103.20	Indirect Tensile Strength by Brazilian Test	**12.6MPa**
BH01	**50893**	108.15	108.22	Point Load	**61.2MPa**
BH01	**50894**	108.22	108.51	Uniaxial Compressive Strength	**107MPa**
BH01	**50895**	108.51	108.62	Point Load	**70.2MPa**
BH01	**50896**	108.62	108.70	Moisture Content	**1.20%**
BH01	**50897**	110.27	110.37	Porosity / Density using Saturation and Calliper	**0.57/2.69**
BH01	**50898**	110.37	110.45	Porosity / Density using Saturation and Buoyancy	**0.7/2.59**
BH01	**50899**	113.00	113.08	Thin Section - Petrology	
BH01	**50900**	113.12	113.19	Moisture Content	**1.50%**
BH01	**50901**	115.89	116.05	Point Load	**52.5MPa**
BH01	**50902**	116.05	116.29	Uniaxial Compressive Strength	**104MPa**
BH01	**50903**	116.29	116.39	Point Load	**62.2MPa**
BH01	**50904**	118.82	118.88	Moisture Content	**1.90%**
BH01	**50905**	123.44	123.55	Moisture Content	**2.20%**
BH01	**50906**	125.90	126.00	Moisture Content	**1.30%**
BH01	**50907**	126.80	126.90	Moisture Content	**2.50%**
BH01	**50908**	128.80	128.89	Point Load	**80.8MPa**
BH01	**50909**	128.89	129.14	Uniaxial Compressive Strength	**79MPa**
BH01	**50910**	129.14	129.21	Point Load	**84.0MPa**
BH01	**50911**	131.12	131.17	Moisture Content	**2.60%**
BH01	**50912**	131.60	131.70	Moisture Content	**1.20%**
BH01	**50913**	132.65	132.62	Moisture Content	**1.80%**
BH01	**50914**	133.21	133.32	Point Load	**69.2MPa**
BH01	**50915**	133.32	133.54	Uniaxial Compressive Strength	**110MPa**
BH01	**50916**	133.54	133.63	Point Load	**61.8MPa**
BH01	**50917**	134.35	134.44	Moisture Content	**1.10%**
BH01	**50918**	137.06	137.20	Porosity / Density using Saturation and Calliper	**0.76/2.81**
BH01	**50919**	37.20	137.30	Porosity / Density using Saturation and Buoyancy	**0.3/2.63**
BH01	**50920**	138.60	138.72	pH Value	**9.2**
BH01	**50921**	140.00	140.20	Deformability in Uniaxial Compression	**58.7MPa**
BH01	**50922**	142.81	142.91	Moisture Content	**1.30%**

BH01	**50923**	146.20	146.30	Point Load	**55.0MPa**
BH01	**50924**	146.30	146.52	Uniaxial Compressive Strength	**100MPa**
BH01	**50925**	146.52	146.61	Point Load	**62.6MPa**
BH01	**50926**	148.97	149.05	Thin Section - Petrology	
BH01	**50927**	150.29	150.37	Porosity / Density using Saturation and Calliper	**0.61/2.75**
BH01	**50928**	151.67	151.75	Porosity / Density using Saturation and Buoyancy	**0.7/2.67**
BH01	**50929**	152.97	153.04	Total Sulphur	**<0.1%**
BH01	**50930**	153.20	153.30	Oxidisable Sulphate	**<0.01%**
BH01	**50931**	154.60	154.68	Moisture Content	**1.40%**
BH01	**50932**	155.20	155.28	Moisture Content	**1.70%**
BH01	**50933**	156.33	156.44	Point Load	**42.0MPa**
BH01	**50934**	156.44	156.68	Uniaxial Compressive Strength	**86MPa**
BH01	**50935**	156.68	156.76	Point Load	**47.3MPa**
BH01	**50936**	163.49	163.56	Moisture Content	**2.50%**
BH01	**50937**	165.17	165.25	Point Load	**77.7MPa**
BH01	**50938**	165.25	165.49	Uniaxial Compressive Strength	**83MPa**
BH01	**50939**	165.49	165.58	Point Load	**64.6MPa**
BH01	**50940**	166.00	166.10	Moisture Content	**1.30%**
BH01	**50941**	172.96	173.07	Porosity / Density using Saturation and Calliper	**0.49/2.68**
BH01	**50942**	173.07	173.20	Porosity / Density using Saturation and Buoyancy	**0.4/2.72**
BH01	**50943**	174.47	174.69	Uniaxial Compressive Strength	**76MPa**
BH01	**50944**	175.18	175.26	Point Load	**58.6MPa**
BH01	**50945**	175.26	175.50	Uniaxial Compressive Strength	**86MPa**
BH01	**50946**	175.50	175.59	Point Load	**58.6MPa**
BH01	**50947**	176.00	176.10	Moisture Content	**1.20%**
BH01	**50948**	180.24	180.50	Indirect Tensile Strength by Brazilian Test	**14.6MPa**
BH01	**50949**	182.12	182.20	pH Value	**9.3**
BH01	**50950**	183.17	183.40	Deformability in Uniaxial Compression	**118.6MPa**
BH01	**50951**	183.90	184.02	Point Load	**48.8MPa**
BH01	**50952**	184.02	184.25	Uniaxial Compressive Strength	**97MPa**
BH01	**50953**	184.25	184.34	Point Load	**70.1MPa**
BH01	**50954**	196.19	186.25	Moisture Content	**1.80%**
BH01	**50955**	193.60	193.68	Total Sulphur	**<0.1%**
BH01	**50956**	194.13	194.20	Porosity / Density using Saturation and Calliper	**0.54/2.69**
BH01	**50957**	194.60	194.67	Point Load	**48.0MPa**
BH01	**50958**	194.67	194.90	Uniaxial Compressive Strength	**114MPa**
BH01	**50959**	194.90	194.99	Point Load	**57.6MPa**
BH01	**50960**	195.77	195.86	Porosity / Density using Saturation and Buoyancy	**0.5/2.71**
BH01	**50961**	201.47	201.55	Oxidisable Sulphate	**<0.01%**
BH01	**50962**	204.62	204.70	Point Load	**83.6MPa**
BH01	**50963**	204.70	204.95	Uniaxial Compressive Strength	**132MPa**

BH01	**50964**	204.95	205.02	Point Load	**60.5**
BH01	**50965**	209.65	209.72	Moisture Content	**1.70%**
BH01	**50966**	210.18	210.30	Porosity / Density using Saturation and Calliper	**0.65/2.69**
BH01	**50967**	210.30	210.40	Porosity / Density using Saturation and Buoyancy	**0.3/2.85**
BH01	**50968**	210.57	210.82	Uniaxial Compressive Strength	**111MPa**
BH01	**50969**	211.10	211.20	Moisture Content	**1.40%**
BH01	**50970**	211.77	211.85	Point Load	**56.2MPa**
BH01	**50971**	211.85	212.10	Uniaxial Compressive Strength	**52MPa**
BH01	**50972**	212.10	212.20	Point Load	**68.7MPa**
BH01	**50973**	212.33	212.58	Deformability in Uniaxial Compression	**104.7MPa**
BH01	**50974**	213.80	213.90	pH Value	**9.1**
BH01	**50975**	218.20	218.28	Moisture Content	**1.50%**
BH01	**50976**	222.52	222.62	Moisture Content	**1.00%**
BH01	**50977**	223.70	223.80	Porosity / Density using Saturation and Calliper	**0.56/2.75**
BH01	**50978**	224.08	224.20	Porosity / Density using Saturation and Buoyancy	**0.3/2.63**
BH01	**50979**	225.65	225.74	Point Load	**80.3MPa**
BH01	**50980**	225.74	225.95	Uniaxial Compressive Strength	**77MPa**
BH01	**50981**	225.95	226.03	Point Load	**72.3MPa**
BH01	**50982**	228.16	228.24	Porosity / Density using Saturation and Calliper	**0.64/2.70**
BH01	**50983**	228.24	228.32	Porosity / Density using Saturation and Buoyancy	**0.4/2.65**
BH01	**50984**	230.13	230.20	Moisture Content	**2.00%**
BH01	**50985**	231.65	231.78	Point Load	**53.0MPa**
BH01	**50986**	231.78	232.00	Uniaxial Compressive Strength	**111MPa**
BH01	**50987**	232.00	232.10	Point Load	**74.6MPa**
BH01	**50988**	232.46	232.60	Deformability in Uniaxial Compression	**69.6MPa**
BH01	**50989**	235.04	235.10	Moisture Content	**1.30%**
BH01	**50990**	235.64	235.73	Total Sulphur	**<0.1%**
BH01	**50991**	236.73	237.03	Uniaxial Compressive Strength	**80MPa**
BH01	**50992**	237.17	237.43	Uniaxial Compressive Strength	**76MPa**
BH01	**50993**	242.82	242.92	Point Load	**53.8MPa**
BH01	**50994**	242.92	243.14	Uniaxial Compressive Strength	**118MPa**
BH01	**50995**	243.14	243.23	Point Load	**64.6MPa**
BH01	**50996**	250.30	250.56	Deformability in Uniaxial Compression	**56.4MPa**
BH01	**50997**	251.81	251.95	Point Load	**52.5MPa**
BH01	**50998**	251.95	252.22	Uniaxial Compressive Strength	**121MPa**
BH01	**50999**	252.22	252.32	Point Load	**61.4MPa**
BH01	**51000**	253.30	253.38	Oxidisable Sulphate	**<0.01%**
BH01	**51001**	259.72	259.82	Point Load	**64.1MPa**
BH01	**51002**	259.82	260.06	Uniaxial Compressive Strength	**143MPa**
BH01	**51003**	260.06	260.18	Point Load	**44.9MPa**
BH01	**51004**	262.43	262.63	Uniaxial Compressive Strength	**66MPa**
BH01	**51005**	262.63	262.73	Point Load	**67.7MPa**

BH01	**51006**	264.80	164.93	Point Load	**48.5MPa**
BH01	**51007**	264.93	264.15	Uniaxial Compressive Strength	**83MPa**
BH01	**51008**	265.15	265.25	Porosity / Density using Saturation and Calliper	**0.63/2.65**
BH01	**51009**	265.25	265.38	Porosity / Density using Saturation and Buoyancy	**0.5/2.64**
BH01	**51010**	268.30	268.40	Uniaxial Compressive Strength	**90MPa**
BH01	**51011**	271.70	271.90	Uniaxial Compressive Strength	**91MPa**

Table 7: Summary of Rock Test Results in BH01.

Location ID	Sample ID	Depth Top	Depth Base	Test	Certificate
BH03	**48801**	4.15	4.42	Triaxial - Unconsolidated / Undrained	x
BH03	**48802**	13.65	13.73	Moisture Content	x
BH03	**48803**	13.73	13.85	Atterberg Limits	x
BH03	**48804**	14.90	15.00	Particle Size Distribution	x
BH03	**48805**	19.00	19.10	Particle Size Distribution	x
BH03	**48806**	19.10	19.20	Atterberg Limits	x
BH03	**48807**	19.25	19.30	Moisture Content	x
BH03	**48808**	19.90	20.00	Moisture Content	x
BH03	**48809**	20.95	21.05	pH	x
BH03	**48810**	21.30	21.40	Moisture Content	x
BH03	**48811**	25.50	25.60	Particle Size Distribution	x
BH03	**48812**	25.80	25.90	Particle Size Distribution	x
BH03	**48813**	26.50	26.60	Particle Size Distribution	x
BH03	**48814**	26.70	26.80	Particle Size Distribution	x
BH03	**48815**	27.20	27.25	pH	x
BH03	**48816**	27.45	27.55	Atterberg Limits	x
BH03	**48817**	27.55	27.65	Particle Size Distribution	x
BH03	**48818**	30.25	30.33	Particle Size Distribution	x
BH03	**48819**	31.20	31.30	Moisture Content	x
BH03	**48822**	33.95	34.03	Moisture Content	x
BH03	**48824**	36.70	36.80	Particle Size Distribution	x
BH03	**48825**	38.60	38.70	Moisture Content	x
BH03	**48826**	38.95	39.05	Organic Matter Content	x
BH03	**48827**	39.25	39.30	Atterberg Limits	x
BH03	**48828**	39.45	39.55	Organic Matter Content	x
BH03	**48829**	39.80	39.83	Moisture Content	x
BH03	**48830**	40.65	40.77	Atterberg Limits	x
BH03	**48831**	41.20	41.25	pH	x
BH03	**48832**	41.30	41.50	Oedometer	x
BH03	**48833**	41.85	42.08	Triaxial - Unconsolidated / Undrained	x
BH03	**48834**	42.30	42.35	Moisture Content	x
BH03	**48835**	42.35	42.40	Organic Matter Content	x
BH03	**48836**	42.65	42.97	Triaxial - Unconsolidated / Undrained	x
BH03	**48837**	42.97	43.30	Oedometer	x

BH03	**48838**	44.05	44.20	Oedometer	x
BH03	**48839**	46.20	46.27	Organic Matter Content	x
BH03	**48840**	46.27	46.59	Triaxial - Unconsolidated / Undrained	x
BH03	**48841**	47.00	47.10	pH	x
BH03	**48842**	47.20	47.27	Moisture Content	x
BH03	**48843**	47.45	47.55	Organic Matter Content	x
BH03	**48844**	47.85	48.02	Oedometer	x
BH03	**48845**	48.20	48.30	Atterberg Limits	x
BH03	**48846**	48.45	48.70	Triaxial - Unconsolidated / Undrained	x
BH03	**48847**	49.00	49.10	Organic Matter Content	x
BH03	**48848**	49.30	49.40	Moisture Content	x
BH03	**48849**	63.15	63.22	Organic Matter Content	x
BH03	**48850**	63.38	63.43	pH	x
BH03	**48851**	63.50	63.55	Moisture Content	x
BH03	**48852**	63.90	63.95	Organic Matter Content	x
BH03	**48853**	64.30	64.35	Moisture Content	x
BH03	**48854**	64.90	64.95	Organic Matter Content	x
BH03	**48855**	65.50	65.60	Moisture Content	x
BH03	**48856**	66.95	67.05	Moisture Content	x
BH03	**48857**	68.40	68.45	Moisture Content	x
BH03	**48858**	70.40	70.50	Moisture Content	x
BH03	**48859**	70.75	70.85	Moisture Content	x
BH03	**48860**	71.60	71.70	Moisture Content	x
BH06	**50742**	5.25	5.50	Triaxial - Unconsolidated / Undrained	x
BH06	**50744**	16.20	16.50	Oedometer	x
BH06	**50745**	16.60	16.70	Moisture Content	x
BH06	**50746**	16.70	16.80	Atterberg Limits	x
BH06	**50747**	17.13	17.20	Organic Matter Content	x
BH06	**50748**	18.00	18.25	Triaxial - Unconsolidated / Undrained	x
BH06	**50749**	18.25	18.35	Moisture Content	x
BH06	**50750**	18.65	18.75	Atterberg Limits	x
BH06	**50851**	18.95	19.05	Organic Matter Content	x
BH06	**50852**	19.70	19.95	Oedometer	x
BH06	**50853**	20.00	20.25	Oedometer	x
BH06	**50854**	21.45	21.52	Moisture Content	x
BH06	**50855**	21.52	21.60	Atterberg Limits	x
BH06	**50856**	21.75	21.80	Organic Matter Content	x

Table 8: Summary of Soil Test Results in BH03 & BH06.

Location ID	**Sample ID**	**Depth Top**	**Depth Base**	**Test**	**Result**
BH04	**48901**	3.5	3.55	Moisture Content	**0.20%**
BH04	**48902**	5.4	5.48	Moisture Content	**0.60%**
BH04	**48903**	8.06	8.36	Deformability in Uniaxial Compression	**119.9MPa**
BH04	**48904**	9.3	9.36	Moisture Content	**0.30%**

BH04	**48905**	10.63	10.88	Deformability in Uniaxial Compression	**41.6MPa**
BH04	**48906**	11.77	11.83	Moisture Content	**0.20%**
BH04	**48907**	12.62	12.75	Point Load	**59.2MPa**
BH04	**48908**	12.85	13.1	Uniaxial Compressive Strength	**76MPa**
BH04	**48909**	13.1	13.25	Point Load	**52.7MPa**
BH04	**48910**	14.4	14.63	Deformability in Uniaxial Compression	**62.0MPa**
BH04	**48911**	14.63	14.74	Point Load	**49.2MPa**
BH04	**48912**	14.74	14.97	Uniaxial Compressive Strength	**86MPa**
BH04	**48913**	14.97	15.13	Point Load	**60.1MPa**
BH04	**48914**	11.77	11.83	Porosity / Density using Saturation and Calliper & Porosity / Density using Saturation and Buoyancy	**0.2/2.72**
BH04	**48915**	17.74	17.86	Point Load	**60.2MPa**
BH04	**48917**	18.12	18.2	Point Load	**56.5MPa**
BH04	**48918**	19.2	19.32	Point Load	**36.5MPa**
BH04	**48919**	20.05	20.12	Thin Section / Petrography	
BH04	**48920**	20.12	20.22	Point Load	**73.9MPa**
BH04	**48921**	20.22	20.5	Uniaxial Compressive Strength	**55MPa**
BH04	**48922**	20.8	20.85	Moisture Content	**0.40%**
BH04	**48923**	21.2	21.3	Point Load	**68.4MPa**
BH04	**48924**	21.8	21.9	Moisture Content	**1%**
BH04	**48925**	22.2	22.31	Point Load	**90.2MPa**
BH04	**48926**	22.6	22.78	Point Load	**60.1MPa**
BH04	**48927**	22.78	23.06	Uniaxial Compressive Strength	**53MPa**
BH04	**48928**	23.1	23.2	Point Load	**64.6MPa**
BH04	**48929**	21.8	21.9	Porosity / Density using Saturation and Calliper & Porosity / Density using Saturation and Buoyancy	**0.4/2.69**
BH04	**48930**	23.7	23.8	Point Load	**77.7MPa**
BH04	**48931**	23.8	24.1	Uniaxial Compressive Strength	**111MPa**
BH04	**48932**	24.17	24.28	Point Load	**74MPa**
BH04	**48933**	24.28	24.52	Uniaxial Compressive Strength	**91MPa**
BH04	**48934**	25.08	25.19	Point Load	**77.5MPa**
BH04	**48935**	25.19	25.41	Deformability in Uniaxial Compression	**64.1MPa**
BH04	**48936**	28.27	28.4	Porosity / Density using Saturation and Calliper	**0.5/2.65**
BH04	**48937**	27.91	28	Point Load	**89.4MPa**
BH04	**48938**	28.27	28.4	Moisture Content	**0.10%**
BH04	**48939**	28.4	28.44	Point Load	**68.3MPa**
BH04	**48941**	29.38	29.54	Indirect Tensile Strength by Brazilian Test	**5.97MPa**
BH04	**48943**	29.86	29.94	Point Load	**92MPa**
BH04	**48949**	30.93	30.03	Point Load	**76.6MPa**
BH04	**48950**	31.03	31.3	Uniaxial Compressive Strength	**76MPa**
BH04	**48951**	31.3	31.4	Point Load	**67.8MPa**
BH04	**48954**	31.66	31.7	Total Sulphur	**<0.1%**
BH04	**48955**	31.76	31.84	Point Load	**59.6MPa**
BH04	**48956**	31.84	31.93	Oxidisable Sulphur	**0.04**
BH04	**48957**	31.93	32.15	Uniaxial Compressive Strength	**78MPa**

BH04	**48958**	32.15	32.26	Point Load	**55.4MPa**
BH04	**48959**	32.26	32.35	pH	**9.3**
BH04	**48962**	32.5	32.57	Point Load	**78.8MPa**
BH04	**48963**	32.57	32.85	Uniaxial Compressive Strength	**92MPa**
BH04	**48964**	32.85	32.96	Point Load	**65.5MPa**
BH04	**48965**	33.12	33.16	Moisture Content	**0.10%**
BH04	**48966**	33.2	33.48	Deformability in Uniaxial Compression	**66.5MPa**
BH04	**48967**	33.48	33.6	Point Load	**49.9MPa**
BH04	**48968**	32.35	32.43	Porosity / Density using Saturation and Buoyancy	**0.4/2.69**
BH04	**48969**	34.56	34.59	Moisture Content	**0.30%**
BH04	**48970**	34.96	35	Moisture Content	**0.20%**
BH05	**48971**	0.65	0.73	Moisture Content	**0.30%**
BH05	**48972**	0.98	1.04	Moisture Content	**0.10%**
BH05	**48973**	1.41	1.5	Moisture Content	**0.10%**
BH05	**48974**	2.62	2.67	Porosity / Density using Saturation and Calliper	**0.4/2.68**
BH05	**48975**	2.8	2.96	Point Load	**27.8Mpa**
BH05	**48976**	1.41	1.5	Porosity / Density using Saturation and Buoyancy	**0.3/2.65**
BH05	**48977**	7.73	7.84	Point Load	**63MPa**
BH05	**48978**	8.1	8.25	Point Load	**43.8MPa**
BH05	**48979**	8.54	8.66	Point Load	**62MPa**
BH05	**48980**	8.9	8.96	Moisture Content	**0.10%**
BH05	**48981**	9.46	9.57	Point Load	**91.5MPa**
BH05	**48982**	9.57	9.77	Uniaxial Compressive Strength	**91MPa**
BH05	**48983**	9.77	9.92	Point Load	**55.4MPa**
BH05	**48984**	10.2	10.26	Point Load	**101.0MPa**
BH05	**48985**	11.3	11.45	Point Load	**43.1MPa**
BH05	**48986**	11.45	11.72	Uniaxial Compressive Strength	**86MPa**
BH05	**48987**	11.72	11.83	Point Load	**77.2MPa**
BH05	**48988**	12.92	13.07	Moisture Content	**0.30%**
BH05	**48989**	13.5	13.6	Point Load	**141.1MPa**
BH05	**48990**	13.7	13.81	Point Load	**67.3MPa**
BH05	**48991**	13.81	14.07	Uniaxial Compressive Strength	**94MPa**
BH05	**48992**	14.07	14.15	Point Load	**84.4MPa**
BH05	**48993**	14.27	14.4	Point Load	**74.0MPa**
BH05	**48994**	14.65	14.89	Uniaxial Compressive Strength	**72MPa**
BH05	**48995**	15.43	15.55	Point Load	**81.8MPa**
BH05	**48996**	15.95	16.22	Deformability in Uniaxial Compression	**57.0MPa**
BH05	**48997**	16.45	16.55	Point Load	**67.3MPa**
BH05	**48998**	16.87	17.19	Uniaxial Compressive Strength	**77MPa**
BH05	**48999**	17.97	18.06	Porosity / Density using Saturation and Buoyancy	**0.3/2.69**
BH05	**50701**	19.7	19.92	Indirect Tensile Strength by Brazilian Test	**3.39MPa**
BH05	**50702**	28.85	28.95	Porosity / Density using Saturation and Calliper	**0.4/2.69**
BH05	**50703**	22.07	22.21	Point Load	**54.3MPa**

BH05	**50704**	22.9	23	Point Load	**87.3MPa**
BH05	**50705**	23.94	24.05	Point Load	**67.2MPa**
BH05	**50706**	24.05	24.3	Deformability in Uniaxial Compression	**44.9MPa**
BH05	**50707**	24.73	24.85	Point Load	**66.4MPa**
BH05	**50708**	25.2	25.4	Deformability in Uniaxial Compression	**22.6MPa**
BH05	**50709**	26	26.12	Point Load	**76.4MPa**
BH05	**50710**	26.12	26.35	Deformability in Uniaxial Compression	**66.3MPa**
BH05	**50711**	27.68	27.88	Uniaxial Compressive Strength	**79MPa**
BH05	**50712**	28.75	28.85	Moisture Content	**0.10%**
BH05	**50715**	29.09	29.18	Total Sulphur	**<0.1**
BH05	**50716**	29.18	29.3	Oxidisable Sulphur	**<0.01**
BH05	**50717**	29.3	29.4	pH	**9.2**
BH05	**50718**	30.3	30.4	Moisture Content	**0.40%**
BH05	**50721**	30.88	30.92	Moisture Content	**0.30%**
BH05	**50725**	32.44	32.54	Point Load	**76.8MPa**
BH05	**50726**	32.54	32.6	Moisture Content	**0.20%**
BH05	**50727**	32.83	32.92	Point Load	**66.7MPa**
BH05	**50728**	32.92	33	Thin Section / Petrography	
BH05	**50729**	33	33.26	Uniaxial Compressive Strength	**116MPa**
BH05	**50730**	33.22	33.26	Porosity / Density using Saturation and Calliper	**0.6/2.69**
BH05	**50731**	33.5	33.7	Uniaxial Compressive Strength	**51MPa**
BH05	**50733**	33.92	33.16	Uniaxial Compressive Strength	**54MPa**
BH05	**50735**	34.5	34.7	Porosity / Density using Saturation and Buoyancy	**0.4/2.68**
BH05	**50736**	37.4	37.5	Point Load	**80.7MPa**
BH05	**50737**	37.5	37.82	Uniaxial Compressive Strength	**131MPa**
BH05	**50738**	37.82	37.92	Point Load	**77.2MPa**
BH05	**50740**	37.92	38.08	Point Load	**52.3MPa**

Table 9: Summary of Rock Test Results in BH04 & BH05

Sample	Test	Result
Bulk Sample	Aggregate Crushing Value	**23%**
Bulk Sample	Aggregate Impact Value	**17%**
Bulk Sample	Aggregate Abrasion Value	**12**
Bulk Sample	Polished Stone Value	**38**
Bulk Sample	Slake Durability	**99.40%**
Bulk Sample	Los Angeles Coefficient	**28**
Bulk Sample	Soundness by Magnesium Sulphate	**1**
Bulk Sample	10% Fines	**150kN**
Bulk Sample	Frost Heave	**3.3mm**

Table 10: Summary of Rock Test Results in Bulk Sample

3.8 In Situ Water Testing

Water samples were obtained from boreholes BH04, BH05 and BH06 and tested for pH, Temperature, Conductivity and Dissolved O_2. Three water samples were obtained and the pH, Temperature, Conductivity and dissolved O_2 data was acquired using a Watterra Pump with each borehole purged for at least 30 minutes. This work was carried out by Ronan Doyle of Ronan Doyle Monitoring Solutions, Ballinrobe County Mayo.

Borehole	pH	Temperature (°C)	Conductivity (µS)	Dissolved O_2 (mg/l)
BH04	7.47	10.5	295	0.21
BH05	7.77	10.5	420	0.8
BH06	12.53	9.8	6187	0.8

Table 11: In Situ Water Testing Results

3.9 Permeability Testing

Falling Head and Packer Testing was carried out on boreholes BH04 and BH05. The ground conditions intersected in boreholes BH03 and BH06 was considered too unstable for permeability testing.

A falling head test was carried out in BH04 on the 5th of January 2016. The rods were removed from the hole and the water level in the borehole was recorded at 17.88m bgl before the test commenced. Initially a volume of 130 litres was pumped into the hole, upon cessation of pumping the water level recovered almost immediately (i.e. faster than the dip meter could be lowered into the hole). A second test was subsequently carried out and 500 litres were pumped into the hole and same rapid recovery to 17.88m bgl was observed.

Falling head tests were carried out in BH05 on the 7th of January 2016. The rods were removed from the hole and the water level in this borehole was recorded at 19.45m bgl before commencement of the test. Initially a volume of 215 litres was pumped into the hole and the hole recovered back to 19.42m bgl and had stabilised after 40 minutes. A second test using a greater volume of water was carried out and 1000 litres of water was pumped into the hole. This test had proceeded almost to conclusion when the water level rose slightly (c.1.0cm) and a obstruction could be felt in the hole. The driller ran the rods back into the hole to assist with the piezometer installation and found that there was clay in the hole from 19.3 to 20.8m. The Falling Head test data is presented in Appendix XI.

Packer testing was carried out in boreholes BH04 and BH05 on the 18th of December 2015 and the 6th of January 2016 respectively. Set up details are presented in Table 12 and the results in Appendix X.

Borehole	Top (m)	Bottom (m)	Midpoint (m)
BH04	18	20	19
BH04	21	23	22
BH04	24	26	25
BH04	28	30	29
BH05	36	38	37
BH05	30	32	31
BH05	24	27	25.5
BH05	20	23	21.5

Table 12: Packer Test Installation Details

The Packer Tests carried out at 28-30m and 21-23m in BH04 suffered from loss of water pressure due to cavities / fractures. For both of these tests only one stage could be measured. All of the scheduled packer tests were carried out in BH05.

It was noted that the water pressure recovery once pumping had ceased was instantaneous in all of the test intervals.

APPENDIX I

Hole	East	North	Elevation
BH1	530370.592	728426.557	16.712
BH3	530023.824	728382.566	26.256
BH4	530150.783	728400.125	32.167
BH5	530186.649	728378.105	34.138
BH6	530125.143	728383.081	30.799

Survey name	Station	East	North	Elevation	Dip	Azimuth	Tool–	Gravity	Mag.Str.	Mag.Dip	Mag.X	Mag.Y	Mag.Z	Roll Angle	Mag.T/face	DLS
*	Metres	Metres	Metres	Metres	Degrees	Degrees	Centigrade	G	nT	Degrees	nT	nT	nT	Degrees	Degrees	deg./30m
BH-1	1	0	0	0	-11.5	268.3	11	1.000147	48955	67.9	18396	0	45367	90	292.4	0
BH-1	4	-2.94	-0.09	-0.6	-11.5	268.1	11	1.00047	48954	67.9	18424	0	45355	90	292.4	1.9
BH-1	7	-5.88	-0.18	-1.2	-11.5	268.4	11	1.000677	48946	67.9	18415	0	45350	89.7	292.1	2.3
BH-1	10	-8.81	-0.28	-1.8	-11.7	267.9	11	1.00063	49023	67.9	18436	0	45424	89	291.5	5.4
BH-1	13	-11.75	-0.39	-2.41	-11.7	267.9	11	1.001172	49022	67.9	18468	0	45410	88.4	290.9	0.4
BH-1	16	-14.68	-0.5	-3.02	-11.8	267.6	11	1.000628	49027	67.9	18422	0	45434	88.4	290.8	3
BH-1	19	-17.62	-0.62	-3.63	-11.9	267.5	11	1.00041	49014	67.9	18451	0	45408	88.2	290.7	0.9
BH-1	22	-20.54	-0.81	-4.27	-12.6	265.4	11	1.002129	49028	68.5	17966	0	45618	89.2	291	22.5
BH-1	25	-23.47	-0.99	-4.91	-12.1	267.2	11	1.000351	49037	67.9	18457	0	45431	88.7	291.1	19
BH-1	28	-26.4	-1.13	-5.54	-12.2	267.3	11	1.000495	49044	67.9	18458	0	45438	88.4	290.8	1.2
BH-1	31	-29.33	-1.28	-6.18	-12.4	267.1	11	1.000687	49069	67.9	18452	0	45467	88.5	290.9	3.2
BH-1	34	-32.25	-1.43	-6.83	-12.6	266.9	11	1.000132	49044	67.9	18419	0	45454	88.4	290.8	2.8
BH-1	37	-35.18	-1.58	-7.48	-12.6	267.1	11	1.000742	49065	67.9	18458	0	45460	88.3	290.7	2.2
BH-1	40	-38.1	-1.73	-8.13	-12.6	267.1	11	1.000358	49075	67.9	18479	0	45463	88.3	290.8	0.4
BH-1	43	-41.02	-1.88	-8.79	-12.6	267.1	11	1.000171	49057	67.9	18429	0	45464	88.5	290.9	0.6
BH-1	46	-43.95	-2.02	-9.44	-12.5	267.3	11	1.000035	49054	67.9	18466	0	45446	88.8	291.3	2
BH-1	49	-46.87	-2.17	-10.09	-12.7	267	11	1.000317	49034	67.9	18438	0	45435	89.4	291.8	2.7
BH-1	52	-49.8	-2.32	-10.75	-12.7	267.1	11	1.000291	49062	68	18415	0	45475	89.7	292.1	0.4
BH-1	55	-52.72	-2.47	-11.41	-12.7	266.9	11	1.000127	49043	67.9	18450	0	45440	90.4	292.9	2
BH-1	58	-55.64	-2.61	-12.06	-12.5	267.8	11	0.99969	49044	67.6	18658	0	45356	90.8	293.6	9.5
BH-1	61	-58.57	-2.74	-12.72	-12.8	267.1	11	1.000477	49098	67.9	18474	0	45490	92.3	294.8	8
BH-1	64	-61.49	-2.89	-13.38	-12.8	267	11	1.00001	49037	67.9	18460	0	45430	93.1	295.6	0.4
BH-1	67	-64.41	-3.04	-14.05	-12.9	266.9	11	1.000212	49044	67.9	18458	0	45438	93.5	296	1.5
BH-1	70	-67.33	-3.2	-14.72	-12.9	267	11	1.0002	49029	67.9	18458	0	45422	94.5	297	1.4
BH-1	73	-70.25	-3.35	-15.39	-12.9	266.9	11	1.000355	49071	67.9	18437	0	45476	94.9	297.4	1.7
BH-1	76	-73.17	-3.51	-16.06	-12.9	267	11	1.000287	49068	67.8	18512	0	45442	95.4	297.9	1.8
BH-1	79	-76.11	-3.53	-16.68	-10.9	272	11	0.992033	49037	67.9	18432	0	45441	95.8	298.3	52.4

Survey name	Station	East	North	Elevation	Dip	Azimuth	Tool−	Gravity	Mag.Str.	Mag.Dip	Mag.X	Mag.Y	Mag.Z	Roll Angle	Mag.T/face	DLS
*	Metres	Metres	Metres	Metres	Degrees	Degrees	Centigrade	G	nT	Degrees	nT	nT	nT	Degrees	Degrees	deg./30m
BH-1	82	-79.04	-3.56	-17.3	-13	266.9	11	1.000459	49018	67.9	18469	0	45406	96.3	298.8	53.7
BH-1	85	-81.96	-3.72	-17.98	-13.2	266.6	11	1.000487	49052	67.9	18490	0	45434	96.5	299.1	3.2
BH-1	88	-84.87	-3.89	-18.66	-13.1	266.8	11	1.000296	49038	67.9	18437	0	45440	96.8	299.2	1.2
BH-1	91	-87.79	-4.06	-19.34	-13.1	266.8	11	1.000282	49031	67.9	18455	0	45426	96.8	299.3	0.7
BH-1	94	-90.71	-4.22	-20.03	-13.1	266.7	11	1.000122	49080	67.9	18447	0	45482	97.2	299.7	1
BH-1	97	-93.62	-4.39	-20.71	-13.2	266.7	11	1.000303	49066	67.9	18470	0	45457	97.6	300.1	0.6
BH-1	100	-96.54	-4.55	-21.4	-13.2	266.7	11	1.000268	49068	67.8	18503	0	45445	97.5	300.1	0.5
BH-1	103	-99.47	-4.63	-22.05	-11.8	270.2	11	0.995246	49056	68.6	17887	0	45678	98.2	300	37
BH-1	106	-102.39	-4.71	-22.7	-13.3	266.7	11	1.00031	49060	67.9	18480	0	45446	97.7	300.2	37.4
BH-1	109	-105.31	-4.88	-23.39	-13.3	266.6	11	1.000017	49021	67.9	18429	0	45425	97.8	300.3	0.7
BH-1	112	-108.22	-5.05	-24.08	-13.4	266.5	11	1.000223	49056	67.9	18482	0	45442	98	300.5	1.5
BH-1	115	-111.13	-5.22	-24.78	-13.4	266.7	11	1.000889	49063	67.9	18460	0	45457	98	300.5	1.4
BH-1	118	-114.05	-5.4	-25.48	-13.5	266.5	11	1.000317	49027	67.9	18468	0	45416	98.3	300.8	2.1
BH-1	121	-116.96	-5.58	-26.18	-13.4	266.6	11	1.000141	49042	67.9	18448	0	45440	98.3	300.8	1.2
BH-1	124	-119.87	-5.75	-26.88	-13.5	266.5	11	1.000272	49046	67.9	18477	0	45433	98.3	300.9	0.9
BH-1	127	-122.78	-5.93	-27.58	-13.5	266.5	11	0.99995	49034	67.9	18473	0	45422	98.3	300.8	0.6
BH-1	130	-125.69	-6.11	-28.28	-13.6	266.4	11	1.000699	49079	67.9	18430	0	45487	98.2	300.7	0.8
BH-1	133	-128.6	-6.29	-28.99	-13.6	266.6	11	1.00039	49055	67.9	18443	0	45456	98.2	300.8	1.6
BH-1	136	-131.51	-6.47	-29.7	-13.7	266.3	11	0.999701	49064	67.9	18444	0	45466	98	300.5	2.8
BH-1	139	-134.42	-6.65	-30.41	-13.7	266.4	11	1.000129	49052	67.9	18462	0	45445	98.2	300.7	0.9
BH-1	142	-137.33	-6.83	-31.12	-13.8	266.4	11	1.000614	49054	67.9	18477	0	45441	98.7	301.3	0.9
BH-1	145	-140.24	-7.02	-31.83	-13.8	266.3	11	1.000523	49075	67.9	18474	0	45465	98.7	301.2	0.7
BH-1	148	-143.14	-7.21	-32.55	-13.8	266.3	11	1.000394	49034	67.9	18471	0	45422	98.9	301.5	0.6

Survey name	Station	East	North	Elevation	Dip	Azimuth	Tool–	Gravity	Mag.Str.	Mag.Dip	Mag.X	Mag.Y	Mag.Z	Roll Angle	Mag.T/face	DLS
*	Metres	Metres	Metres	Metres	Degrees	Degrees	Centigrade	G	nT	Degrees	nT	nT	nT	Degrees	Degrees	deg./30m
BH-1	151	-146.05	-7.39	-33.26	-13.8	266.4	11	1.000164	49043	67.9	18474	0	45430	98.9	301.5	1.5
BH-1	154	-148.96	-7.57	-33.98	-13.9	266.4	11	1.000365	49066	67.9	18451	0	45464	99.1	301.6	1
BH-1	157	-151.87	-7.76	-34.7	-13.9	266.3	11	1.000252	49055	67.8	18506	0	45430	99.2	301.8	1
BH-1	160	-154.77	-7.95	-35.43	-14	266.2	11	0.999691	49068	67.9	18477	0	45456	99.2	301.7	0.6
BH-1	163	-157.68	-8.14	-36.15	-14	266.3	11	1.001008	49040	67.9	18411	0	45453	99.3	301.8	0.5
BH-1	166	-160.58	-8.33	-36.88	-14	266.2	11	0.999912	49061	67.9	18462	0	45455	100.3	302.8	0.6
BH-1	169	-163.48	-8.52	-37.6	-14	266.3	11	1.00026	49044	67.9	18480	0	45430	100.3	302.9	1.2
BH-1	172	-166.39	-8.71	-38.33	-14.1	266.4	11	1.000443	49080	67.9	18462	0	45476	100.3	302.8	0.4
BH-1	175	-169.29	-8.89	-39.06	-14.1	266.2	11	0.999983	49089	67.9	18458	0	45487	100.3	302.8	1.5

APPENDIX II

Rotary Core Log

Borehole No.	**BH01**	Sheet 1 of 28	
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Hole Type RC
Co-ords:	530370.59 - 728426.56		
Location:	Galway	Level: 16.71	Scale 1:50
Client:	Galway County Council	Dates: 13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		0.00 - 5.60								Concrete Plinth
		5.60 - 6.30	14	100	60	41	5.60	11.11		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. (Core invert not marked)
		6.30 - 7.52	3	100	100	100	6.30	10.41		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Sub-vertical stylolites, occasional coarse shelled bioclast (Brachiopod)
		7.52 - 10.15	6	100	89	81	7.52	9.19		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Occasional fine grained scattered bioclasts, minor stylolites

Continued on next sheet

Remarks

Rotary Core Log

Project Name: Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530370.59 - 728426.56	Borehole No. **BH01** Sheet 2 of 28
			Hole Type RC
Location: Galway		Level: 16.71	Scale 1:50
Client: Galway County Council		Dates: 13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		10.15 - 11.10	2	88	88	88	10.15	6.56		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Very occasional fine grained bioclast
		11.10 - 12.66	5	100	44	38	11.10	5.61		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. pellety / slightly oolitic texture
		12.66 - 14.20	2	100	100	96	12.66	4.05		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. pellety / slightly oolitic intervals with small rounded bioclasts
		14.20 - 14.58	18	100	29	29	14.20	2.51		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Intersecting conjugate joints
		14.58 - 15.46	2	100	100	100	14.58	2.13		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Minor white calcite fill along joint
		15.46 - 15.86	15	100	25	0	15.46	1.25		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. White calcite fill and weak oxidation along steeply dipping joint surface
		15.86 - 17.04	2	100	100	100	15.86	0.85		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. pellety / slightly oolitic texture, minor thick shelled brachiopods
		17.04 - 21.07	3	97	87	86	17.04	-0.33		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Slightly pellety scattered fine bioclastic debris with occasional coarse shelled brachiopod fragment

Continued on next sheet

Remarks

Rotary Core Log

Project Name: Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530370.59 - 728426.56	Borehole No. **BH01** Sheet 3 of 28
Location: Galway		Level: 16.71	Hole Type RC
Client: Galway County Council		Dates: 13/11/2015 - 21/12/2015	Scale 1:50
			Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		21.07 - 21.60	23	100	53	40	21.07	-4.36		Strong. fresh, grey / pale grey, fine to medium grained, massive LIMESTONE. minor bioclastic debris and white calcite veinlets, basal 10cm is rubble
		21.60 - 22.75	3	100	100	100	21.60	-4.89		Strong. fresh, grey / pale grey, fine to medium grained, massive LIMESTONE. Occasional coarse shelled brachiopod fragments
		22.75 - 24.34	4	100	78	65	22.75	-6.04		Strong. fresh, grey / pale grey, fine to medium grained, massive LIMESTONE. Thin, discontinuous white/pink dolomite veinlets dipping at 45'. Minor scattered fine grained bioclasts and very fine stylolites
		24.34 - 24.73	15	92	0	0	24.34	-7.63		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Cavity developed with weak oxidation and pitting / dissolution on contacts
		24.73 - 31.68	2	100	100	100	24.73	-8.02		Strong. fresh, grey, fine to medium grained, massive LIMESTONE. with hairline white calcite veinlets dipping at 50 - 70'. Minor scattered poorly sorted bioclastic debris. Fine sub-vertical stylolites

Continued on next sheet

Remarks

Rotary Core Log

Borehole No.
BH01
Sheet 4 of 28

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords:	530370.59 - 728426.56	Hole Type RC
Location:	Galway		Level:	16.71	Scale 1:50
Client:	Galway County Council		Dates:	13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
									▦		31
		31.68 - 33.22	7	100	77	55	31.68	-14.97	▦	Strong. fresh, grey, fine to medium grained, massive LIMESTONE. fine sub-vertical stylolites. 31.78m calcite filled vugs locally developed	32 33
		33.22 - 37.10	2	100	97	95	33.22	-16.51	▦	Strong. fresh, grey, fine to medium grained, massive LIMESTONE. Small scattered bioclasts, very rare coarse shell and coral fragment. Minor fine stylolites	34 35 36 37
		37.10 - 38.70	6	100	59	51	37.10	-20.39	▦	Strong. fresh, brownish pale grey, fine to medium grained, massive LIMESTONE. Fine grained scattered bioclastic debris, minor very fine stylolites	38
		38.70 - 40.45	2	100	100	100	38.70	-21.99	▦	Strong. fresh, grey, fine to medium grained, massive LIMESTONE. Very minor scattered bioclastic debris, minor orange limonitic staining along a joint surface at 39.35m	39 40

Continued on next sheet

Remarks

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Rotary Core Log

Project Name: Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530370.59 - 728426.56	Borehole No. **BH01** Sheet 5 of 28
Location: Galway		Level: 16.71	Hole Type RC
Client: Galway County Council		Dates: 13/11/2015 - 21/12/2015	Scale 1:50
			Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		40.45 - 43.30	3	100	90	88	40.45	-23.74		Strong. fresh, grey, fine to medium grained, massive LIMESTONE. Minor bioclastic debris, and fine stylolites
		43.30 - 44.30	6	90	9	0	43.30	-26.59		Strong. fresh, grey, fine to medium grained, massive LIMESTONE. Fine vuggy texture and faint stylolites
		44.30 - 52.98	6	100	96	91	44.30	-27.59		Strong. fresh, light grey, fine to medium grained, massive LIMESTONE. Scattered bioclastic debris, fragments of coarse shelled brachiopods or solitary corals. locally developed fine vuggy texture (49.1 - 49.55m). White calcite veinlets dip 90', azimuth 020' to core invert

41 42 43 44 45 46 47 48 49 50

Continued on next sheet

Remarks

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Rotary Core Log

			Borehole No. **BH01** Sheet 6 of 28
Project Name: Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530370.59 - 728426.56	Hole Type RC
Location: Galway		Level: 16.71	Scale 1:50
Client: Galway County Council		Dates: 13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		52.98 - 53.74	9	97	37	13	52.98	-36.27		Strong. fresh, light grey, fine to medium grained, massive LIMESTONE. Minor fine stylolites
		53.74 - 56.10	3	94	94	90	53.74	-37.03		Strong. fresh, light grey, fine to medium grained, massive LIMESTONE. Very rare small bioclastic fragments, fine stylolites
		56.10 - 58.60	3	100	96	92	56.10	-39.39		Strong. fresh, grey, medium grained, massive LIMESTONE. Pellety texture with scattered small bioclastic fragments and faint stylolites.
							58.60	-41.89		Strong. fresh, light grey, fine to medium grained, massive LIMESTONE. Minor bioclastic debris, and fine stylolites

Continued on next sheet

Remarks

Rotary Core Log

Borehole No.	**BH01**	Sheet 7 of 28	
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530370.59 - 728426.56
Hole Type	RC		
Location:	Galway	Level:	16.71
Scale	1:50		
Client:	Galway County Council	Dates:	13/11/2015 - 21/12/2015
Logged By	Dave Blaney		

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
		58.60 - 61.47	3	100	99	99					61
		61.47 - 62.25	10	100	55	47	61.47	-44.76		Strong. fresh, light grey, fine to medium grained, massive LIMESTONE. Fine vuggy texture, 61.94m a 1cm thick white calcite vein dipping at 80' azimuth 185' to core invert	62
		62.25 - 63.73	1	100	100	100	62.25	-45.54		Strong. fresh, grey, fine to medium grained, massive LIMESTONE. Occasional fine stylolite	63
		63.73 - 64.22	10	94	69	61	63.73	-47.02		Strong. fresh, grey/light grey, fine to medium grained, massive LIMESTONE. Minor bioclastic debris, and fine stylolites. Some coarse vugs (6mm wide) irregular shaped with orange/brown limonitic infill	64
		64.22 - 67.85	3	100	100	100	64.22	-47.51		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Incipient pellety texture , scattered bioclastic debris, and faint stylolites	65 66 67
		67.85 - 68.78	9	92	77	60	67.88	-51.17		Strong. fresh, grey, fine to medium grained, massive LIMESTONE. Minor bioclastic debris, and fine stylolites	68
											69 70

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Remarks

Rotary Core Log

Project Name: Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530370.59 - 728426.56	Borehole No. **BH01** Sheet 8 of 28
			Hole Type RC
Location: Galway		Level: 16.71	Scale 1:50
Client: Galway County Council		Dates: 13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
		68.78 - 72.31	3	98	96	96					71 72
		72.31 - 73.39	6	100	30	19	72.31	-55.60		Strong. fresh, grey, fine to medium grained, massive LIMESTONE. Minor bioclastic debris, and fine stylolites. Axial parallel jointing	73
		73.39 - 75.70	3	100	94	94	73.39	-56.68		Strong. fresh, pale grey, fine grained, massive LIMESTONE. Minor fine stylolites	74 75
		75.70 - 76.37	12	96	67	16	75.70	-58.99		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE.	76
		76.37 - 77.60	2	100	100	95	76.37	-59.66		Strong. fresh, grey, fine to medium grained, massive LIMESTONE. Fine stylolites	77
		77.60 - 78.20	20	100	12	0	77.60	-60.89		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. 77.85m 1cm thick white calcite vein, 78.16m 1cm thick white orange calcite vein (Fe stains)	78
							78.20	-61.49		Strong. fresh, pale grey, fine grained, massive LIMESTONE. Numerous stylolites	79 80

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Remarks

Rotary Core Log

Project Name: Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530370.59 - 728426.56	Borehole No. **BH01** Sheet 9 of 28
			Hole Type RC
Location: Galway		Level: 16.71	Scale 1:50
Client: Galway County Council		Dates: 13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
		78.20 - 86.15	3	99	99	98					81 82 83 84 85 86
		86.15 - 88.77	2	100	96	96	86.15	-69.44		Strong. fresh, grey, fine to medium grained, massive LIMESTONE. Occasional stylolites and fine grained bioclastic debris. 87.06m - 1cm thick white calcite vein	87 88
		88.77 - 90.30	7	100	49	23	88.77	-72.06		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. 90.09m - 2cm thick white calcite vein. Locally developed fine vuggy texture	89 90

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Remarks

Rotary Core Log

Project Name: Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530370.59 - 728426.56	Borehole No. **BH01** Sheet 10 of 28
Location: Galway		Level: 16.71	Hole Type RC
			Scale 1:50
Client: Galway County Council		Dates: 13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
		90.30 - 95.95	2	100	99	98	90.30	-73.59		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Minor faint stylolites	91 92 93 94 95
		95.95 - 100.33	3	99	94	89	95.95	-79.24		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. small scattered bioclasts with some large (7cm dia.) coarse shelled brachiopods	96 97 98 99 100

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Remarks

Rotary Core Log

Borehole No.
BH01
Sheet 11 of 28

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords:	530370.59 - 728426.56	Hole Type RC
Location:	Galway		Level:	16.71	Scale 1:50
Client:	Galway County Council		Dates:	13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
		100.33 - 102.74	6	97	85	71	100.33	-83.62		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Scattered small partially oxidised vugs. 101.4 & 101.43m 1cm thick white calcite veins dip 90' Azimuth 360'	101 102
		102.74 - 105.90	3	100	99	99	102.74	-86.03		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Fine bioclastic debris scattered throughout	103 104 105
		105.90 - 108.60	2	100	100	99	105.90	-89.19		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Thin (c.1mm), randomly orientated white / brown calcite veinlets over top 40cm. scattered fine bioclastic debris and fine stylolites	106 107 108
							108.60	-91.89		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Occasional scattered fine bioclastic debris and fine stylolites . Minor white calcite veining dipping at 85' to 180'	109 110

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Remarks

Rotary Core Log

Borehole No.	**BH01**	Sheet 12 of 28	
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No.	Lackagh Quarry
Co-ords:	530370.59 - 728426.56	Hole Type	RC
Location:	Galway	Level:	16.71
Scale	1:50		
Client:	Galway County Council	Dates:	13/11/2015 - 21/12/2015
Logged By	Dave Blaney		

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		108.60 - 111.55	5	100	98	86				
		111.55 - 113.73	1	100	100	100	111.55	-94.84		Strong. fresh, grey, fine grained, massive LIMESTONE. Fine black stylolites
		113.73 - 114.33	3	100	0	0	113.73	-97.02		Strong. fresh, grey, fine grained, massive LIMESTONE. Fine grained bioclastic debris. Axial parallel jointing
		114.33 - 119.52	1	100	100	98	114.33	-97.62		Strong. fresh, grey, fine to medium grained, massive LIMESTONE. Disseminated very fine grained bioclastic debris
							119.52	-102.81		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Faint pellety texture, etched stylolites and scattered small vugs, often

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Remarks

Rotary Core Log

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530370.59 - 728426.56	Borehole No. **BH01** Sheet 13 of 28
				Hole Type RC
Location:	Galway		Level: 16.71	Scale 1:50
Client:	Galway County Council		Dates: 13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
		119.52 - 127.29	4	100	95	87				weakly oxidised. Disseminated fine grained bioclastic debris	121 122 123 124 125 126 127
		127.29 - 128.75	6	99	97	82	127.29	-110.58		Strong. fresh, grey, fine to medium grained, massive LIMESTONE. Incipient mottled texture and scattered fine bioclastic debris.	128
							128.75	-112.04		Strong. fresh, dark grey, fine to medium grained, massive LIMESTONE. Wispy black argillaceous partings. Scattered fine bioclastic debris with some coarse shelled brachiopods / gastropods. thick black stylolites with argillic infill. Occasional white calcite veinlet	129 130

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Remarks

Rotary Core Log

					Borehole No. **BH01** Sheet 14 of 28
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords:	530370.59 - 728426.56	Hole Type RC
Location:	Galway		Level:	16.71	Scale 1:50
Client:	Galway County Council		Dates:	13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
		128.75 - 134.90	1	100	97	97					131 132 133 134
		134.90 - 136.05	4	84	84	84	134.90	-118.19		Strong. fresh, dark grey, fine to medium grained, massive LIMESTONE. Wispy black argillaceous partings. Scattered fine bioclastic debris with some coarse shelled brachiopods.	135
		136.05 - 137.52	3	100	100	95	136.05	-119.34		Strong. fresh, dark grey, fine to medium grained, massive LIMESTONE. Weak intraclastic breccia texture minor stylolites and black argillic partings	136 137
		137.52 - 141.84	2	100	100	100	137.52	-120.81		Strong. fresh, grey, fine to medium grained, massive LIMESTONE. Small scattered bioclasts, incipient intraclastic breccia texture locally developed minor discontinuous white calcite veinlets	138 139 140

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Remarks

Rotary Core Log

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530370.59 - 728426.56	Borehole No. **BH01** Sheet 15 of 28
				Hole Type RC
Location:	Galway		Level: 16.71	Scale 1:50
Client:	Galway County Council		Dates: 13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		141.84 - 142.93	3	100	100	100	141.84	-125.13		Strong. fresh, grey, fine to medium grained, massive LIMESTONE. Small scattered bioclasts, incipient bioturbated / burrowed texture
		142.93 - 143.70	0	100	100	100	142.93	-126.22		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE.. Pellety / almost oolitic texture
		143.70 - 148.30	1	100	100	100	143.70	-126.99		Strong. fresh, grey, fine to medium grained, massive LIMESTONE. Intraclastic breccia texture sub-rounded clasts 0.5 - 2.0cm dia. possibly related to bioturbation / burrowing. Minor stylolites and a very rare bioclast
		148.30 - 148.90	10	100	0	0	148.30	-131.59		Core is crosscut by a 2cm thick band of weak / very weak, fresh, fine grained Black MUDSTONE. Soft / Friable texture, locally altered to clay dip 32' to 060'
							148.90	-132.19		Strong. fresh, dark grey / black, fine to medium grained, massive LIMESTONE. Intraclastic breccia texture poorly sorted, very irregular / angular clasts of fine grained limestone (micrite) in a black / dark grey locally argillaceous matrix. Intensity of brecciation decreasing with depth

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Remarks

Rotary Core Log

				Borehole No. **BH01** Sheet 16 of 28
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530370.59 - 728426.56	Hole Type RC
Location:	Galway		Level: 16.71	Scale 1:50
Client:	Galway County Council		Dates: 13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		148.90 - 154.60	2	100	99	97				
		154.60 - 161.75	1	100	100	71	154.60	-137.89		Strong. fresh, grey, fine to medium grained, massive LIMESTONE. Stylolites locally up to 3mm thick. Minor bioclastic debris. Locally developed incipient intraclastic breccia / bioturbation textures

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Remarks

Rotary Core Log

Borehole No.	**BH01**
	Sheet 17 of 28
Project Name:	Lackagh Quarry Preliminary Ground Investigation
Project No.	Lackagh Quarry
Co-ords:	530370.59 - 728426.56
Hole Type	RC
Location:	Galway
Level:	16.71
Scale	1:50
Client:	Galway County Council
Dates:	13/11/2015 - 21/12/2015
Logged By	Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description
				TCR	SCR	RQD				
		161.75 - 166.30	1	100	100	98	161.75	-145.04		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Locally developed pellety / oolitic texture. Scattered bioclastic debris
		166.30 - 168.90	1	100	100	99	166.30	-149.59		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Numerous coarse bioclasts and white calcite infilling small voids
							168.90	-152.19		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Slight pellety texture. Scattered fine to medium grained bioclasts

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Remarks

Rotary Core Log

Borehole No.	**BH01**	Sheet 18 of 28

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords:	530370.59 - 728426.56	Hole Type RC
Location:	Galway		Level:	16.71	Scale 1:50
Client:	Galway County Council		Dates:	13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
		168.90 - 172.00	1	100	100	100			▦		171
key key Incorrect Incorrect Inc key key Incorrect Incorrect Inc key key		172.00 - 175.65	2	100	100	99	172.00	-155.29	▦	Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE.	172 173 174 175
		175.65 - 177.00	1	100	100	100	175.65	-158.94	▦	Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Scattered coarse shelled brachiopods	176
		177.00 - 182.50	1	100	100	100	177.00	-160.29	▦	Strong. fresh, grey, fine to medium grained, massive LIMESTONE. Minor stylolites, some up to 2mm thick. Scattered fine bioclastic debris	177 178 179 180

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Remarks

Rotary Core Log

Borehole No.	**BH01**	Sheet 19 of 28	
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	
Co-ords:	530370.59 - 728426.56	Hole Type	RC
Location:	Galway		
Level:	16.71	Scale	1:50
Client:	Galway County Council		
Dates:	13/11/2015 - 21/12/2015	Logged By	Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
									▦	
		182.50 - 186.80	1	100	100	99	182.50	-165.79	▦	Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Locally developed incipient intraclastic breccia texture. Fine stylolites and minor bioclasts
		186.80 - 189.00	0	0	0	0	186.80	-170.09		Cavity - No recovery. Pitting / dissolution textures and slight brown oxidation on contacts
		189.00 - 190.30		100	0	0	189.00	-172.29	▤	Soft to firm, light brown, fine grained sandy CLAY. Some tabular / angular clasts of light brown oxidised mudstone within the clay

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Remarks

Keynetix

Rotary Core Log

Borehole No.
BH01
Sheet 20 of 28

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords:	530370.59 - 728426.56	Hole Type RC
Location:	Galway		Level:	16.71	Scale 1:50
Client:	Galway County Council		Dates:	13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
			0						▤		
		190.30 - 191.20	0	100	100	100	190.30	-173.59	▦	Strong. fresh, grey, fine to medium grained, massive LIMESTONE.	191
		191.20 - 192.85	8	100	64	41	191.20	-174.49	▦	Strong. fresh, grey / dark grey, fine to medium grained, massive LIMESTONE.	192
		192.85 - 195.70	1	100	100	100	192.85	-176.14	▦	Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Light brown sandy clay coating joint surfaces	193 194 195
		195.70 - 198.70	1	100	100	100	195.70	-178.99	▦	Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Scattered coarse shelled brachiopods	196 197 198
							198.70	-181.99	▦	Strong. fresh, light grey / grey, fine to medium grained, massive LIMESTONE. Occasional coarse shelled brachiopod, locally developed incipient intraclastic breccia texture	199 200

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Remarks

AGS

Rotary Core Log

			Borehole No. **BH01** Sheet 21 of 28
Project Name: Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530370.59 - 728426.56	Hole Type RC
Location: Galway		Level: 16.71	Scale 1:50
Client: Galway County Council		Dates: 13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		198.70 - 203.00	2	91	91	91			▨	
		203.00 - 203.90	9	94	94	56	203.00	-186.29	▨	Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Minor coarse shelled brachiopods. Joints coated with light brown fine sandy clay
		203.90 - 207.50	1	100	98	98	203.90	-187.19	▨	Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Scattered coarse shelled brachiopods
							207.50	-190.79	▨	Strong. fresh, grey, fine to medium grained, massive LIMESTONE.

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Remarks

Keynetix

Rotary Core Log

Borehole No.	**BH01**	Sheet 22 of 28			
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords:	530370.59 - 728426.56	Hole Type RC
Location:	Galway		Level:	16.71	Scale 1:50
Client:	Galway County Council		Dates:	13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		207.50 - 214.50	1	100	100	99				
		214.50 - 216.90	2	100	90	90	214.50	-197.79		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. disseminated bioclastic debris
		216.90 - 217.60	3	100	100	100	216.90	-200.19		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Slightly vuggy with minor oxidation focused upon vugs
		217.60 - 221.55	4	97	87	78	217.60	-200.89		Strong. fresh, light grey / grey, fine to medium grained, massive LIMESTONE.

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Remarks

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Rotary Core Log

Borehole No.	**BH01**	Sheet 23 of 28		
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530370.59 - 728426.56	Hole Type RC
Location:	Galway		Level: 16.71	Scale 1:50
Client:	Galway County Council		Dates: 13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
											221
		221.55 - 223.55	5	100	98	96	221.55	-204.84		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Minor oxidation and light brown clay localised along joints and along some stylolites	222 223
		223.55 - 226.55	3	97	84	81	223.55	-206.84		Strong. fresh, pale grey/ grey, medium grained, massive LIMESTONE. Distinct pellety texture, fine grained bioclastic debris. 226.4 - 226.5 evidence of oxidation, dissolution (pitting) along a shallowly dipping joint plane	224 225 226
		226.55 - 229.10	3	100	97	95	226.55	-209.84		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. slight dissolution and oxidation focused on some joint surfaces	227 228
		229.10 - 229.20	0	0	0	0	229.10	-212.39		Cavity infilled with light brown soft / firm sticky clay	229
							229.20	-212.49		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Slight discolouration and oxidation along some joint surfaces	230

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Remarks

Rotary Core Log

Project Name: Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530370.59 - 728426.56	Borehole No. **BH01** Sheet 24 of 28
Location: Galway		Level: 16.71	Hole Type RC
			Scale 1:50
Client: Galway County Council		Dates: 13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
		229.20 - 231.10	4	95	91	86	231.10	-214.39			231
		231.10 - 233.20	1	100	98	95	233.20	-216.49		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE.	232 233
		233.20 - 234.15	11	91	79	45	234.15	-217.44		Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Joints and fractures infilled with light brown fine / medium grained sand. 232.78 2cm white calcite vein	234
		234.15 - 237.55	6	99	80	70	237.55	-220.84		Strong. fresh, grey, fine to medium grained, massive LIMESTONE. Locally developed fine vuggy texture. 236.6m joint with intense bright orange Fe Staining.	235 236 237
		237.55 - 239.20	0	0	0	0	239.20	-222.49		CAVITY - coarse grained yellow sand and angular gravel with some light brown silt. Recover 30 - 35%	238 239
										Strong. fresh, light grey / grey, fine to medium grained, massive LIMESTONE. Locally developed coarse vuggy texture - vugs up to 5mm dia.	240

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Remarks

Rotary Core Log

Borehole No.	**BH01**	Sheet 25 of 28	
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	
Co-ords:	530370.59 - 728426.56	Hole Type	RC
Location:	Galway		
Level:	16.71	Scale	1:50
Client:	Galway County Council		
Dates:	13/11/2015 - 21/12/2015	Logged By	Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	**Coring**			Depth (m)	Level (m)	Legend	Stratum Description
				TCR	SCR	RQD				
		239.20 - 241.40	6	50	19	13			▦	
		241.40 - 243.90	4	100	97	95	241.40	-224.69	▦	Strong. fresh, pale grey, fine to medium grained, massive LIMESTONE. Scattered poorly sorted bioclastic debris. Fine grained orange brown sand coating joint surfaces
		243.90 - 245.58	7	85	36	29	243.90	-227.19	▦	Strong. slightly weathered, pale grey, fine to medium grained, massive LIMESTONE. 243.9-244.35m axial parallel discontinuity with black argillaceous lamina. Orange brown clayey sand coating joint surfaces
		245.58 - 247.25	0	0	0	0	245.58	-228.87		CAVITY - 5% recovery of yellow brown fine to medium grained sand
		247.25 - 248.37	4	100	61	38	247.25	-230.54	▦	Strong. fresh, pale grey / grey, mottled, fine to medium grained, massive LIMESTONE. Fine vuggy texture with minor oxidation / Fe staining localised within the vugs. Some axial parallel jointing
		248.37 - 250.20	3	100	97	93	248.37	-231.66	▦	Strong. fresh, dark grey, medium grained, massive LIMESTONE. Poorly sorted bioclastic debris

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Remarks

Rotary Core Log

Borehole No.	**BH01**	Sheet 26 of 28	
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Hole Type RC
Co-ords:	530370.59 - 728426.56		
Location:	Galway	Level:	16.71
Scale	1:50		
Client:	Galway County Council	Dates:	13/11/2015 - 21/12/2015
Logged By	Dave Blaney		

Well	Water Strikes	Depth (m)	Type / FI	**Coring**			Depth (m)	Level (m)	Legend	Stratum Description
				TCR	SCR	RQD				
		250.20 - 253.00	2	100	98	98	250.20	-233.49		Strong. fresh, dark grey, medium grained, massive LIMESTONE. Poorly sorted bioclastic debris. Discontinuous randomly orientated white calcite veinlets
		253.00 - 255.50	2	100	92	92	253.00	-236.29		Strong. fresh, grey, medium grained, massive LIMESTONE. Scattered poorly sorted bioclastic debris. Incipient intraclastic breccia texture
		255.50 - 255.90	7	100	0	0	255.50	-238.79		Strong. grey LIMESTONE cross cut by cavity / dissolution zone bright orange staining and dissolution textures on cavity contact
		255.90 - 256.90	4	100	60	60	255.90	-239.19		Strong. fresh, grey, medium grained, massive LIMESTONE. Scattered bioclastic debris
		256.90 - 257.35	22	78	0	0	256.90	-240.19		Moderately strong, black, fine to medium grained LIMESTONE - black argillite rich zones - Rubble poorly sorted fragments with some polished surfaces.
		257.35 - 259.40	3	100	68	68	257.35	-240.64		Moderately strong. black / dark grey, fine to medium grained, massive LIMESTONE. Intraclastic breccia, irregular poorly sorted limestone clasts in a black argillite rich matrix
		259.40 - 259.50	0	100	0	0	259.40	-242.69		Strong. fresh, dark grey, medium grained, massive LIMESTONE.

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Remarks

Rotary Core Log

Project Name: Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530370.59 - 728426.56	Borehole No. **BH01** Sheet 27 of 28
			Hole Type RC
Location: Galway		Level: 16.71	Scale 1:50
Client: Galway County Council		Dates: 13/11/2015 - 21/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		259.50 - 263.10	3	100	90	87				
		263.10 - 263.70	3	58	0	0	263.10	-246.39		Weak, black / grey MUDSTONE, running sub-parallel to core axis band is 2 - 3cm thick and partially altered to clay. The contact with the limestone shows evidence of oxidation / Fe staining
		263.70 - 266.40	2	100	100	100	263.70	-246.99		Strong. fresh, grey / pale grey, medium grained, massive LIMESTONE. Mottled and evidence of bioturbation / burrowing. 265.4 - 265.46 fracture zone with rubble and coarse brown sand
		266.40 - 267.10	17	100	40	40	266.40	-249.69		Strong. fresh, grey / pale grey, medium grained, massive LIMESTONE. Mottled and evidence of bioturbation / burrowing. Core is coated with coarse brown sand
		267.10 - 267.70	2	100	100	100	267.10	-250.39		Strong. fresh, grey / pale grey, medium grained, massive LIMESTONE. Mottled and evidence of bioturbation / burrowing.
		267.70 - 270.30	6	100	55	52	267.70	-250.99		Strong. fresh, grey / dark grey, medium grained, massive LIMESTONE. Occasional stylolitic and axial parallel joint

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Remarks

Rotary Core Log

Borehole No.	**BH01**	Sheet 28 of 28	
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	
Co-ords:	530370.59 - 728426.56	Hole Type	RC
Location:	Galway		
Level:	16.71	Scale	1:50
Client:	Galway County Council		
Dates:	13/11/2015 - 21/12/2015	Logged By	Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		270.30 - 272.40	1	100	100	100	270.30	-253.59	▦	Strong. fresh, grey / dark grey, medium grained, massive LIMESTONE.
		272.40 - 273.40	0	0	0	0	272.40	-255.69		CAVITY no recovery
		273.40 - 274.16	5	79	39	20	273.40	-256.69	▦	Strong. fresh, very pale grey, medium grained, massive LIMESTONE. Probably a boulder within cavity / unconsolidated sediments
		274.16 - 276.70	0	8	0	0	274.16	-257.45		CAVITY - unconsolidated ground only 10% medium to coarse limestone cobbles and some gravel recovered
							276.70	-259.99		End of borehole at 276.70 m

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Remarks

Rotary Core Log

Borehole No.	**BH03**	Sheet 1 of 11	
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No.	Lackagh Quarry
Co-ords:	530023.82 - 728382.57	Hole Type	RC
Location:	Galway	Level:	26.26
Scale	1:50		
Client:	Galway County Council	Dates:	13/11/2015 - 09/12/2015
Logged By	Dave Blaney		

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Stratum Description
							1.20	25.06	No Recovery
							1.45	24.81	Very soft, light brown, sandy CLAY with minor angular gravel
							2.70	23.56	Rubble of sub-angular to sub-rounded grey Limestone fragments and minor creamy coloured calcite. Lumps of soft light grey/brown clay. (Recovery 0.35m)
							3.00	23.26	Stiff, grey brown, sandy CLAY, occasional sub angular gravel and cobbles of dark grey limestone
							3.20	23.06	Coarse cobbles of dark grey limestone with firm / stiff grey brown sandy clay
							3.55	22.71	Coarse COBBLES with gravel. Sub-angular to sub-rounded grey / dark grey limestone with minor pink (tonalitic) granite
							4.00	22.26	Core loss
		4.15 - 4.42	C				4.85	21.41	Stiff / very stiff, light grey/brown sandy CLAY with minor (10 - 15%) scattered angular limestone gravel
							6.00	20.26	Stiff / very stiff, light grey/brown sandy CLAY with angular limestone gravel & cobbles
							6.55	19.71	Core loss
							6.85	19.41	Stiff / very stiff, light grey/brown sandy CLAY with angular limestone gravel, cobbles and occasional boulders
							7.65	18.61	Stiff / very stiff, grey / brown sandy CLAY with (12 - 20%) angular limestone gravel and occasional sub-rounded cobbles
							8.05	18.21	Core loss
							8.25	18.01	Loose angular GRAVEL with cobbles. Coated with stiff sandy clay
									Stiff / very stiff, light grey / brown, sandy CLAY, 205 sub-angular / sub-rounded gravel and occasional sub-rounded cobble and small boulder

Continued on next sheet

Remarks
All angles measured relative to core normal

Rotary Core Log

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Borehole No. **BH03** Sheet 2 of 11
Co-ords:	530023.82 - 728382.57		Hole Type RC
Location:	Galway	Level: 26.26	Scale 1:50
Client:	Galway County Council	Dates: 13/11/2015 - 09/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
											11
							11.55	14.71		Stiff / very stiff, light grey / brown, sandy CLAY, 205 sub-angular / sub-rounded gravel and occasional sub-angular cobbles and small boulder	12
							12.94	13.32		Soft, dark chocolate brown CLAY	13
							12.98	13.28		Core Loss	
		13.65 - 13.73 13.73 - 13.85	D D				13.65	12.61		Soft / very soft, greenish grey, fine sandy SILT (recovery 0.5m)	14
		14.90 - 15.00	D				14.75	11.51		Core Loss	15 16
							16.15	10.11		Soft / firm, grey / green SILT	
							16.45	9.81		Soft / very soft, grey brown SILT with very thin clay laminae (Mobilised and coating surface by drilling additive)	
							16.85	9.41		Core loss	17 18
		19.00 - 19.10 19.10 - 19.20	D D				18.60	7.66		Soft / very soft, grey SILT	19
		19.25 - 19.30 19.90 - 20.00	D D				19.25	7.01		Soft / firm, grey SILT, locally developed faint brown laminae (smearing of clay surface)	20

Continued on next sheet

Remarks
All angles measured relative to core normal

Rotary Core Log

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Borehole No. **BH03** Sheet 3 of 11
Co-ords:	530023.82 - 728382.57		Hole Type RC
Location:	Galway		
Level:	26.26		Scale 1:50
Client:	Galway County Council		
Dates:	13/11/2015 - 09/12/2015		Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		20.95 - 21.05	D						××××	
		21.30 - 21.40	D						××××	
							21.70	4.56	××××	Very soft / soft, grey SILT (Recovery 50%)
							23.00	3.26	××××	Soft / firm, grey SILT (Recovery 60%)
							25.20	1.06	××××	Soft / very soft, grey SILT (Recovery 90%)
		25.50 - 25.60	D						××××	
		25.80 - 25.90	D						××××	
		26.50 - 26.60	D						××××	
		26.70 - 26.80	D						××××	
		27.20 - 27.25	D						××××	
		27.45 - 27.55	D						××××	
		27.55 - 27.65	D				27.50	-1.24	××××	Firm grey SILT with centimetric scale horizontal banding
							28.45	-2.19	××××	Soft, grey SILT (recovery 60%)
							30.00	-3.74		

Continued on next sheet

Remarks
All angles measured relative to core normal

Rotary Core Log

Borehole No. **BH03**	Sheet 4 of 11		
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530023.82 - 728382.57
Hole Type	RC		
Location:	Galway	Level:	26.26
Scale	1:50		
Client:	Galway County Council	Dates:	13/11/2015 - 09/12/2015
Logged By	Dave Blaney		

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
		30.25 - 30.33	D							Soft / firm grey SILT	
											31
		31.20 - 31.30	D								
		31.35 - 31.45	D								
							31.73	-5.47		Firm, grey / brown SILT	
											32
							32.40	-6.14		Soft, grey SILT	
											33
		33.70 - 33.80	D								
		33.95 - 34.03	D								
											34
							34.60	-8.34		Soft / Firm, light grey SILT. Minor fine grained sand	
											35
											36
		36.05 - 36.15	D				36.05	-9.79		Loose / medium dense, light grey / brown, silty SAND (recovery 30%)	
		36.70 - 36.80	D								
											37
											38
							38.38	-12.12		Firm, dark chocolate brown organic CLAY, Small fibres bottom 0.5m of core coated with fine grained grey sand	
		38.60 - 38.70	D								
		38.95 - 39.05	D								
											39
		39.25 - 39.30	D								
		39.45 - 39.55	D								
		39.80 - 39.83	D								
											40

Continued on next sheet

Remarks
All angles measured relative to core normal

Rotary Core Log

Project Name: Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530023.82 - 728382.57	Borehole No. **BH03** Sheet 5 of 11
Location: Galway		Level: 26.26	Hole Type RC
			Scale 1:50
Client: Galway County Council		Dates: 13/11/2015 - 09/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		40.65 - 40.77	D				40.65	-14.39		Loose / medium dense, grey, fine to medium grained SAND (recovery 60%)
							41.00	-14.74		Firm grey / brown, organic CLAY, minor dark brown banding 0.5 - 1cm thick
		41.20 - 41.25	D							
		41.30 - 41.50	C							
							41.80	-15.54		Stiff / very stiff, dark brown, organic CLAY. Basal 4cm laminated - light / dark brown millimetric scale laminae
		41.85 - 42.08	C							
		42.30 - 42.35	D							
		42.35 - 42.40	D				42.40	-16.14		Firm / stiff, dark brown grey, CLAY
		42.65 - 42.97	C							
		42.97 - 43.30	C							
							43.25	-16.99		Soft to firm light grey CLAY
		44.05 - 44.20	C							
							44.20	-17.94		Core Loss
							44.85	-18.59		Firm, dark grey brown CLAY
							45.24	-18.98		Soft, grey SILT
							45.30	-19.04		Very Stiff, Dark brown / grey, organic CLAY
		46.20 - 46.27	D							
		46.27 - 46.59	C							
		47.00 - 47.10	D							
		47.20 - 47.27	D							
		47.45 - 47.55	D							
		47.85 - 48.02	C							
		48.20 - 48.30	D							
		48.45 - 48.70	C							
		49.00 - 49.10	D							
		49.30 - 49.40	D							
							50.00	-23.74		

Continued on next sheet

Remarks
All angles measured relative to core normal

Rotary Core Log

Project Name: Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530023.82 - 728382.57	Borehole No. **BH03** Sheet 6 of 11
Location: Galway		Level: 26.26	Hole Type RC
			Scale 1:50
Client: Galway County Council		Dates: 13/11/2015 - 09/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
										Firm grey CLAY, with cobbles of strong pale grey limestone rounded to sub-angular
							50.35	-24.09		Soft, light greyish brown, cobbly CLAY, cobbles of pale grey limestone, comprise 50% of material
							51.30	-25.04		Boulder of pale grey massive limestone, stylolitic with stylolites rotated to sub-vertical orientation
							52.56	-26.30		Soft / firm, brownish grey gravelly CLAY, angular gravel (10 - 20%), sub-rounded coarse cobbles / small boulders (30 - 40%) of light grey massive limestone. (recovery 80%)
							56.40	-30.14		Sub-rounded COBBLES with coarse gravel - coated by soft light grey clay
							57.15	-30.89		Soft / firm Pale grey CLAY with angular cobbles of grey limestone (recovery 40%)
							57.85	-31.59		Soft grey brown CLAY with angular gravel and cobbles (Recovery 40%)

Continued on next sheet

Remarks
All angles measured relative to core normal

Rotary Core Log

Borehole No.	**BH03**	Sheet 7 of 11	
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530023.82 - 728382.57
Hole Type	RC		
Location:	Galway	Level:	26.26
Scale	1:50		
Client:	Galway County Council	Dates:	13/11/2015 - 09/12/2015
Logged By	Dave Blaney		

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
							60.55	-34.29		BOULDER of strong, pale grey, fine to medium grained Limestone
							62.20	-35.94		Soft to firm grey brown cobbly CLAY - cobbles of angular limestone
							62.52	-36.26		Stiff brown, organic CLAY
		63.15 - 63.22	D							
		63.38 - 63.43	D							
		63.50 - 63.55	D							
		63.90 - 63.95	D							
							64.05	-37.79		Loose / medium dense, brown / grey, medium grained SAND
							64.11	-37.85		Firm / stiff, brown / dark brown, organic CLAY, Finely laminated (0.5 - 1.5mm laminae) light / dark brown. Occasional small white clay flecks / blebs. Millimetric to centimetric scale bands of fine to medium grained sand, locally developed grading - coarsening down
		64.30 - 64.35	D							
		64.90 - 64.95	D							
		65.50 - 65.60	D							
							65.78	-39.52		Stiff pale grey CLAY
							65.85	-39.59		Firm / stiff, brownish grey, finely laminated CLAY with sub-rounded cobbles of grey limestone, locally friable and broken up in situ
							66.48	-40.22		Firm grey, fine sandy CLAY, with 10% angular gravel
							66.85	-40.59		Firm, pale creamy grey, fine grained sandy CLAY (recovery 80%)
		66.95 - 67.05	D							
							67.65	-41.39		Firm, grey / creamy grey fine sandy CLAY laminated and banded texture with small clasts of creamy white, soft weather limestone
		68.40 - 68.45	D							
							69.15	-42.89		BOULDER of strong, fresh pale grey, fine grained Limestone
							69.89	-43.63		

Continued on next sheet

Remarks
All angles measured relative to core normal

Rotary Core Log

Borehole No.	**BH03**	Sheet 8 of 11	
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	
Co-ords:	530023.82 - 728382.57	Hole Type	RC
Location:	Galway	Level:	26.26
Scale	1:50		
Client:	Galway County Council	Dates:	13/11/2015 - 09/12/2015
Logged By	Dave Blaney		

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
										Firm, dark brown / grey, laminated CLAY, with boulders of light grey limestone
		70.40 - 70.50	D							
		70.75 - 70.85	D							
							72.98	-46.72		Soft / firm, grey / brown fine sandy CLAY with angular fine to medium grained limestone gravel and cobbles
							73.95	-47.69		Loose. light grey / brown medium grained SAND, with bands of soft brown clay (Recovery 50%)
							75.00	-48.74		BOULDER of strong, fresh, pale grey Limestone
							76.14	-49.88		Firm dark brown organic CLAY, minor coarse grained gravel
							76.35	-50.09		Soft dark brown organic CLAY - very light / low density
							76.42	-50.16		Soft light brown / grey, gravelly CLAY, 50 -60% coarse angular gravel and occasional cobbles, poor recovery of clay but all cobbles / gravel have a clay coating
							79.10	-52.84		BOULDER of strong light grey limestone
							79.54	-53.28		Soft / firm grey brown sandy CLAY, with sub-angular limestone gravel / cobbles

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Remarks
All angles measured relative to core normal

Rotary Core Log

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530023.82 - 728382.57	Borehole No. **BH03** Sheet 9 of 11
Location:	Galway		Level: 26.26	Hole Type RC
Client:	Galway County Council		Dates: 13/11/2015 - 09/12/2015	Scale 1:50
				Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
							80.10	-53.84		Loose coarse gravelly COBBLES of light grey limestone. evidence of reworking by the bit
							85.55	-59.29		Tricone drilling - Open hole drilling - no recovery

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Remarks
All angles measured relative to core normal

Rotary Core Log

Borehole No.
BH03
Sheet 10 of 11

Project Name: Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530023.82 - 728382.57	Hole Type RC
Location: Galway		Level: 26.26	Scale 1:50
Client: Galway County Council		Dates: 13/11/2015 - 09/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
									incorrect key		91 92 93 94 95 96 97 98 99 100

Continued on next sheet

Remarks
All angles measured relative to core normal

Rotary Core Log

Borehole No.	BH03	Sheet 11 of 11	
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No.	Lackagh Quarry
Co-ords:	530023.82 - 728382.57	Hole Type	RC
Location:	Galway	Level:	26.26
Scale	1:50		
Client:	Galway County Council	Dates:	13/11/2015 - 09/12/2015
Logged By	Dave Blaney		

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
							104.95	-78.69		Strong, grey, fine to medium grained, massive LIMESTONE. Discontinuous white calcite veining dipping at 55 - 65' and up to 1cm thick., scatter bioclast debris.
							107.10	-80.84		Rubble of gravel sized pale grey Limestone fragments
		107.50 - 108.16	7	90	52	52	107.50	-81.24		Strong, fresh pale grey, fine grained, massive LIMESTONE. Scattered bioclastic debris, stylolitic thin argillite partings
							108.16	-81.90		Soft, dark brown CLAY, with cobbles of angular / sub-angular limestone
		108.60 - 109.90		100	100	100	108.60	-82.34		Strong, fresh, grey medium grained, massive LIMESTONE. Scattered fine bioclastic debris. 109.4m small calcite filled void with cubic crystals of purple fluorite
							109.90	-83.64		End of borehole at 109.90 m

Remarks

All angles measured relative to core normal

Rotary Core Log

Borehole No.	**BH04**
Sheet	1 of 7
Project Name:	Lackagh Quarry Preliminary Ground Investigation
Project No.	Lackagh Quarry
Co-ords:	530150.78 - 728400.13
Hole Type	RC
Location:	Galway
Level:	32.17
Scale	1:25
Client:	Galway County Council
Dates:	11/11/2015 - 12/11/2015
Logged By	Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		0.00 - 1.20		0	0	0	1.20	30.97		No Recovery sandy gravelly soil
		1.20 - 1.35		100	0	0	1.35	30.82		Mid brown, soft CLAY, with fine to medium grained, angular, limestone gravel
		1.35 - 1.50		100	0	0	1.50	30.67		Light grey to pale brown soft CLAY
		1.50 - 2.84		37	0	0	2.84	29.33		Rubble comprising - Strong, Slightly weathered pale grey fine to medium grained LIMESTONE
		2.84 - 3.36		87	13	0	3.36	28.81		Strong, fresh, pale grey to brownish grey, fine to medium grained LIMESTONE
		3.36 - 4.00		100	0	0	4.00	28.17		Strong, fresh, pale grey / brown, fine to medium grained massive LIMESTONE. Broken in chaotic angular fragments clasts ranging in size from 0.5cm to 10cm across in a matrix of firm to stiff brown / grey clay between fragments and in bands up to 10cm thick.
		4.00 - 4.20	25	100	0	0	4.20	27.97		Strong, fresh, pale grey / brown, fine to medium grained massive LIMESTONE. two fracture sets, 1. dipping at 25' Planar / Rough, 2. Dipping at 85', Planar / Rough coated with grey / brown clay.
		4.20 - 4.45		100	0	0	4.45	27.72		A rubble of Strong, fresh, pale grey / brown, fine to medium grained massive LIMESTONE.
		4.45 - 4.90	9	100	24	24	4.90	27.27		Strong, fresh, pale grey / brown, fine to medium grained massive LIMESTONE. Two fracture sets, 1. dipping at 15 -30' Planar to slightly undulating / Rough, infilled with grey /brown grey stiff clay with fine grained sand, 2. Dipping at 65', Planar / Rough

Continued on next sheet

Remarks
All angles measured relative to short core axis

Rotary Core Log

Borehole No.	**BH04**	Sheet 2 of 7	
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	
Co-ords:	530150.78 - 728400.13	Hole Type	RC
Location:	Galway	Level:	32.17
Scale	1:25		
Client:	Galway County Council	Dates:	11/11/2015 - 12/11/2015
Logged By	Dave Blaney		

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		4.90 - 5.95	10	100	10	10	5.95	26.22		Strong, fresh, pale grey / brown, fine to medium grained massive LIMESTONE. Etched, sub-horizontal stylolites. Two fracture sets, 1. Closely spaced, dipping at 15-25' Planar to slightly undulating / Rough, coated with light brown / grey clay and fine sand, 2. Dipping at 70 - 90', Planar -undulating/ Rough coated with grey / brown clay and fine grained sand.
		5.95 - 6.20		88	0	0	6.20	25.97		Rubble of Strong, fresh, pale grey / brown, fine to medium grained massive LIMESTONE. Fragments angular and 1 - 7cm across.
		6.20 - 7.30	8	100	0	0	7.30	24.87		Strong, fresh, pale grey / brown, fine to medium grained massive LIMESTONE.. Slightly etched stylolites. two fracture sets, 1. dipping at 5 - 20' Planar / Rough,, grey clay infill 2. Dipping at 70 - 90', Planar - undulating / Rough coated with grey / brown clay.
		7.30 - 7.53	2	100	100	70	7.53	24.64		Strong, fresh, pale grey / brown, fine to medium grained massive LIMESTONE. One fracture set, dipping at 10' Planar / Rough,
		7.53 - 7.80	7	100	0	0	7.80	24.37		Strong, fresh, pale grey / brown, fine to medium grained massive LIMESTONE. Sub-horizontal stylolites. 3 - 10cm apart. One fracture set dipping at 70 - 90' Undulating / Rough, brown clay fill - aperture width up to 2mm..
		7.80 - 8.60	3	100	93	93	8.60	23.57		Strong, fresh, pale grey / brown, fine to medium grained massive LIMESTONE. Sub horizontal, well developed stylolites two fracture sets, 1. dipping at 5 - 10' Planar / Rough, 2. Dipping at 45', Planar / Rough no infill
		8.60 - 11.36	5	100	13	13				Strong, fresh, pale grey / brown, fine to medium grained massive LIMESTONE. Sub horizontal stylolites 10-20cm apart. Locally developed, sub -vertical white calcite veinlets at 9.7m. Three fracture sets, 1. dipping at 10 - 25' Undulating to Planar / Rough, locally developed light brown clay and fine grained sand, 2. Dipping at 70 - 90, Planar / Rough coated / infilled with with grey / brown clay. 3. Locally developed (between 9.4 - 97m), dipping at 85' Planar / Rough controlled by hairline white calcite veinlets

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Remarks
All angles measured relative to short core axis

Rotary Core Log

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords:	530150.78 - 728400.13	Borehole No. **BH04** Sheet 3 of 7
					Hole Type RC
Location:	Galway		Level:	32.17	Scale 1:25
Client:	Galway County Council		Dates:	11/11/2015 - 12/11/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
											11
		11.36 - 12.50	8	100	72	66	11.36	20.81		Strong, fresh, grey, fine to medium grained massive LIMESTONE. two fracture sets, 1. dipping at 5-15' Planar / Rough, locally developed thin clay light brown coating, 2. Dipping at 55', Planar / Rough coated with white grey calcite.	12
		12.50 - 15.86	1	100	100	100	12.50	19.67		Strong, fresh, grey / pale grey, fine to medium grained massive LIMESTONE. Sub horizontal stylolites., minor fine bioclastic debris. One fracture set dipping at 10' Planar / Rough.	13 14 15

Continued on next sheet

Remarks
All angles measured relative to short core axis

Rotary Core Log

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Borehole No. **BH04** Sheet 4 of 7
Co-ords:	530150.78 - 728400.13		Hole Type RC
Location:	Galway	Level: 32.17	Scale 1:25
Client:	Galway County Council	Dates: 11/11/2015 - 12/11/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
		15.86 - 17.74	6	100	41	41	15.86	16.31		Strong, fresh, grey, slightly mottled, fine to medium grained, massive LIMESTONE. Two fracture sets, 1. dipping at 10-25' undulating / Rough, Grey/brown to orange-brown clay coating fracture surfaces. and locally infilling fractures - aperture up to 2mm thick. 2. Dipping at 60 - 70', Planar / Rough very minor clay coating.	16 17
		17.74 - 18.40	0	100	100	100	17.74	14.43		Strong, fresh, pale grey / grey, slightly mottled, fine to medium grained, massive LIMESTONE. 5mm wide calcite vein dipping at 85'.	18
		18.40 - 18.50		100	0	0	18.40	13.77		Very soft, dark bluish grey CLAY	
		18.50 - 18.60		100	0	0	18.50	13.67		Medium strength, fresh, faintly laminated, black MUDSTONE. Disseminated, sub mm to mm scale blebs of crystalline pyrite. Basal contact has a wavy / undulating nature.	
		18.60 - 19.36	1	100	100	100	18.60	13.57		Strong, fresh, grey / dark grey, fine to medium grained, massive LIMESTONE. Faint brecciated intraclastic texture. - very irregular shaped angular, centimetric scale clasts in a dark grey fine grained matrix. Chaotic network of shaley stylolitic partings - incipient randomly orientated fracturing. One fracture set. dipping at 5' Planar / Rough, no infill	19
		19.36 - 19.55		79	0	0	19.36	12.81		Dark grey, soft CLAY with friable angular / tabular grey limestone fragments 2 - 5mm across	
		19.55 - 19.95	18	100	58	40	19.55	12.62		Strong, fresh, grey / dark grey, slightly mottled, fine to medium grained, massive LIMESTONE. Brecciated texture, angular / irregularly shaped intraclasts 0.5 - 3cm across, in a dark grey fine grained matrix (micrite), clasts are matrix	
							19.95	12.22			20

Continued on next sheet

Remarks
All angles measured relative to short core axis

Rotary Core Log

Borehole No.	**BH04**	Sheet 5 of 7	
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Hole Type RC
Co-ords:	530150.78 - 728400.13		
Location:	Galway	Level: 32.17	Scale 1:25
Client:	Galway County Council	Dates: 11/11/2015 - 12/11/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
		19.95 - 20.78	0	100	100	100	20.78	11.39		supported. One fracture set, dipping at 40-45' Planar / Rough, minor grey/brown clay. Strong, fresh, grey, slightly mottled, fine to medium grained, massive LIMESTONE. Brecciated texture, sub-angular, irregular shaped, intraclasts in a dark grey fine grained matrix. Minor bioclastic debris.	
		20.78 - 21.64	2	100	100	100	21.64	10.53		Strong, fresh, grey, fine to medium grained, massive LIMESTONE. Incipient breccia texture. Sub-horizontal stylolites 10 - 15cm apart, minor scattered bioclasts. One fracture set dipping at 25' Planar / Rough, no infill (rubbly)	21
		21.64 - 22.60	9	96	57	57	22.60	9.57		Strong, fresh, grey / pale grey, slightly mottled, fine to medium grained, massive LIMESTONE. Sub-horizontal stylolites and very small discontinuous white calcite veins. Three fracture sets, 1. dipping at 5-10' Planar to slightly stepped / Rough,. 2. Dipping at 30 - 40', Planar / Rough, 3. Dipping at 70 - 75' Planar / Rough minor orange brown clay particulary over top 20cm. .	22
		22.60 - 26.50	2	100	100	99				Strong, fresh, pale grey / brownish grey, fine to medium grained, massive LIMESTONE. Scattered small bioclasts and an occasional larger (2- 3cm) coral fragment. Sub-horizontal stylolites 20 - 30cm apart. One fracture set dipping at 5-10' Planar / Rough, minor pale brown sandy clay coating.	23 24 25

Continued on next sheet

Remarks
All angles measured relative to short core axis

Rotary Core Log

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Borehole No. **BH04** Sheet 6 of 7
Co-ords:	530150.78 - 728400.13		Hole Type RC
Location:	Galway		
Level:	32.17		Scale 1:25
Client:	Galway County Council		
Dates:	11/11/2015 - 12/11/2015		Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
											26
		26.50 - 27.20	9	100	46	20	26.50	5.67		Strong, fresh, pale grey / brownish grey, fine to medium grained, massive LIMESTONE. Two fracture sets, 1. dipping at 5-10 Planar / Rough, no infill. 2. Dipping at 55-60', Planar / Rough, very minor yellowish brown clay coating.	27
		27.20 - 28.95	4	100	87	78	27.20	4.97		Strong, fresh, pale grey, fine to medium grained, massive LIMESTONE. Two fracture sets, 1. closely / medium spaced, dipping at 5-10' Planar / Rough, Grey/brown to orange-brown clay coating fracture surfaces. and locally infilling fractures - aperture up to 2mm thick. 2. Dipping at 45'', Planar / Rough	28
		28.95 - 29.32		0	0	0	28.95	3.22		CAVITY. Contacts display evidence of dissolution, pitting etc... thin coatings of yellowish brown clay	29
		29.32 - 30.20	3	100	100	100	29.32	2.85		Strong, fresh, pale grey, fine to medium grained, massive LIMESTONE. Sub-horizontal stylolites 10 - 20cm apart. One fracture set, 1. Closely spaced, dipping at 0-5' Planar / Rough,	30

Continued on next sheet

Remarks
All angles measured relative to short core axis

Rotary Core Log

Borehole No.
BH04
Sheet 7 of 7

Project Name: Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530150.78 - 728400.13	Hole Type RC
Location: Galway		Level: 32.17	Scale 1:25
Client: Galway County Council		Dates: 11/11/2015 - 12/11/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		30.20 - 30.40		100	0	0	30.20	1.97		Very soft light brown / grey CLAY with a band of pale brown sand 5cm thick at top. Cavity Fill?
		30.40 - 33.72	2	100	100	98	30.40	1.77		Strong, fresh, pale grey, fine to medium grained, massive LIMESTONE. Sub-horizontal stylolites. One fracture sets dipping at 5-20' Planar / Rough, Medium spaced.
		33.72 - 34.30	7	100	0	0	33.72	-1.55		Strong, fresh, pale grey, fine to medium grained, massive LIMESTONE. Sub-horizontal stylolites. Two fracture sets 1. dipping at 5-10' Planar / Rough, no infill. 2. dipping at 75-85', Planar / Rough.
		34.30 - 35.00	1	100	100	100	34.20	-2.03		Strong, fresh, pale grey, fine to medium grained, massive LIMESTONE. Minor sub-horizontal stylolites. One fracture sets dipping at 250' Planar to undulating / Rough, no infill.
							35.00	-2.83		End of borehole at 35.00 m

Remarks
All angles measured relative to short core axis

Rotary Core Log

Project Name: Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530186.65 - 728378.11	Borehole No. **BH05** Sheet 1 of 9
Location: Galway		Level: 34.14	Hole Type RC
Client: Galway County Council		Dates: 06/11/2015 - 10/11/2015	Scale 1:25
			Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
							0.40	33.74	⁘	Overburden minor cobbles recovered
		0.40 - 0.95	13	100	0	0	0.95	33.19	▦	Strong, pale grey, medium grained, massive LIMESTONE. Joint set dipping at 5 - 10' Planar / Rough, no infill. Joint set dipping at 85 - 90' Planar / Rough, grey calcite coating joint surface
		0.95 - 1.17	0	100	100	100	1.17	32.97	▦	Strong, pale grey, medium grained, massive pellety LIMESTONE
		1.17 - 1.50	12	100	0	0	1.50	32.64	▦	Strong, pale grey, medium grained, massive LIMESTONE. Joints dipping at 5 - 10' Planar - slightly undulating / Rough,, very close to closely spaced,
		1.50 - 2.30	11	100	0	0	2.30	31.84	▦	Strong pale grey / grey, medium grained, massive LIMESTONE. Joints dipping at 5 - 10' Planar / Rough. Set of two conjugate joints dipping at 85 - 90' with strike angle between sets of 110 / 70' Planar to Slightly undulating / Rough
		2.30 - 3.27	11	100	32	32	3.27	30.87	▦	Strong, pale grey, fine to medium grained, slightly bioclastic, massive LIMESTONE. Minor stylolites, Very closely to closely spaced fractures dipping at 5 - 15', Planar to slightly undulating / Rough.
		3.27 - 5.80	8	99	0	0			▦	Strong, grey / pale grey, medium grained, pellety, massive LIMESTONE. closely spaced fracture dipping at 5 - 15', Planar to slightly undulating / Rough. Fracture set dipping at 85' planar / rough

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Remarks
All angles measured relative to short core axis

Rotary Core Log

Borehole No.	**BH05**	Sheet 2 of 9	
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	
Co-ords:	530186.65 - 728378.11	Hole Type	RC
Location:	Galway		
Level:	34.14	Scale	1:25
Client:	Galway County Council		
Dates:	06/11/2015 - 10/11/2015	Logged By	Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
		5.80 - 8.00	6	100	0	0	5.80	28.34		Strong, pale grey, medium grained, pellety, massive LIMESTONE. fine grained scattered bioclastic debris, Sub horizontal stylolites. Very closely to closely spaced fractures dipping at 5 - 20', Planar to slightly undulating / Rough, minor fine grained grey sand infill. Axial parallel conjugate jointing dipping at 85 - 90' striking 120 / 60 relative to each other. minor clay coating	6 7
		8.00 - 8.68	1	91	91	91	8.00	26.14		Strong, pale grey, medium grained, massive LIMESTONE. fine grained scattered bioclastic debris, Sub horizontal stylolites.	8
		8.68 - 9.50	11	100	88	37	8.68	25.46		Strong, pale grey, fine grained, massive LIMESTONE. Sub horizontal stylolites. Fractures dipping at 5 - 10', Planar / Rough, Fractures dipping at 45' Planar - slightly undulating / Rough	9
		9.50 - 10.25	0	100	100	100	9.50	24.64		Strong, pale grey, fine grained, massive LIMESTONE. fine, sub horizontal stylolites, spaced 5 - 10cm.	10

Continued on next sheet

Remarks
All angles measured relative to short core axis

Rotary Core Log

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530186.65 - 728378.11	Borehole No. **BH05** Sheet 3 of 9
Location:	Galway		Level: 34.14	Hole Type RC
Client:	Galway County Council		Dates: 06/11/2015 - 10/11/2015	Scale 1:25
				Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
		10.25 - 11.34	13	100	0	0	10.25	23.89		Strong, pale grey, fine grained, massive LIMESTONE. Sub horizontal stylolites. Three fractures sets 1. dipping at 5 - 10', Planar / Rough, no infill; 2. dipping at 45 - 50' planar to slightly undulating / Rough, fine sand coating fracture surfaces. 3. dipping at 85 - 90', Planar to slightly undulating / Rough cross-cutting the other fracture sets.	11
		11.34 - 12.62	3	100	100	78	11.34	22.80		Strong, pale grey, fine to medium grained, massive LIMESTONE. Sub horizontal stylolites. Two fracture sets 1. dipping at 5 - 10', Planar to slightly undulating / Rough, 2. dipping at 85 - 90', Planar / Rough very minor iron staining.	12
		12.62 - 13.27	15	100	0	0	12.62	21.52		Strong, pale grey / grey, fine / medium grained, massive LIMESTONE. Two fractures sets 1. Close to very closely spaced dipping at 5 - 20', Planar / Rough; 2. dipping at 70 - 80', Planar / Rough	13
		13.27 - 15.04	4	100	100	96	13.27	20.87		Strong, grey, fine / medium grained, massive LIMESTONE. Very small scattered bioclasts, Occasional sub-horizontal stylolites. Small elongate calcite filled "Birdseyes", elongate sub vertical long axis 5 - 10mm long and 0.5mm wide. Two fracture sets 1. Medium spaced dipping at 5 - 15', Planar / Rough; 2. Widely spaced, dipping at 55', Planar / Rough	14 15

Continued on next sheet

Remarks
All angles measured relative to short core axis

Rotary Core Log

Project Name: Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530186.65 - 728378.11	Borehole No. **BH05** Sheet 4 of 9
Location: Galway		Level: 34.14	Hole Type RC
			Scale 1:25
Client: Galway County Council		Dates: 06/11/2015 - 10/11/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	**Coring**			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
		15.04 - 15.44	18	100	100	0	15.04	19.10	▦	Strong, grey, fine / medium grained, massive LIMESTONE. Very small scattered bioclasts and a large 1cm dia. gastropod , Occasional sub-horizontal stylolites. Two fracture sets 1. Closely to very closely spaced dipping at 5 - 15', Planar / Rough; 2. Dipping at 85', Planar to slightly undulating / Rough	
		15.44 - 16.82	2		100	100	15.44	18.70	▦	Strong, grey, fine / medium grained, massive LIMESTONE. Occasional sub-horizontal stylolites. Faint intraclasts centimetric scale. One fracture set dipping at 10', Planar / Rough;	16
		16.82 - 18.40	8	100	100	63	16.82	17.32	▦	Strong, grey, fine / medium grained, massive LIMESTONE. Fine grained scattered bioclastic debris. Locally developed intraclasts, clasts are rounded to sub-rounded 1 - 2cm in dia. Two fracture sets 1. Medium spaced dipping at 10 - 15', Planar / Rough, minor associated rubble; 2. Sub-vertical - undulating dipping at 80 - 90', Planar / Rough	17 18
		18.40 - 19.26	7	100	95	60	18.40	15.74	▦	Strong, grey, fine grained, massive LIMESTONE. Thin band of coarse brachiopod shells at 18.82m. Two fracture sets 1. Medium spaced, dipping at 10', Planar / Rough, minor light brown clay coating the fracture surfaces; 2. Dipping at 80-85', Planar / Rough associated with thin white calcite veinlets	19
		19.26 - 19.95	3	100	100	100	19.26	14.88	▦	Strong, pale grey, fine / medium grained, massive, pellety LIMESTONE. Fine scattered bioclasts, Occasional sub-horizontal stylolites. Fracture set dipping at 5 - 10', Planar / Rough, no infill.	
							19.95	14.19			20

Continued on next sheet

Remarks
All angles measured relative to short core axis

Rotary Core Log

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Borehole No. **BH05** Sheet 5 of 9
Co-ords:	530186.65 - 728378.11		Hole Type RC
Location:	Galway	Level: 34.14	Scale 1:25
Client:	Galway County Council	Dates: 06/11/2015 - 10/11/2015	Logged By Dave Blaney

Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD
19.95 - 20.20	24	100	60	0
20.20 - 20.30	0	0	0	0
20.30 - 20.45	0	100	100	100
20.45 - 20.75	20	100	0	0
20.75 - 21.50	9	100	35	24
21.50 - 22.40	4	100	94	94
22.40 - 23.73	5	100	16	16
23.73 - 25.55	2	100	93	93

Depth (m)	Level (m)	Legend	Stratum Description
20.20	13.94		Strong, grey, fine / medium grained, massive LIMESTONE. Two fracture sets 1. Closely spaced dipping at 5 - 10', Planar / Rough; 2. Dipping at 45', Planar / Rough light brown clay infill, up to 2mm thick.
20.30	13.84	incorrect incorrect incorrec key key key	Core loss
20.45	13.69		Very stiff, light brown / orange brown CLAY. Finely laminated.
20.75	13.39		Strong, grey, fine / medium grained, massive LIMESTONE. Small black millimetric scale blebs- burrowing? Three fracture sets 1. Very closely spaced, dipping at 5', Planar / Rough; 2. Dipping at 80', Planar / Rough with white calcite coating fracture surfaces. 3. dipping at 70', undulating / rough crosscut by set 2.
21.50	12.64		Strong, grey pale grey mottled, fine / medium grained, massive, pellety LIMESTONE. Intraclastic texture sub-angular to sub-rounded clasts 1 - 2cm dia. in a darker grey fine grained matrix. Two fracture sets 1. Dipping at 10 - 15', Planar / Rough; 2. Dipping at 60', Planar to undulating / Rough, fracture surfaces coated with light brown clay
22.40	11.74		Strong, grey, medium grained, massive LIMESTONE. Very small scattered bioclasts with occasional coarse brachiopods. Minor sub-horizontal stylolites. Two fracture sets 1. Medium spaced dipping at 10', Planar / Rough; 2. Medium spaced, dipping at 35', Planar / Rough
23.73	10.41		Strong, pale grey, fine / medium grained, massive LIMESTONE. Occasional sub-horizontal stylolites with minor oxidation. Thin hairline, steeply dipping white calcite veinlets. Two fracture sets 1. Medium spaced dipping at 5 - 10', Planar / Rough; 2. Dipping at 80-85', Planar / Rough, light brown clay coating fracture surfaces, locally developed fracture infill up to 1mm thick
			Strong, grey / grey brown, fine / medium grained, massive LIMESTONE. Occasional faint, sub-horizontal stylolites. Minor scatter fine bioclastic debris. Two fracture sets 1. Medium spaced dipping at 5 - 10', Planar / Rough; 2. Dipping at 60', Planar / Rough

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Remarks
All angles measured relative to short core axis

Rotary Core Log

Borehole No.
BH05
Sheet 6 of 9

Project Name: Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530186.65 - 728378.11	Hole Type RC
Location: Galway		Level: 34.14	Scale 1:25
Client: Galway County Council		Dates: 06/11/2015 - 10/11/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
		25.55 - 25.85	13	100	80	80	25.55	8.59		Strong, grey / brownish grey, fine / medium grained, massive LIMESTONE. Very small scattered bioclasts, Two fracture sets 1. dipping at 10 - 20', Planar / Rough; 2. Dipping at 50', Planar / Rough no infill	
		25.85 - 26.60	3	100	91	91	25.85	8.29		Strong, grey, fine / medium grained, massive LIMESTONE. Slightly oxidised sub-horizontal stylolites. Fracture set dipping at 5 - 10', Planar / Rough; no infill	26
		26.60 - 27.65	9	100	37	37	26.60	7.54		Strong, pale grey / brownish grey, fine / medium grained, massive LIMESTONE. Occasional thick shelled bioclasts - brachiopod, Three fracture sets 1. Dipping at 10 - 20', Planar / Rough; 2. Close spaced, dipping at 55 - 60', Planar / Rough; 3. Dipping at 85', Planar / Rough minor white calcite coating fracture surfaces	27
		27.65 - 28.03	3	100	100	100	27.65	6.49		Strong, pale grey / brownish grey, fine / medium grained, massive LIMESTONE. Occasional sub-horizontal stylolites. Fracture set dipping at 5 ', Planar / Rough, no infill	28
							28.03	6.11		Strong, pale grey / brownish grey, fine / medium grained, massive LIMESTONE. Three fracture sets 1. Close spaced dipping at 5 - 20', Planar / Rough; 2. Widely spaced, dipping at 40-50', Planar / Rough, at 31.7m light brown clay infill 1mm thick; 3. Axial parallel - 90', crosscuts all the other fracture sets. Planar / rough with a thin coating of white calcite.	29 30

Continued on next sheet

Remarks
All angles measured relative to short core axis

Keynetix

Rotary Core Log

Project Name: Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530186.65 - 728378.11	Borehole No. **BH05** Sheet 7 of 9
Location: Galway		Level: 34.14	Hole Type RC
			Scale 1:25
Client: Galway County Council		Dates: 06/11/2015 - 10/11/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description	
		28.03 - 32.03	3	100	0	0					31
		32.03 - 34.72	4	100	100	97	32.03	2.11		Strong, pale grey / brownish grey, fine / medium grained, massive LIMESTONE. Occasional sub-horizontal stylolites. One fracture set, close to Medium spaced, dipping at 5 - 20', Planar / Rough, no infill.	32 33 34
							34.72	-0.58		Strong, grey . brownish grey, fine / medium grained, massive LIMESTONE. Very small scattered bioclasts, and a rare thick shelled	35

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Remarks
All angles measured relative to short core axis

AGS

Keynetix

Rotary Core Log

Borehole No.

BH05

Sheet 8 of 9

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords:	530186.65 - 728378.11	Hole Type RC
Location:	Galway		Level:	34.14	Scale 1:25
Client:	Galway County Council		Dates:	06/11/2015 - 10/11/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
		34.72 - 37.20	6	100	4	4				brachiopod . Occasional sub-horizontal stylolites. Three fracture sets 1. Close spaced dipping at 10 - 20', Planar / Rough; 2. Very widely spaced, dipping at 35-40', Planar / Rough; 3. 75 - 85' Undulating / rough, fracture surface coated with light brown clay. Crosscuts other fracture sets
		37.20 - 38.00	0	100	100	100	37.20	-3.06		Strong, grey / pale grey, fine / medium grained, massive LIMESTONE.
		38.00 - 40.00		100	0	0	38.00	-3.86		Strong, pale grey, fine to medium grained, massive LIMESTONE. Occasional stylolites, two fracture sets. 1. dipping at 5', planar / rough , 2. dipping at 85-90' Planar / rough coated and partially infilled by light brown clay

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Continued on next sheet

Remarks

All angles measured relative to short core axis

AGS

Rotary Core Log

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530186.65 - 728378.11	Borehole No. **BH05** Sheet 9 of 9
				Hole Type RC
Location:	Galway		Level: 34.14	Scale 1:25
Client:	Galway County Council		Dates: 06/11/2015 - 10/11/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
							40.30	-6.16		End of borehole at 40.30 m

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Remarks
All angles measured relative to short core axis

Rotary Core Log

Borehole No.	**BH06**	Sheet 1 of 5	
Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	
Co-ords:	530125.14 - 728383.08	Hole Type	RC
Location:	Galway		
Level:	30.80	Scale	1:50
Client:	Galway County Council		
Dates:	10/12/2015 - 18/12/2015	Logged By	Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
							0.10	30.70		TOPSOIL
							1.05	29.75		Soft, pale grey, sandy CLAY (Recovery 35%)
							1.50	29.30		Loose grey to dark grey cobbly BOULDERS of bioclastic limestone, minor pale grey sandy clay
							3.10	27.70		Firm, light yellowish brown, sandy CLAY, coarse grained sub-angular cobbles of dark grey limestone and occasional granite cobble (recovery 45%)
		5.25 - 5.50	C							
							7.91	22.89		Very stiff , light yellowish brown sandy CLAY with coarse gravel / cobbles and occasional boulders of sub-rounded to sub-angular limestone with minor granite
							7.96	22.84		Firm / stiff light grey CLAY
										Very stiff, light brown sandy CLAY with minor light orange oxidation spots / patches. Coarse gravel / cobbles and occasional boulders of sub-rounded to sub-angular limestone with minor granite
		9.95 - 10.20	C							

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Remarks
All angles measured relative to short core axis

Rotary Core Log

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Borehole No. **BH06** Sheet 2 of 5
Co-ords:	530125.14 - 728383.08	Hole Type	RC
Location:	Galway	Level:	30.80
Scale	1:50	Client:	Galway County Council
Dates:	10/12/2015 - 18/12/2015	Logged By	Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
							15.20	15.60		Loose, medium grained angular clayey GRAVEL with small cobbles all coarse fragments coated with sticky, soft, dark grey clay
							15.93	14.87		Very Stiff dark grey / brown CLAY
		16.20 - 16.50	C							
		16.60 - 16.70	D							
		16.70 - 16.80	D							
		17.13 - 17.20	D							
		18.00 - 18.25	C				18.00	12.80		Very Stiff grey CLAY
		18.25 - 18.35	D							
		18.65 - 18.75	D							
		18.95 - 19.05	D							
		19.70 - 19.95	C							
		20.00 - 20.25	C							

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Continued on next sheet

Remarks
All angles measured relative to short core axis

AGS

Rotary Core Log

Borehole No.
BH06
Sheet 3 of 5

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Hole Type RC
Co-ords:	530125.14 - 728383.08		
Location:	Galway	Level: 30.80	Scale 1:50
Client:	Galway County Council	Dates: 10/12/2015 - 18/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Stratum Description
							21.20	9.60	Firm grey CLAY
		21.45 - 21.52 21.52 - 21.60	D D				21.48	9.32	Firm / Stiff finely laminated dark brown / brown CLAY
							21.82	8.98	Firm, dark brown CLAY with 60% tabular angular gravel
							21.92	8.88	Firm grey fine sandy CLAY with angular limestone gravel and some coarse cobbles and small boulders
							22.60	8.20	Very soft, light grey sandy CLAY with rounded gravel
							22.84	7.96	Soft, grey sandy CLAY angular gravel / cobbles
							23.30	7.50	Firm / Stiff grey sandy CLAY with sub-angular / angular matrix supported coarse gravel and cobbles
							23.60	7.20	Soft, grey, sandy CLAY with medium / coarse grained, angular gravel and an occasional boulder (25cm dia.
							25.50	5.30	Soft / firm grey / green sandy CLAY with sub angular cobbles and boulders. Some of the clay is washed out and is just coated the cobbles and boulders
							26.65	4.15	Stiff / very stiff, light grey CLAY occasional boulder of pale grey limestone
							27.30	3.50	Loose, grey / dark grey cobbly GRAVEL with occasional boulders of limestone coated with very soft brownish grey clay

Continued on next sheet

Remarks
All angles measured relative to short core axis

Rotary Core Log

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords:	530125.14 - 728383.08	Borehole No. **BH06** Sheet 4 of 5
Location:	Galway		Level:	30.80	Hole Type RC
Client:	Galway County Council		Dates:	10/12/2015 - 18/12/2015	Scale 1:50
					Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	Coring SCR	Coring RQD	Depth (m)	Level (m)	Legend	Stratum Description
							30.85	-0.05		Soft / very soft, pale grey / greenish grey bouldery CLAY, cobbles and coarse gravel, clay washed out and just left coating fragments in some areas.
							33.20	-2.40		Firm greenish grey (Khaki) CLAY with angular coarse cobbles of pale grey limestone
							33.50	-2.70		Firm, greenish grey gravelly CLAY, gavel composed of dark grey limestone
							33.70	-2.90		Pale grey, medium grained, fresh, massively bedded limestone BOULDER Broken up along a series of fractures - undulating rough dipping at 70-80' and planar rough dipping at 50-60'. Minor grey clay coating joint surfaces.
							34.70	-3.90		Loose sub-angular COBBLES coated with soft pale grey clay
							35.10	-4.30		Soft greenish grey sandy, gravelly CLAY with angular cobbles and small boulders of pale grey / occasionally black limestone
							39.10	-8.30		Loose sub-angular COBBLES of very dark grey limestone (Recovery 30%)

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Continued on next sheet

Remarks
All angles measured relative to short core axis

AGS

Rotary Core Log

Borehole No.	**BH06**	Sheet 5 of 5

Project Name:	Lackagh Quarry Preliminary Ground Investigation	Project No. Lackagh Quarry	Co-ords: 530125.14 - 728383.08	Hole Type RC
Location:	Galway		Level: 30.80	Scale 1:50
Client:	Galway County Council		Dates: 10/12/2015 - 18/12/2015	Logged By Dave Blaney

Well	Water Strikes	Depth (m)	Type / FI	Coring TCR	SCR	RQD	Depth (m)	Level (m)	Legend	Stratum Description
							40.60	-9.80		Loose, coarse gravelly COBBLES, angular to sub-angular with some coated by greenish grey clay occasional small boulder
							44.40	-13.60		BOULDER of strong, fresh, fine / medium grained, massively bedded Limestone. 44.8m a joint filled with soft, dark grey clay, 2cm thick (Possibly bedrock)
							45.00	-14.20		End of borehole at 45.00 m

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Remarks
All angles measured relative to short core axis

AGS

APPENDIX III

PROJECT NAM Lackagh Quarry
CLIENT: Galway County Council
ENGINEER: ARUP

REPORT NO:
HOLE NO: BH-01
LOGGED BY: Dave Blaney

Depth of Discontinuity (m BGL)	Azimuth	Dip	Non Intact? (NI)	Roughness										Aperture					Filling					Weathering						Hole Azimuth	Hole Dip	True Azimuth	True Dip
				Stepped			Undulating			Planar			Other	V Open	Open	Mod Open	Tight	V Tight	Clean	Staining	% Soil	% Mineral	Clay	No	Sl	Mod	High	Comp					
				R	Sm	St	R	Sm	St	R	Sm	St		>10 mm	2.5-10	0.5-2.5	0.1-0.5	<0.1															
5.80		45					X									X			X					X					No Invert marked	268	-11.5		
5.95		10								X						X			X					X					No Invert marked	268	-11.5		
6.10		20								X						X			X					X					No Invert marked	268	-11.5		
6.18		25	X							X						X			X					X					No Invert marked	268	-11.5		
6.30		65	X							X						X			X					X					No Invert marked	268	-11.5		
6.90	180	85								X						X			X					X						268	-11.5		
7.08	190	60								X						X			X					X						268	-11.5		
7.52	165	65								X						X			X					X						268	-11.5		
7.58	165	65								X						X			X					X						268	-11.5		
7.66	230	70								X						X			X					X						268	-11.5		
7.90	180	55					X									X			X					X						268	-11.5		
8.35	285	90								X						X			X					X						268	-11.5		
8.55	210	75								X						X			X					X						268	-11.5		
8.72	135	72								X						X			X					X						268	-11.5		
8.83	60	82								X						X			X					X						268	-11.5		
8.85	150	90					X									X			X					X						268	-11.5		
9.35	195	78								X						X			X					X						268	-11.5		
9.67	215	90								X						X			X					X						268	-11.5		
9.81	130	62								X						X			X					X						268	-11.5		
9.90	335	82								X						X			X					X						268	-11.5		
10.17	330	90								X						X			X					X						268	-11.7		
10.20	180	90					X									X			X					X						268	-11.7		
10.71	10	90								X						X			X					X						268	-11.7		
10.90	5	82								X						X			X					X						268	-11.7		
11.42	0	75								X						X			X					X						268	-11.7		
11.44	115	74								X						X			X						X				Slight Fe Staining	268	-11.7		
11.54	200	40	X							X						X			X					X						268	-11.7		
11.92	145	45								X						X			X					X						268	-11.7		
11.97	180	85								X						X			X					X						268	-11.7		
12.20	285	45					X									X			X					X						268	-11.7		
12.35	350	50	X							X						X			X					X						268	-11.7		
12.47	100	65								X						X			X					X						268	-11.7		
13.02	150	60								X						X			X					X						268	-11.7		
13.33	220	60								X						X						x		X					Partial coating of white calcite	268	-11.7		
13.43	350	75								X						X			X					X						268	-11.7		
14.32	25	72								X						X			X					X						268	-11.7		
14.36	120	85								X						X			X					X						268	-11.7		
14.39	185	62								X						X			X					X						268	-11.7		
14.42	30	80								X						X			X					X						268	-11.7		
14.45	120	80								X						X			X					X						268	-11.7		
14.52	140	65								X						X						X	X	X					Minor white calcite and smears of pale brown clay	268	-11.7		
14.56	50	80								X						X			X					X						268	-11.7		
14.70	170	80								X						X						X			X				White clacite and small patches of Fe Staining	268	-11.7		
15.27	165	80								X						X						X		X					Very Minor white calcite	268	-11.7		
15.47	170	80								X						X						X		X						268	-11.7		
15.58	130	72								X						X						X	X	X					White clacite and minor clay smears	268	-11.7		
15.63	355	50								X						X			X					X						268	-11.7		
15.68	75	90								X						X			X					X						268	-11.7		
15.76	135	85								X						X			X					X						268	-11.7		
15.83	195	60								X						X							X	X					Minor light brown clay	268	-11.7		
16.33	170	85								X						X			X					X						268	-11.8		
17.05	180	85								X						X			X					X						268	-11.8		

17.64	25	84	X							X						X			X					X						268	-11.8		
17.76	30	80								X						X							X	X					Minor smear of light brown clay	268	-11.8		
18.06	270	20								X						X			X					X						268	-11.8		
18.12	185	85	X							X						X			X					X						268	-11.8		
18.59	35	75								X						X						X		X					Minor light grey calcite	268	-11.8		
19.48	145	80								X						X			X					X						268	-11.9		
20.07	40	70								X						X			X					X						268	-11.9		
20.26	135	90								X						X			X					X						268	-11.9		
20.57	225	65								X						X			X					X						268	-11.9		
21.10	120	90	X							X						X			X					X						268	-11.9		
21.14	220	60								X						X			X					X						268	-11.9		
21.20	170	90								X						X							X	X					Minor smear of light brown clay	268	-11.9		
21.33	310	70								X						X			X					X						268	-11.9		
21.38	315	70								X						X			X					X						268	-11.9		
21.41	230	75	X							X						X			X					X						268	-11.9		
21.58	230	70								X						X			X					X						268	-11.9		
22.34	5	90								X						X			X					X						268	-11.9		
22.48	30	60								X						X			X					X						268	-11.9		
22.73	170	48								X						X			X					X						268	-11.9		
22.96	290	52		X												X			X					X						268	-11.9		
23.03	20	60								X						X						X		X					Creamy white calcite coating	268	-11.9		
23.56	220	65								X						X			X					X						268	-11.9		
23.86	320	65					X									X						X			X				Pale grey calcite / minor grey clay and very slight Fe staining	268	-11.9		
24.26	20	80								X						X			X					X						268	-11.9		
24.35	140	70								X						X							X		X				Minor clay / localised dark brown Fe staining	268	-11.9		
24.73	125	90								X						X								X						268	-11.9		
24.94	130	90								X						X			X					X						268	-11.9		
26.18	185	85								X						X			X					X						267	-12.1		
27.35	0	85								X						X			X					X						267	-12.1		
27.48	30	80								X						X			X					X						267	-12.1		
27.84	195	80								X						X			X					X						267	-12.1		
28.16	175	85								X						X			X					X						267	-12.2		
28.74	5	80		X												X			X					X						267	-12.2		
31.02	15	90								X						X						X		X					White / Grey calcite deposited on fracture surface	267	-12.4		
31.25	320	85		X												X			X					X						267	-12.4		
31.34	0	50								X						X			X					X						267	-12.4		
31.66	195	75								X						X			X					X						267	-12.4		
31.73	10	60	X							X						X			X					X						267	-12.4		
31.76	10	85										X			X							X		X					Creamy white calcite vein, 4mm thick weak striae	267	-12.4		
31.82	20	70		X											X				X					X						267	-12.4		
32.01	50	90								X						X			X					X						267	-12.4		
32.08	330	50								X						X			X					X						267	-12.4		
32.64	145	65								X						X			X					X						267	-12.4		
32.90	20	90								X						X			X					X						267	-12.4		
32.97	315	62								X						X			X					X						267	-12.4		
33.11	30	35								X						X			X					X						267	-12.4		
33.20	310	80								X						X			X					X						267	-12.4		
33.70	310	70	X							X						X			X					X						267	-12.4		
34.05	60	75								X						X			X			X		X					Minor white calcite coating fracture surface	267	-12.6		
35.04	0	90								X						X			X					X						267	-12.6		
35.35	10	72		X												X			X					X						267	-12.6		
35.48	335	78								X						X			X					X						267	-12.6		
36.43	175	85								X						X			X					X						267	-12.6		
36.88	235	90								X						X			X					X						267	-12.6		
36.95	235	90								X						X			X					X						267	-12.6		
37.23	195	15					X									X			X					X						267	-12.6		
37.31	225	65								X						X			X					X						267	-12.6		
37.51	215	70								X						X			X					X						267	-12.6		
38.13	175	88								X						X			X					X						267	-12.6		
38.20	230	22		X												X			X					X						267	-12.6		
38.30	305	75								X						X			X					X						267	-12.6		
38.50	5	15								X						X			X					X						267	-12.6		

39.35	180	45								X						X				X					X				Minor orange Fe staining	267	-12.6		
40.53	160	40								X						X			X					X						267	-12.6		
40.80	0	90								X						X			X					X						267	-12.6		
41.03	50	88								X						X			X					X						267	-12.6		
41.20	315	90								X						X								X						267	-12.6		
41.67	180	10					X									X			X			X		X					Traces of white calcite	267	-12.6		
41.97	30	30								X						X			X					X						267	-12.6		
42.52	0	90								X						X			X					X						267	-12.6		
43.28	225	62								X						X			X					X						267	-12.5		
43.40	170	10								X						X			X					X						267	-12.5		
43.70	75	60								X						X			X					X						267	-12.5		
43.90	285	80								X						X			X					X						267	-12.5		
44.02	15	48								X						X			X					X						267	-12.5		
44.22	170	40								X						X			X					X						267	-12.5		
44.47	30	50								X						X			X					X						267	-12.5		
44.52	30	50								X						X			X					X						267	-12.5		
45.16	15	50								X						X			X					X						267	-12.5		
45.30	180	75								X					X					X		X			X				White calcite, minor Fe staining	267	-12.5		
45.47	30	55								X						X			X					X						267	-12.5		
45.62	30	70								X						X			X					X						267	-12.5		
45.70	25	55								X						X				X					X				Slight Fe staining	267	-12.5		
45.88	175	42								X						X						X		X					Discontinuous coating of white calcite	267	-12.5		
46.06	0	75								X						X			X					X						267	-12.7		
46.88	310	75								X						X			X					X						267	-12.7		
47.20	120	80								X						X							X	X					Minor brown clay	267	-12.7		
47.50	15	80								X						X			X					X						267	-12.7		
47.75	320	80					X									X						X		X					Partial coating of white calcite	267	-12.7		
47.88	310	75								X						X						X		X					Partial coating of white calcite	267	-12.7		
48.34	240	80								X						X			X					X						267	-12.7		
49.08	175	75								X						X			X					X						267	-12.7		
49.54	45	84								X						X			X					X						267	-12.7		
49.70	225	58								X						X			X					X						267	-12.7		
50.28	0	90								X						X			X					X						267	-12.7		
50.77	160	45								X						X			X					X						267	-12.7		
51.04	175	90								X						X			X					X						267	-12.7		
51.52	140	50								X						X			X					X						267	-12.7		
51.60	120	65								X						X			X					X						267	-12.7		
51.65	120	70								X						X			X					X						267	-12.7		
51.75	125	65								X						X			X					X						267	-12.7		
51.84	145	80								X						X			X					X						267	-12.7		
52.14	140	62								X						X			X					X						267	-12.7		
25.23	140	60								X						X			X					X						267	-12.7		
52.70	45	85								X						X			X					X						267	-12.7		
53.07	310	65	X							X						X			X					X						267	-12.7		
53.27	345	30								X						X			X					X						267	-12.7		
53.35	0	90								X						X			X					X						267	-12.7		
53.43	0	90								X						X			X					X						267	-12.7		
53.48	80	85	X				X									X			X					X						267	-12.7		
52.52	355	85								X						X			X					X						267	-12.7		
53.56	285	75	X				X									X			X					X						267	-12.7		
53.80	5	90								X						X			X					X						267	-12.7		
53.94	0	90								X						X			X					X						267	-12.7		
54.70	170	85								X						X			X					X						267	-12.7		
55.34	20	85								X						X			X					X						267	-12.7		
55.44	20	85								X						X			X					X						267	-12.7		
55.73	355	90								X						X			X					X						267	-12.7		
56.14	30	44					X									X			X					X						267	-12.7		
56.61	320	85								X						X			X					X						267	-12.7		
57.28	320	85								X						X			X					X						267	-12.7		
57.75	55	80	X							X						X			X					X						267	-12.7		
58.20	175	50					X									X			X					X					Curved / Arcuate joint surface	267	-12.7		
58.31	345	50								X						X			X					X						267	-12.7		

58.48	0	80							X						X			X					X					Possible drillers break	267	-12.7		
58.80	5	90									X				X			X					X					Triae due to intersecting stylolite	267	-12.7		
59.47	355	90							X						X			X					X						267	-12.7		
59.63	160	85							X						X			X					X						267	-12.7		
59.83	170	80				X									X			X					X					Curved / Arcuate joint surface	267	-12.7		
60.00	5	90							X						X			X					X						267	-12.7		
61.02	180	80							X						X			X					X						267	-12.8		
61.47	140	70							X						X						X		X					Trace grey calcite	267	-12.8		
61.80	90	85	X				X									X			X					X						267	-12.8		
61.85	200	65				X									X				X					X				Partial orange / brown Fe staining	267	-12.8		
62.02	20	80				X									X			X					X					Very Rough joint surface	267	-12.8		
62.17	50	60							X						X			X					X						267	-12.8		
62.58	145	60							X						X						X		X					Light grey calcite coating	267	-12.8		
63.77	40	50							X						X			X					X						267	-12.8		
63.97	200	42							X						X			X					X						267	-12.8		
64.06	30	65							X						X			X					X						267	-12.8		
64.20	210	50							X						X			X					X						267	-12.8		
64.50	345	50							X						X			X					X						267	-12.8		
64.98	180	85							X						X			X					X						267	-12.8		
65.72	130	75							X						X			X					X						267	-12.8		
65.88	130	80							X						X			X					X						267	-12.8		
66.97	50	80							X						X			X					X						267	-12.8		
66.99	50	78							X						X			X					X						267	-12.8		
67.20	175	78							X						X			X					X						267	-12.9		
67.60	220	80							X						X			X					X						267	-12.9		
67.70	45	90							X						X			X					X						267	-12.9		
67.90	60	72	X							X						X			X					X						267	-12.9		
68.38	350	90							X						X			X					X						267	-12.9		
68.60	355	90							X						X			X					X						267	-12.9		
68.66	350	90							X						X			X					X						267	-12.9		
68.73	0	90							X						X						X		X					Calcite vein 1mm thick	267	-12.9		
68.78	0	80							X						X						X		X					Calcite vein	267	-12.9		
68.90	170	75							X						X			X					X					Very irregular	267	-12.9		
69.25	355	90							X						X			X					X						267	-12.9		
69.66	20	75							X						X			X					X						267	-12.9		
69.93	325	85	X							X						X			X					X						267	-12.9		
69.98	140	75							X						X			X					X						267	-12.9		
70.13	10	80							X						X			X					X						267	-12.9		
70.27	15	80							X						X			X					X						267	-12.9		
70.60	5	80									X				X			X					X					Slickensides, plunging at 25' to 270'	267	-12.9		
71.43	355	80				X									X			X					X					Curved Arcuate Joint	267	-12.9		
71.90	50	82							X						X			X					X						267	-12.9		
72.34	310	80							X						X			X					X						267	-12.9		
72.45	50	30							X						X				X					X				Slight pale orange Fe staining	267	-12.9		
72.50	135	45	X							X						X			X					X						267	-12.9		
72.80	0	90							X						X			X					X						267	-12.9		
73.20	295	30							X						X			X					X						267	-12.9		
73.74	35	72							X						X			X					X						267	-12.9		
73.98	75	65		X												X			X					X					very small mm scale steps	267	-12.9		
74.50	350	78									X				X						X		X					White grey calcite vein, sub-horizontal striae	267	-12.9		
74.60	80	75				X											X	X					X						267	-12.9		
74.73	195	72							X						X			X					X					Very rough texture - almost stepped	267	-12.9		
75.14	5	80							X						X			X					X						267	-12.9		
75.27	150	55							X						X			X					X						267	-12.9		
75.50	170	85									X				X			X					X					Faint stating	267	-12.9		
75.80	20	75	X							X						X			X					X						267	-12.9		
75.92	30	65							X						X			X					X						267	-12.9		
76.09	25	70							X						X			X					X						267	-12.9		
76.19	165	60							X						X			X					X						267	-12.9		
76.39	50	50	X				X									X			X					X						267	-12.9		
76.72	200	70							X						X			X					X						267	-12.9		
77.10	325	70							X						X			X					X						267	-12.9		

77.17	205	85								X						X			X					X						267	-12.9		
77.63	305	55	X							X						X			X					X						267	-12.9		
77.67	65	80	X							X						X			X					X						267	-12.9		
77.80	110	85	X							X						X			X					X						267	-12.9		
77.86	20	75								X						X			X					X						267	-12.9		
77.93	335	90					X									X				X					X				urved / Arcuate fracture, Minor Fe staining	267	-12.9		
78.02	50	90								X						X			X					X						267	-12.9		
78.06	155	90	X							X						X			X					X						267	-12.9		
78.13	180	90	X							X						X			X					X						267	-12.9		
78.18	160	85	X							X						X			X					X						267	-12.9		
78.37	180	90	X							X						X			X					X						267	-12.9		
79.93	140	90	X				X									X			X					X						267	-12.9		
80.07	140	70		X												X			X					X						267	-12.9		
80.16	180	90								X						X			X					X						267	-12.9		
80.65	45	65								X						X						X		X					Thin coating of grey calcite	267	-12.9		
80.94	310	85								X						X			X					X						267	-12.9		
81.15	40	74								X						X			X					X						267	-12.9		
81.20	300	90								X						X			X					X						267	-12.9		
81.66	5	78										X				X				X					X				weak, sub-horizontal striae - Minor Fe staining	267	-12.9		
81.85	340	38								X						X			X					X						267	-12.9		
82.26	320	60					X									X			X					X						267	-13.1		
82.36	145	72										X				X			X					X					Striae formed by intersection offracture with stylolite	267	-13.1		
82.59	220	68										X				X			X					X						267	-13.1		
82.80	220	64					X									X			X					X					Curved / arcuate	267	-13.1		
83.12	320	58								X						X			X					X						267	-13.1		
83.40	355	44								X						X			X					X						267	-13.1		
83.53	335	84					X									X			X					X						267	-13.1		
84.00	0	90								X						X			X					X						267	-13.1		
84.25	10	88										X				X			X					X					Striae from intersection of stylolites	267	-13.1		
85.05	170	80								X						X			X					X					Curved / Arcuate joint surface	267	-13.1		
85.32	170	82								X						X				X		X			X				White / orange Fe stained clacite	267	-13.1		
86.10	310	54								X						X			X					X						267	-13.1		
86.38	220	50								X						X			X					X						267	-13.1		
86.62	350	38								X						X			X					X						267	-13.1		
86.96	350	52								X						X			X					X						267	-13.1		
87.47	205	58								X						X			X					X						267	-13.1		
87.53	285	70	X							X						X			X					X						267	-13.1		
88.14	10	88								X						X			X					X						267	-13.1		
88.77	0	90								X						X			X					X						267	-13.1		
88.82	90	78					X									X			X					X					Curved / Arcuate	267	-13.1		
88.99	0	42				X										X			X					X					Partially striated	267	-13.1		
89.13	340	42								X						X			X					X						267	-13.1		
89.35	210	52								X						X			X					X						267	-13.1		
89.44	70	82					X									X			X					X					Curved / Arcuate	267	-13.1		
89.64	10	78								X						X			X					X						267	-13.1		
89.75	100	86	X				X									X			X					X					Curved / Arcuate	267	-13.1		
90.00	80	84					X									X			X					X						267	-13.1		
90.30	100	84					X											X				X		X					Grey calcite	267	-13.1		
90.85	330	82									X					X			X					X					smooth	267	-13.1		
91.18	350	90								X						X			X					X						267	-13.1		
91.48	220	82								X						X			X					X						267	-13.1		
91.58	0	90								X						X			X					X						267	-13.1		
91.83	355	90								X						X			X					X						267	-13.1		
91.96	160	84								X						X			X					X						267	-13.1		
92.71	345	78								X						X			X					X						267	-13.1		
93.14	165	88								X						X						X		X					Partially coated with white calcite	267	-13.1		
93.97	320	82								X						X			X					X						267	-13.1		
94.75	350	70								X						X			X					X						267	-13.2		
95.00	10	78								X						X						X		X					Partially coated with white calcite	267	-13.2		
95.32	355	80								X						X			X					X						267	-13.2		
95.98	340	76	X	X												X			X					X						267	-13.2		
96.02	350	78								X						X			X					X						267	-13.2		

96.13	15	90		X												X			X					X						267	-13.2		
96.84	5	90					X									X			X					X					Curved / Arcuate	267	-13.2		
97.44	180	48								X						X			X					X						267	-13.2		
97.53	195	86								X					X							X			X				Joint infilled with 5mm white calcite veinlet minor Fe stain	267	-13.2		
98.92	225	74								X						X			X					X						267	-13.2		
98.37	320	48								X						X			X					X						267	-13.2		
98.92	5	90								X						X			X					X						267	-13.2		
99.35	225	58								X						X						X		X					Partially coated with grey calcite	267	-13.2		
99.40	185	80								X						X			X					X						267	-13.2		
99.70	185	36								X						X				X					X				Trace Fe staining	267	-13.2		
100.08	355	40								X						X			X					X						267	-13.2		
100.45	340	46								X						X			X					X						267	-13.2		
100.60	320	70		X												X			X					X					Very rough / irregular - pitted surface	267	-13.2		
100.65	195	56								X						X			X					X						267	-13.2		
100.74	215	62								X						X			X					X						267	-13.2		
100.85	140	62		X												X				X				X					Minor Fe Staining	267	-13.2		
100.91	210	70								X						X			X					X						267	-13.2		
101.16	345	36								X						X						X		X					Trace grey calcite	267	-13.2		
101.70	310	42								X						X			X					X					Very rough - almost stepped	267	-13.2		
101.43	350	90								X				X								X			X				Coarsely crystalline white calcite vein - Fe staining	267	-13.2		
101.65	170	72								X						X			X						X				Minor Fe staining	267	-13.2		
102.27	0	38								X						X			X					X						267	-13.2		
102.50	0	90	X						X							X				X					X				Stiae with locallised Fe Staining	267	-13.2		
102.55	180	18	X							X						X			X					X						267	-13.2		
103.48	340	80	X							X						X			X					X						267	-13.2		
103.87	355	86								X						X			X					X						267	-13.2		
103.92	330	76	X							X						X			X					X						267	-13.2		
103.95	210	62	X							X						X			X					X						267	-13.2		
104.15	150	38								X						X			X					X						267	-13.2		
104.78	350	74								X						X			X					X						267	-13.2		
105.42	350	88								X						X			X					X						267	-13.2		
105.54	345	85								X						X			X					X						267	-13.2		
105.70	0	90								X						X			X					X						267	-13.2		
106.13	185	50								X						X			X					X						267	-13.3		
106.30	150	62								X						X			X					X						267	-13.3		
107.10	5	50								X						X			X					X						267	-13.3		
107.35	10	48								X						X							X	X					Trace Fe staining -minor light brown clay	267	-13.3		
107.84	180	88								X						X			X					X						267	-13.3		
108.61	180	44								X						X			X					X						267	-13.3		
108.80	40	70								X						X								X						267	-13.3		
108.92	305	84								X						X						X		X					Slightly oxidised calcite	267	-13.3		
108.98	320	90								X						X			X					X						267	-13.3		
109.40	320	90								X						X			X					X						267	-13.3		
109.17	140	84								X						X			X					X						267	-13.3		
108.36	150	70								X						X			X					X						267	-13.3		
109.42	140	88								X						X			X					X						267	-13.3		
109.54	115	86	X	X												X			X					X						267	-13.3		
109.60	320	78								X						X			X					X						267	-13.3		
109.91	310	90								X						X						X		X						267	-13.3		
110.25	300	74								X						X			X					X						267	-13.3		
110.95	315	52								X						X						X		X						267	-13.3		
111.09	325	78								X						X			X					X						267	-13.3		
111.30	60	86								X						X						X		X						267	-13.3		
112.40	325	82		X												X			X					X						267	-13.4		
113.52	30	54		X												X						X		X						267	-13.4		
114.00	0	8	X				X									X			X					X						267	-13.4		
115.30	335	84								X						X			X					X						267	-13.4		
117.92	215	88								X						X			X					X						267	-13.4		
118.32	330	82								X						X			X					X						267	-13.5		
118.74	330	80								X						X			X					X						267	-13.5		
119.15	20	55	X				X									X			X					X						267	-13.5		
119.38	5	90								X						X			X					X						267	-13.5		

119.52	230	56								X						X			X					X						267	-13.5		
119.66	235	70								X						X								X						267	-13.5		
120.15	50	24					X									X			X			X		X						267	-13.5		
120.68	10	90					X									X			X					X						267	-13.5		
120.95	5	84								X						X			X					X						267	-13.5		
121.40	135	90								X						X			X					X						267	-13.5		
121.58	140	62	X							X						X				X					X					267	-13.5		
122.10	135	70		X												X				X					X					267	-13.5		
122.40	340	84								X					X							X			X					267	-13.5		
122.58	150	70					X									X			X					X						267	-13.5		
122.64	140	70		X												X			X					X						267	-13.5		
122.80	50	70					X									X						X		X						267	-13.5		
123.00	115	78					X									X			X					X						267	-13.5		
123.05	115	74					X									X			x						X					267	-13.5		
123.28	140	74					X									X			X					X					Very rough joint surface	267	-13.5		
123.38	20	68								X						X						X		X					Minor white grey calcite	267	-13.5		
123.44	320	80					X									X			X					X					Crystalline white calcite vein	267	-13.5		
123.52	160	60		X												X			X						X				Pitted surface - Dissolution	267	-13.5		
123.60	325	40								X						X			X					X						267	-13.5		
124.12	15	76								X						X						X		X					Minor light grey calcite	267	-13.5		
124.42	130	78								X						X						X		X					Minor white calcite	267	-13.5		
125.05	50	90					X									X			X					X					Curved / arcuate	267	-13.5		
125.28	25	64					X									X			X					X						267	-13.5		
125.62	320	90								X						X			X					X						267	-13.5		
126.10	240	80	X							X						X			X						X				Very weak Fe staining	267	-13.5		
126.25	150	58					X									X			X					X						267	-13.5		
126.72	235	72								X						X			X					X						267	-13.5		
126.83	325	64								X						X			X					X					Very irreglaur jointing	267	-13.5		
126.87	325	64								X						X			X					X						267	-13.5		
126.93	325	76								X								X	X					X						267	-13.5		
127.05	200	80					X									X			X					X						267	-13.5		
127.54	150	68					X									X			X					X					Slight undulation	267	-13.5		
127.61	320	70					X									X			X					X						267	-13.5		
127.67	315	82					X									X			X					X						267	-13.5		
127.80	220	74								X						X			X					X					Sub-parallel white calcite veinlets	267	-13.5		
127.91			X							X						X			X					X					Non Intact / broken core - pocssibly drilling related	267	-13.5		
128.36	195	52								X						X			X					X						267	-13.5		
128.41	165	62								X						X			X					X						267	-13.5		
128.48	150	62								X						X			X					X						267	-13.5		
129.60	195	62					X									X			X					X						267	-13.5		
129.83	20	60		X												X			X					X						267	-13.5		
130.25	205	42									X					X						X		X					Slightly polished - black argillite coating surface	266	-13.6		
130.30	80	80						X								X						X		X					Slightly polished - black argillite coating surface	266	-13.6		
130.62	170	84								X						X			X					X						266	-13.6		
131.47	160	48								X						X			X					X						266	-13.6		
131.60	80	80	X				X									X						X		X					Black argilite - stylolitic contact	266	-13.6		
131.71	350	70								X						X			X					X						266	-13.6		
132.14	340	86								X							X					X		X					White calcite vein	266	-13.6		
133.45	210	48								X						X			X					X						266	-13.6		
134.73	160	62					X									X			X					X						266	-13.6		
134.90	340	80								X				X								X		X					Infilled with 20mm thick white calcite vein	266	-13.6		
135.38	185	40								X						X			X					X						266	-13.6		
135.57	180	90					X									X			X					X					Strongly undulating	266	-13.6		
136.47	180	32								X						X			X					X						266	-13.7		
136.72	175	32								X						X			X					X						266	-13.7		
137.10	340	86								X						X			X					X						266	-13.7		
137.70	10	82								X						X			X					X						266	-13.7		
138.39	320	90								X						X			X					X						266	-13.7		
139.60	25	86								X						X			X					X						266	-13.7		
140.65	150	62					X									X			X					X						266	-13.7		
140.90	190	54								X						X			X					X						266	-13.7		
141.02	190	68								X						X			X					X						266	-13.7		

141.40	5	86								X						X			X					X						266	-13.7		
142.05	10	90								X						X			X					X						266	-13.7		
142.60	40	46		X												X			X					X						266	-13.8		
142.79	150	72								X							X		X					X						266	-13.8		
142.86	130	80								X						X			X					X						266	-13.8		
144.36	150	68								X						X			X					X						266	-13.8		
145.45	155	62								X						X			X					X						266	-13.8		
145.57	140	58								X						X			X					X						266	-13.8		
145.80	130	66								X						X			X					X						266	-13.8		
148.30			X																										148.3 148.5m NI / Broken & Friable core	266	-13.8		
149.10	350	86								X						X			X					X						266	-13.8		
149.77	155	70	X	X												X			X					X						266	-13.8		
150.44	160	76								X						X			X					X						266	-13.8		
150.84	30	70		X												X			X					X						266	-13.8		
150.88	140	90								X						X			X					X						266	-13.8		
150.93	320	80		X												X			X					X						266	-13.8		
151.20	310	72		X												X			X					X						266	-13.8		
151.60	150	82								X						X			X					X						266	-13.8		
152.09	10	90								X						X			X					X						266	-13.8		
152.56	165	60		X												X							X	X					Very rough / pitted / evidence of dissolution, Black argillite	266	-13.8		
152.94	20	84		X												X			X					X					Very rough / pitted / evidence of dissolution, Black argillite	266	-13.8		
153.35	15	90								X						X			X					X						266	-13.8		
153.70	140	74		X												X			X					X					Very rough / pitted / evidence of dissolution, Black argillite	266	-13.8		
154.30	350	90								X						X			X					X						266	-13.9		
154.80	355	60								X						X			X					X						266	-13.9		
154.90	355	60								X						X			X					X						266	-13.9		
155.12	340	60								X						X			X					X						266	-13.9		
155.90	340	82		X												X			X					X					Very Rough	266	-13.9		
156.30	350	90								X						X			X					X						266	-13.9		
157.15	5	86								X						X			X					X						266	-13.9		
159.45	5	90								X						X			X					X						266	-13.9		
159.60	120	86								X						X			X					X						266	-13.9		
162.05	5	82								X						X			X					X						266	-14		
163.48	325	88								X						X			X					X						266	-14		
163.57	330	86								X						X			X					X						266	-14		
163.97	15	90					X									X			X					X						266	-14		
164.08	5	90					X									X			X					X						266	-14		
164.55	180	44								X						X			X					X						266	-14		
165.00	325	86								X						X			X					X						266	-14		
167.00	60	74								X						X			X					X						266	-14		
167.68	135	90								X						X			X					X						266	-14		
168.64	140	80								X						X			X					X						266	-14		
168.69	140	82								X						X			X					X						266	-14		
171.07	60	78								X						X						X		X					Minor grey calcite	266	-14		
171.30	310	80								X						X			X					X						266	-14		
171.66	315	80								X						X			X					X						266	-14		
172.15	60	90								X						X						X		X					Minor grey calcite	266	-14.1		
172.56	315	90								X						X			X					X						266	-14.1		
173.00	320	74								X						X			X					X						266	-14.1		
173.40	325	76		X												X			X					X						266	-14.1		
173.44	330	76								X						X			X					X						266	-14.1		
174.05	320	76								X						X			X					X						266	-14.1		
174.86	330	82								X						X			X					X						266	-14.1		
176.52	310	70								X						X			X					X						266	-14.1		
177.10	180	18					X									X			X					X						266	-14.1		
179.77	0	90								X						X			X					X						266	-14.1		
180.17	350	84								X						X			X					X						266	-14.1		
180.75	330	86								X						X			X					X						266	-14.1		
182.53	45	86								X						X			X					X						266	-14.1		
182.97	115	76								X						X			X					X						266	-14.1		
183.95	230	76								X						X			X					X						266	-14.1		
185.83	50	68								X						X			X					X						266	-14.1		

186.17	180	88								X						X			X					X						266	-14.1		
186.24	180	85								X						X			X					X						266	-14.1		
186.53	40	80								X						X			X					X						266	-14.1		
191.20	335	90	X							X						X							X	X					Light brown sandy clay coating joints	266	-14.1		
191.64	40	72	X							X						X							X	X					Light brown sandy clay coating joints	266	-14.1		
191.72	40	72	X							X						X							X	X					Light brown sandy clay coating joints	266	-14.1		
191.90	340	52								X						X							X	X					Light brown sandy clay coating joints	266	-14.1		
192.21	350	38	X							X						X							X	X					Light brown sandy clay coating joints	266	-14.1		
192.50	140	48								X						X			X					X						266	-14.1		
192.70	330	80	X							X						X						X	X	X					White calcite & Light brown sandy clay	266	-14.1		
192.82	5	78								X						X			X					X						266	-14.1		
193.50	5	78								X						X			X					X						266	-14.1		
194.80	20	70								X						X			X					X						266	-14.1		
196.30	5	78								X						X			X					X						266	-14.1		
196.74	340	70								X						X			X					X						266	-14.1		
199.10	180	90								X						X			X					X						266	-14.1		
199.45	20	50								X						X						X		X					Wjite grey calcite	266	-14.1		
199.52	140	68								X						X			X					X						266	-14.1		
199.97	5	90								X						X			X					X						266	-14.1		
200.95	250	42	X						X							X				X					X				Slight Fe staining	266	-14.1		
203.00	345	38								X						X							X	X					Light brown, fine grained sand infill	266	-14.1		
203.21	340	54								X						X			X					X						266	-14.1		
203.24	340	56								X						X			X					X						266	-14.1		
203.32	345	50								X						X			X					X						266	-14.1		
203.64	340	70								X						X			X					X						266	-14.1		
203.69	345	62								X						X						X	X	X						266	-14.1		
203.87	145	54								X						X							X		X				Light brown grey clay coating, minor Fe staining	266	-14.1		
205.40	5	90								X						X			X					X						266	-14.1		
205.68	140	42								X						X			X					X						266	-14.1		
205.93	130	68								X						X			X					X						266	-14.1		
206.68	195	62		X												X				X					X				Slight Fe Staining	266	-14.1		
207.02	10	90								X						X			X					X						266	-14.1		
207.25	345	40		X												X			X					X						266	-14.1		
207.60	350	90								X						X			X					X						266	-14.1		
209.30	0	90								X						X			X					X						266	-14.1		
210.15	170	76								X						X			X					X						266	-14.1		
210.94	0	90								X						X			X					X						266	-14.1		
212.94	20	78								X						X			X					X						266	-14.1		
213.00	145	90								X						X							X		X				Brown grey clay coating, minor Fe staining	266	-14.1		
213.80	20	72								X						X			X					X						266	-14.1		
214.65	215	38								X						X			X					X						266	-14.1		
215.00	210	36								X						X			X					X						266	-14.1		
216.05	15	62		X												X						X		X					White calcite	266	-14.1		
216.80	30	70								X						X						X		X					Minor white calcite	266	-14.1		
216.90	135	74								X						X			X					X						266	-14.1		
217.10	340	88		X												X			X					X						266	-14.1		
217.33	330	90		X												X			X					X						266	-14.1		
217.92	330	82	X							X						X			X					X						266	-14.1		
217.94	40	78	X							X						X			X					X						266	-14.1		
218.04	330	82		X												X				X					X				slight oxidation	266	-14.1		
218.36	310	78								X						X				X					X				slight oxidation	266	-14.1		
218.37	310	76								X						X			X						X				slight oxidation	266	-14.1		
218.56	210	82								X						X			X					X						266	-14.1		
218.92	310	90								X						X			X						X				slight oxidation	266	-14.1		
219.70	320	86								X						X			X						X				slight oxidation	266	-14.1		
219.74	330	90								X						X			X						X				slight oxidation	266	-14.1		
219.77	330	90	X							X						X			X					X						266	-14.1		
220.44	240	42					X									X			X					X						266	-14.1		
220.58	310	90								X						X			X					X						266	-14.1		
220.74	45	78	X							X						X						X		X					Trace white calcite	266	-14.1		
221.61	120	46		X												X				X					X				Leached / pitted - slight Fe staining	266	-14.1		
221.90	20	60								X						X				X				X					Very light Fe staining	266	-14.1		

222.05	25	52								X					X							X		X					White calcite veining	266	-14.1		
223.34	15	58								X						X			X					X						266	-14.1		
222.55	160	70								X						X							X	X					Trace light brown clay smearing	266	-14.1		
222.65	20	58								X						X						X		X					White calcite	266	-14.1		
223.00	135	76								X						X							X	X					Minor yellow brown clay coating	266	-14.1		
223.05	140	78								X						X							X	X					Minor yellow brown clay coating	266	-14.1		
223.65	120	42								X						X			X					X						266	-14.1		
224.00	30	82								X						X						X		X					Coarse crystalline calcite	266	-14.1		
224.50	60	52								X						X			X					X						266	-14.1		
224.71	145	62								X						X			X					X						266	-14.1		
225.00	120	58								X						X							X	X					Trace light brown clay	266	-14.1		
225.45	170	36								X						X			X					X						266	-14.1		
226.35	220	40					X									X							X			X			Intensely oxidised, pitted - dissolution	266	-14.1		
226.62	140	62								X				X					X						X				Fe staining / minor clay	266	-14.1		
226.74	150	70								X						X				X					X				Slightly leached / dissolution	266	-14.1		
227.84	150	72								X						X				X					X				Slightly leached / dissolution	266	-14.1		
227.92	140	80								X						X				X					X				Slightly leached / dissolution	266	-14.1		
227.95	210	60	X	X												X			X					X						266	-14.1		
228.55	45	86								X						X			X					X						266	-14.1		
228.75	30	90								X						X			X					X						266	-14.1		
229.00	50	80								X				X									X		X				Clay filled cavity 10cm wide	266	-14.1		
229.10	50	80								X				X									X		X				Clay filled cavity 10cm wide	266	-14.1		
229.90	145	42								X						X							X	X					Minor grey brown clay	266	-14.1		
230.20	310	82								X						X							X		X				Slightly leached with grey / brown clay	266	-14.1		
230.36	310	90								X						X							X		X				Slightly leached with grey / brown clay	266	-14.1		
230.60	230	76	X													X									X				Axial parallel / broken int angular elongate fragments	266	-14.1		
230.93	310	90								X						X							X		X				Slightly leached grey sandy clay coating	266	-14.1		
231.10	35	72								X						X							X		X				Slightly leached grey clay coating	266	-14.1		
232.10	160	82								X						X			X					X						266	-14.1		
232.17	145	66								X						X			X					X						266	-14.1		
232.22	170	53								X						X			X					X						266	-14.1		
232.80	345	88									X					X						X		X					White calcite vein, vertical striae	266	-14.1		
233.20	55	68	X							X						X							X	X					Coarse brown grey sand	266	-14.1		
233.34	210	70								X						X			X					X						266	-14.1		
233.40	340	58	X							X					X								X	X					fine grained briwn / grey sand	266	-14.1		
233.56	50	82								X						X							X	X					Minor sand coating	266	-14.1		
233.70	310	82					X									X							X	X					Minor sand coating	266	-14.1		
233.90	180	88	X				X									X							X	X					Minor sand coating	266	-14.1		
134.10	180	86	X				X									X							X	X					Minor sand coating	266	-14.1		
234.36	160	70								X						X							X	X					Minor clayey sand	266	-14.1		
234.48	345	42					X									X			X					X					Curved / arcuate joint plane	266	-14.1		
234.96	160	64	X				X									X							X	X					Trace clay	266	-14.1		
235.03	350	78	X							X						X			X					X						266	-14.1		
235.08	0	60	X							X						X			X					X						266	-14.1		
235.19	150	72	X							X						X			X					X						266	-14.1		
235.26	180	50	X	X												X			X					X						266	-14.1		
235.31	155	48		X												X							X	X					Light brown clay coating	266	-14.1		
235.65	230	32								X						X			X					X						266	-14.1		
235.80	175	64								X						X							X	X					Soft grey brown clay	266	-14.1		
235.87	140	75					X									X							X	X					Soft grey brown clay	266	-14.1		
236.20	70	64	X							X						X							X	X					Minor grey clay	266	-14.1		
236.30	50	78	X							X						X							X	X					Minor grey clay	266	-14.1		
236.37	320	54	X							X						X							X	X					Minor grey clay	266	-14.1		
236.48	60	78		X												X			X					X						266	-14.1		
236.60	20	38								X					X								X				X		Fine sand infill & bright orange Fe staining	266	-14.1		
237.18	20	36								X						X			X					X						266	-14.1		
237.55	110	64								X						X								X					Upper contact of a cavity	266	-14.1		
239.25		45	X							X						X						X	X	X					No Invert marked	266	-14.1		
239.86		90		X												X			X					X					No Invert marked	266	-14.1		
240.00			X																					X					240.0 - 240.2m Rubble recovered	266	-14.1		
241.20		15								X						X				X					X				No Invert marked - Slight oxidation	266	-14.1		
241.55	220	42								X						X				X					X				Slight Oxidation	266	-14.1		

242.15	150	90								X						X				X					X				Slight Oxidation, fine sand	266	-14.1		
242.45	35	52								X						X				X					X				Slight Oxidation	266	-14.1		
242.70	320	88								X						X							X	X					Yellow brown clay coating joint surface	266	-14.1		
242.80	330	90								X						X							X	X					Yellow brown clay coating joint surface	266	-14.1		
243.50	20	90								X						X			X					X						266	-14.1		
243.53	20	84								X						X							X		X				Slightly oxidised with brown clay coating	266	-14.1		
243.55	20	86								X						X							X		X				Slightly oxidised with brown clay coating	266	-14.1		
243.74	175	44								X						X							X		X				Slightly oxidised with brown clay and fine sand coating	266	-14.1		
244.30	0	10					X									X						X			X				Black argillite caoting , undulating and axial paraleel	266	-14.1		
244.76	50	66								X						X				X						X			Bright orange oxidation	266	-14.1		
245.35	10	10								X						X							X		X				Orange brown sand coating surface, leached contact	266	-14.1		
247.70	0	28								X						X			X					X						266	-14.1		
247.90	95	78					X									X				X					X				Slight oxidation	266	-14.1		
248.05	310	30								X						X				X					X				Slight oxidation	266	-14.1		
249.00	315	90								X						X							X		X				Orange brown sandy clay coating	266	-14.1		
249.05	320	90	X							X						X			X					X						266	-14.1		
249.54	355	70								X						X							X	X						266	-14.1		
250.90	25	78					X									X							X	X					Orange brown fine grained sand	266	-14.1		
252.60	345	52	X							X						X							X	X					coarse yellow brown sand infill	266	-14.1		
253.15	145	82								X						X			X					X						266	-14.1		
254.11	0	90								X						X			X					X						266	-14.1		
254.70	140	48								X						X			X					X						266	-14.1		
254.94	160	78								X						X				X					X				Weak Fe staining	266	-14.1		
255.30	40	72	X	X												X				X					X				Weak Fe staining	266	-14.1		
255.33	230	80								X						X							X	X					Minor Orange brown clay	266	-14.1		
255.93		60	X							X						X			X						X				No Invert Marked	266	-14.1		
256.10		75					X									X							X	X					No Invert Marked - Curved / Arcuate	266	-14.1		
256.57		45								X						X			X					X					No Invert Marked	266	-14.1		
256.60		45								X						X			X					X					No Invert Marked	266	-14.1		
256.70		45								X						X			X					X					No Invert Marked	266	-14.1		
257.00		20	X					X								X			X					X					No Invert Marked - Polished	266	-14.1		
257.60		90	X					X								X			X					X					No Invert Marked - Polished and undulating	266	-14.1		
257.90		90	X					X								X			X					X					No Invert Marked	266	-14.1		
258.50		45								X						X			X					X					No Invert Marked	266	-14.1		
258.70		30								X						X							X	X					No Invert Marked - minor sand	266	-14.1		
259.05		85						X								X			X					X					No Invert Marked - slightly polished	266	-14.1		
260.23	155	78								X						X			X					X						266	-14.1		
260.51	150	70								X						X			X					X						266	-14.1		
260.70	40	90								X						X							X	X					Minor clay	266	-14.1		
260.80	280	38	X				X									X			X					X						266	-14.1		
260.84	150	78								X						X			X					X						266	-14.1		
261.30	170	62								X						X					X			X					Coarse sand	266	-14.1		
261.42	170	56								X						X			X					X						266	-14.1		
262.94	340	86								X						X			X					X						266	-14.1		
263.15	195	80								X						X			X					X						266	-14.1		
263.45	165	18					X									X				X						X				266	-14.1		
263.95	340	84								X						X			X					X						266	-14.1		
264.20	340	74								X						X			X					X						266	-14.1		
265.07	310	84	X							X						X				X					X				Slightly oxidsed	266	-14.1		
265.48	210	66								X				X							X				X				Coarse sand infill / ribble	266	-14.1		
266.09	210	70								X						X			X					X						266	-14.1		
266.35	305	72								X						X			X					X						266	-14.1		
266.44		55								X						X					X			X					No Invert Marked - Coarse sand	266	-14.1		
266.62		75								X						X					X			X					No Invert Marked - Coarse brown sand	266	-14.1		
267.05	50	72								X						X			X					X						266	-14.1		
267.15	40	662								X						X					X	X		X					Grey calcite & coarse brown sand	266	-14.1		
267.75	250	18								X						X					X			X					Minor Sand	266	-14.1		
267.96		60								X						X			X					X					No Invert Marked	266	-14.1		
268.04		65								X						X			X					X					No Invert Marked	266	-14.1		
268.50			X													X								X					268.5 - 268.65m Coarse Rubble	266	-14.1		
268.65		45								X						X			X					X					No Invert Marked	266	-14.1		
268.79		45								X						X			X					X					No Invert Marked	266	-14.1		

269.00		85	X							X						X			X					X					No Invert Marked - Conjugate Jointing	266	-14.1		
269.00		75					X									X			X					X					No Invert Marked - Conjugate Jointing	266	-14.1		
269.52	140	76								X						X			X					X						266	-14.1		
269.75	90	48								X						X			X					X						266	-14.1		
270.15	310	30								X						X			X					X						266	-14.1		
271.54	180	82								X						X			X					X						266	-14.1		

PROJECT NAME Lackagh Quarry	REPORT NO:	
CLIENT: Glaway County Council	HOLE NO:	BH-04
ENGINEER: ARUP	LOGGED BY:	Dave Blaney

Depth of Discontinuity (m BGL)	Orient.to Short Core Axis	Non Intact? (NI)	Roughness										Aperture					Filling					Weathering					Comments
			Stepped			Undulating			Planar			Other	V Open	Open	Mod Open	Tight	V Tight	Clean	Staining	% Soil	% Mineral	Clay	No	Sl	Mod	High	Comp	
			R	Sm	St	R	Sm	St	R	Sm	St		>10mm	2.5-10	0.5-2.5	0.1-0.5	<0.1											
5.30	20								x						x							x	x					Grey brown soft clay
5.40	20								x						x							x	x					Grey brown soft clay
5.60	50								x						x							x	x					Grey brown soft clay
5.70	80					x									x							x	x					Grey brown soft clay
6.35	10					x									x							x	x					Grey brown soft clay
6.40	90								x							x						x	x					Minor clay smeared on fracture surface
6.70	90								x							x						x	x					Minor clay smeared on fracture surface
6.50	15					x									x			x					x					
6.68	35					x									x			x					x					
6.95	85								x						x							x	x					Minor br/gy clay smeared on fracture surface
7.02	5								x						x			x					x					
7.37	15								x						x			x					x					
7.54	15								x						x			x					x					
7.73	75					x									x			x					x					
7.75	80					x									x							x	x					Stiff / Firm br/gy clay 1mm aperture
7.86	10								x						x			x					x					
8.20	10					x									x			x					x					
8.70	70					x									x			x					x					
8.90	80					x									x							x	x					Firm gy/br clay 2mm aperture
8.95	5					x									x							x	x					Minor gy/br clay smearing fract. Surface
9.05	80					x									x							x	x					Firm gy/br clay 1mm aperture
9.10	10					x									x							x	x					
9.16	80					x									x							x	x					
9.24	55					x									x			x					x					
9.72	85					x									x							x	x					
9.33	85					x									x							x	x					
9.40	50					x									x			x					x					
9.50	85								x						x							x	x					Minor light grey clay smearing
10.00	80					x									x							x	x					Minor light grey clay smearing
10.50	80					x									x							x	x					Localised small smears of light grey clay
10.87	5								x						x			x					x					
11.06	80					x									x			x					x					
11.30	60					x									x			x					x					
11.60	45								x						x			x					x					

PROJECT NAME **Lackagh Quarry**
CLIENT: **Glaway County Council**
ENGINEER: ARUP

REPORT NO:
HOLE NO: **BH-04**
LOGGED BY: **Dave Blaney**

Depth of Discontinuity (m BGL)	Orient.to Short Core Axis	Non Intact? (NI)	Roughness										Aperture					Filling					Weathering					Comments
			Stepped			Undulating			Planar			Other	V Open	Open	Mod Open	Tight	V Tight	Clean	Staining	% Soil	% Mineral	Clay	No	Sl	Mod	High	Comp	
			R	Sm	St	R	Sm	St	R	Sm	St		>10mm	2.5-10	0.5-2.5	0.1-0.5	<0.1											
11.63	5	x							x						x			x					x					
11.79	45								x						x			x					x					
11.80	5	x							x						x			x					x					
11.97	15					x									x			x					x					
12.50	60								x						x						x		x					White / grey calcite coating
12.51	15								x						x			x					x					
12.92	15					x									x			x					x					
14.40	10					x									x			x					x					
15.14	10					x									x			x					x					
15.90	70								x						x							x	x					Minor light grey clay smearing fract. Surface
16.38	10					x								x				x						x				Minor etching / pitting on fract. Surface
16.55	70					x									x			x					x					
16.77	5					x									x			x					x					
17.05	10					x									x			x					x					Strongly undulating - 30mm amplitude
17.40	10					x								x								x	x					Orange / brown clay infill
17.50	80					x									x							x		x				Minor clay and locallised Fe. staining
17.60	45	x							x						x			x					x					
17.65	70	x							x						x			x					x					
18.77	10								x						x			x					x					
19.93	25					x							x					x					x					
20.98	10								x						x			x					x					
21.85	60					x									x			x					x					
22.05	20					x								x				x					x					
22.15	40								x						x			x					x					
22.35	10								x						x			x					x					
23.10	10								x						x			x						x				Slight Fe Staining
23.13	0								x						x			x					x					
23.62	5								x						x			x					x					
24.17	20								x						x			x					x					
24.98	5					x									x			x					x					
25.16	10					x								x				x						x				Slight Fe Staining
25.58	10								x						x			x					x					
25.80	10								x						x			x					x					

PROJECT NAME **Lackagh Quarry**

CLIENT: **Glaway County Council**

ENGINEER: ARUP

REPORT NO:

HOLE NO: **BH-04**

LOGGED BY: **Dave Blaney**

Depth of Discontinuity (m BGL)	Orient.to Short Core Axis	Non Intact? (NI)	Roughness										Aperture					Filling					Weathering					Comments
			Stepped			Undulating			Planar			Other	V Open	Open	Mod Open	Tight	V Tight	Clean	Staining	% Soil	% Mineral	Clay	No	Sl	Mod	High	Comp	
			R	Sm	St	R	Sm	St	R	Sm	St		>10mm	2.5-10	0.5-2.5	0.1-0.5	<0.1											
26.52	5					x									x			x					x					
26.70	75								x						x							x	x					Fine smear of light brown clay
26.72	20	x							x						x			x					x					
26.96	5					x									x			x					x					
27.06	60	x							x						x			x					x					
27.09	15	x							x						x			x					x					
27.13	10	x							x						x			x					x					
27.18	60	x							x						x			x					x					
27.53	5								x						x			x					x					
27.84	5					x									x			x					x					
27.87	5								x						x			x					x					
27.98	5								x						x			x					x					
28.25	5								x						x							x	x					Trace light grey clay coating
28.55	50								x						x			x					x					
28.90						x							x									x		x				37cm wide void - minor clay / slight oxidat.
29.77	5								x						x			x					x					
29.94	5								x						x			x					x					
30.10	5								x						x			x					x					
30.63	15					x									x							x	x					Minor light brown clay smearing
30.69	5								x						x							x	x					Minor light brown clay smearing
30.92	10					x									x			x					x					
31.43	10					x									x							x	x					Minor light brown clay smearing
31.60	5					x									x							x	x					Minor light brown clay smearing
32.47	20								x						x			x					x					
32.90	5								x						x			x					x					
33.94	10	x							x						x			x					x					
34.00	85								x						x			x					x					
34.04	10	x							x						x			x					x					
34.30	10	x							x						x			x					x					
34.52	75								x						x			x					x					
34.57	15	x							x						x			x					x					
34.96	15								x						x			x					x					

PROJECT NAME Lackagh Quarry
CLIENT: Galway County Council
ENGINEER: ARUP

REPORT NO:
HOLE NO: BH-05
LOGGED BY: Dave Blaney

Depth of Discontinuity (m BGL)	Orient.to Short Core Axis	Non Intact? (NI)	Roughness										Aperture					Filling					Weathering					Comments
			Stepped			Undulating			Planar			Other	V Open	Open	Mod Open	Tight	V Tight	Clean	Staining	% Soil	% Mineral	Clay	X	Sl	Mod	High	Comp	
			R	Sm	St	R	Sm	St	R	Sm	St		>10mm	2.5-10	0.5-2.5	0.1-0.5	<0.1											
0.52	5	X				X									X			X					X					
0.60	5					X									X			X					X					
0.63	85								X						X						X		X					White / brown crystalline calcite
0.63	85								X						X			X					X					
0.68	5					X									X			X					X					
0.75	5	X							X						X			X					X					
0.84	5	X							X						X			X					X					
0.90	5								X						X			X					X					
1.31	15								X						X							X	X					Pale brown clay smearing fract. Surface
1.37	10	X				X									X							X	X					Pale brown clay smearing fract. Surface
1.40	10	X				X									X							X	X					Pale brown clay smearing fract. Surface
1.50	85	X							X						X							X	X					Pale brown clay smearing fract. Surface
1.66	5					X									X							X	X					Pale brown clay smearing fract. Surface
1.83	85	X							X						X			X					X					
2.13	10								X						X			X					X					
2.22	20		X												X			X					X					
2.42	5								X						X			X					X					
2.47	10								X						X			X					X					
2.57	10								X						X			X					X					
2.64	5								X						X			X					X					
2.70	10								X						X			X					X					
2.77	20					X									X			X					X					
2.82	5								X						X			X					X					
2.99	15								X						X			X					X					
3.07	10					X									X			X					X					
3.20	10								X						X			X					X					
3.27	20								X						X			X					X					
3.50	85					X									X			X					X					Minor fine gr. Sand coating fract. Surface
3.45	15	X				X									X			X					X					
3.62	20	X				X			X						X			X					X					
4.02	15								X						X			X					X					
4.10	85								X						X							X			X			Fine sandy clay coating & weak Fe staining
4.10	85								X						X							X			X			Joints are sub-parallel c.2-3cm apart
4.16	5								X						X			X					X					

		PROJECT NAME Lackagh Quarry																									**REPORT NO:**	
		CLIENT: Galway County Council																									**HOLE NO:**	**BH-05**
		ENGINEER: ARUP																									**LOGGED BY:**	**Dave Blaney**
Depth of Discontinuity (m BGL)	**Orient.to Short Core Axis**	**Non Intact? (NI)**	**Roughness**										**Aperture**					**Filling**					**Weathering**					**Comments**
			Stepped			**Undulating**			**Planar**			**Other**	**V Open**	**Open**	**Mod Open**	**Tight**	**V Tight**	**Clean**	**Staining**	**% Soil**	**% Mineral**	**Clay**	**X**	**Sl**	**Mod**	**High**	**Comp**	
			R	**Sm**	**St**	**R**	**Sm**	**St**	**R**	**Sm**	**St**		**>10mm**	**2.5-10**	**0.5-2.5**	**0.1-0.5**	**<0.1**											
4.25	5	X							X						X			X					X					
4.50	5	X							X						X			X					X					
4.73	5	X							X						X			X					X					
4.60	85								X						X							X			X			Fine sandy clay coating & weak Fe staining
4.60	85								X						X							X			X			Fine sandy clay coating & weak Fe staining. Joints are parallel and 2cm apart
4.74	5	X							X						X			X					X					
4.83	5	X							X						X			X					X					
3.85-8.0	85-90								X						X						X	X			X			Fine sandy clay coating & Fe staining. Fracture is are axial parallel and continue for 4.15m. From 6.5m white calcite deposited on fracture surface. 7.0-7.65m firm brown/grey clay infill - aparture up to 4mm wide
4.97	5	X							X						X			X					X					
5.07	10	X							X						X							X	X					Minor clay coating fracture surface
5.13	20	X							X						X							X	X					Minor clay coating fracture surface
5.20	75	X							X						X			X					X					Conjugate with vertical joint
5.16	10	X							X						X			X					X					
5.61	20	X				X									X			X					X					
5.73	10	X							X						X			X					X					
5.80	5	X							X						X			X					X					
5.97	5	X							X						X			X					X					
6.10	85	X	X												X							X	X					Conjugate with vertical fracture strike 120 / 60'
6.26	5	X							X						X			X					X					
6.38	10	X							X						X							X	X					Light brown clay
6.48	5	X							X						X			X					X					
6.60	5	X							X						X			X					X					
6.74	5	X							X						X			X					X					
6.78	5	X							X						X			X					X					
6.88	15	X				X									X			X					X					
6.91	10	X				X									X			X					X					
7.13	5	X							X						X			X					X					
7.37	5	X							X						X			X					X					
7.57	10	X							X						X			X					X					
7.74	15								X						X			X					X					
8.64	0								X						X				X					X				Orange brown Fe staining
8.68	50								X						X				X					X				Orange brown Fe staining
8.73	50								X						X				X					X				Orange brown Fe staining

		PROJECT NAME Lackagh Quarry																									**REPORT NO:**	
		CLIENT: Galway County Council																									**HOLE NO:**	**BH-05**
		ENGINEER: ARUP																									**LOGGED BY:**	**Dave Blaney**
Depth of Discontinuity (m BGL)	**Orient.to Short Core Axis**	**Non Intact? (NI)**	**Roughness**										**Aperture**					**Filling**					**Weathering**					**Comments**
			Stepped			**Undulating**			**Planar**			**Other**	**V Open**	**Open**	**Mod Open**	**Tight**	**V Tight**	**Clean**	**Staining**	**% Soil**	**% Mineral**	**Clay**	**X**	**Sl**	**Mod**	**High**	**Comp**	
			R	**Sm**	**St**	**R**	**Sm**	**St**	**R**	**Sm**	**St**		**>10mm**	**2.5-10**	**0.5-2.5**	**0.1-0.5**	**<0.1**											
8.92	45		X												X				X					X				Orange brown Fe staining
9.20	45								X						X							X		X				Orange brown Fe staining
9.35	60		X												X				X					X				Orange brown Fe staining, light brown clay smearing
10.25	5								X						X			X					X					
10.4 - 11.3	85								X						X						X	X		X				Axial parallel fracture, minor calcite and orange brown clay coating fracture surface
10.50	5								X						X			X					X					
11.20	50					X									X						X	X	X					Light grey calcite and minor brown clay coating fracture surface
11.30	5								X						X			X					X					
11.90	5		X												X						X		X					Fracture devoped along stylolite, black argillite lining
11.95	80	X							X						X			X						X				Minor Fe staining
12.05	15					X									X			X					X					
12.42	10		X												X						X		X					Fracture devoped along stylolite, black argillite lining
12.60	55								X						X			X					X					
12.6 - 13.4	85								X						X				X					X				Minor Fe staining
12.78	0	X							X						X							X	X					Minor light brown clay
12.84	5	X							X						X							X	X					Minor light brown clay
13.02	5	X							X						X			X					X					
13.26	5	X							X						X			X					X					
13.52	20								X						X			X					X					
13.82	5								X						X			X					X					
14.39	30								X						X							X	X					Sand/clay coating, minor Fe staining
14.72	55								X						X			X					X					
15.00	30								X						X			X					X					
15.15	15		X												X						X		X					Fracture devoped along stylolite, black argillite lining
15.20	85	X				X									X			X					X					
15.33	85	X				X									X			X					X					
15.40	20					X									X							X	X					Minor brown clay
15.55	10		X												X						X		X					Fracture devoped along stylolite, black argillite lining
16.59	10					X									X			X					X					
16.86	10								X						X							X		X				Minor light brown clay, some pitting & weak oxidation of fracture surface
16.90	30								X						X							X		X				Minor light brown clay, some pitting & weak oxidation of fracture surface

		PROJECT NAME Lackagh Quarry																									**REPORT NO:**	
		CLIENT: Galway County Council																									**HOLE NO:**	**BH-05**
		ENGINEER: ARUP																									**LOGGED BY:**	**Dave Blaney**
Depth of Discontinuity (m BGL)	**Orient.to Short Core Axis**	**Non Intact? (NI)**	**Roughness**										**Aperture**					**Filling**					**Weathering**					**Comments**
			Stepped			**Undulating**			**Planar**			**Other**	**V Open**	**Open**	**Mod Open**	**Tight**	**V Tight**	**Clean**	**Staining**	**% Soil**	**% Mineral**	**Clay**	**X**	**Sl**	**Mod**	**High**	**Comp**	
			R	**Sm**	**St**	**R**	**Sm**	**St**	**R**	**Sm**	**St**		**>10mm**	**2.5-10**	**0.5-2.5**	**0.1-0.5**	**<0.1**											
17.20	10								X						X							X	X					Grey/brown clay coating fract. Surface
17.25	85	X				X									X							X	X					Minor grey / brown clay
17.40	45					X									X							X	X					Minor grey/brown clay coating fract. Surface
17.78	5					X									X							X	X					Undulating - amplitude 2cm, brown clay infill
18.03	15		X												X							X	X					Minor clay
18.30	15					X									X			X					X					
18.50	85	X							X						X						X		X					Minor white calcite
18.60	20								X						X							X	X					Orange/brown clay smeared on fract surface
18.80	10								X						X							X	X					Orange/brown clay smeared on fract surface
18.90	85								X						X						X		X					Minor white calcite
18.97	10					X									X			X					X					
19.20	20					X									X							X	X					Orange/brown clay infill
19.60	5								X						X			X					X					
19.98	45	X							X						X							X	X					Orange/brown clay infill, aperture up to 2mm thick
20.00	45	X							X						X							X	X					Orange/brown clay infill, aperture up to 2mm thick
20.04	45								X						X			X					X					
20.12	10								X						X			X					X					
20.60	85								X						X			X					X					
20.60	75					X									X							X	X					Orange/brown clay coating fract. Surface
20.52	10								X						X			X					X					
20.73	20	X	X												X							X	X					Very rough - Orange/brown clay coating fract. Surface
20.87	35	X	X												X							X	X					Very rough - Orange/brown clay coating fract. Surface
20.97	50					X									X							X	X					Orange/brown clay coating fract. Surface
21.23	55					X									X							X	X					Brown sandy clay coating
21.35	55					X									X							X	X					Brown sandy clay coating
21.42	55					X							X									X	X					Joint aperture is >10mm infilled with orange brown clay
21.86	30	X							X						X			X					X					
21.90	20								X						X			X					X					
22.05	45								X						X			X					X					

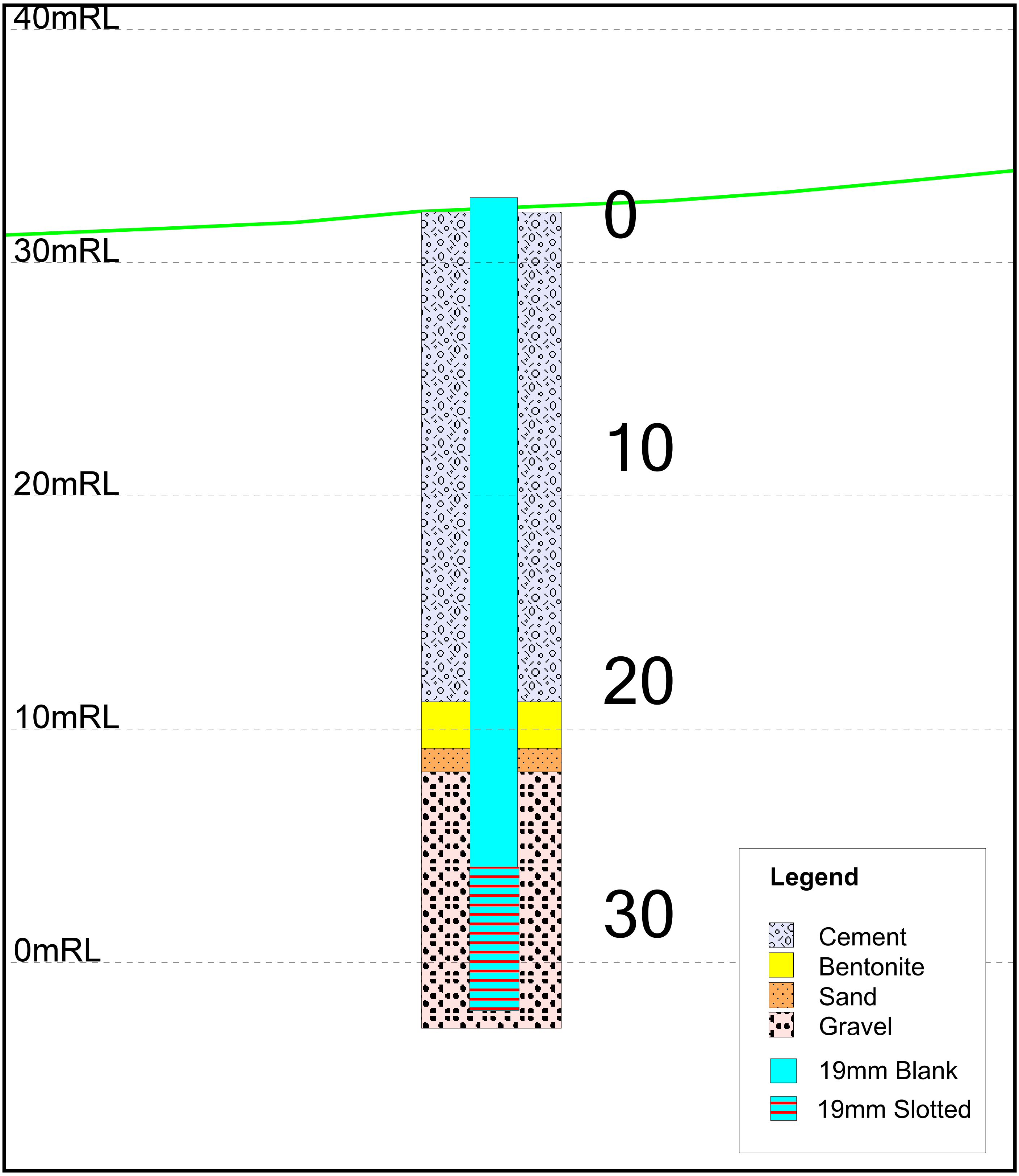
		PROJECT NAME Lackagh Quarry																									**REPORT NO:**	
		CLIENT: Galway County Council																									**HOLE NO:**	**BH-05**
		ENGINEER: ARUP																									**LOGGED BY:**	**Dave Blaney**

Depth of Discontinuity (m BGL)	**Orient.to Short Core Axis**	**Non Intact? (NI)**	**Roughness**										**Aperture**					**Filling**					**Weathering**					**Comments**
			Stepped			**Undulating**			**Planar**			**Other**	**V Open**	**Open**	**Mod Open**	**Tight**	**V Tight**	**Clean**	**Staining**	**% Soil**	**% Mineral**	**Clay**	**X**	**Sl**	**Mod**	**High**	**Comp**	
			R	**Sm**	**St**	**R**	**Sm**	**St**	**R**	**Sm**	**St**		**>10mm**	**2.5-10**	**0.5-2.5**	**0.1-0.5**	**<0.1**											
22.10	5								X						X			X					X					
22.45	85	X							X						X							X		X				Clay coating fract surface minor Fe staining
22.92	10	X							X						X							X	X					Clay coating fract surface
23.40	70								X						X							X	X					Light brown clay over basal 30cm
23.60	5	X							X						X			X					X					
23.72	10								X						X						X		X					Minor light grey calcite
24.40	60								X						X			X					X					
24.50	0								X						X			X					X					
25.04	0								X						X			X					X					
25.52	45								X						X						X		X					Minor light grey calcite
25.82	25					X									X			X					X					
26.37	5								X						X			X					X					
26.61	5								X						X			X					X					
26.70	80	X							X						X				X				X					Minor Fe staining
27.10	85								X						X						X		X					Minor white calcite
27.14	20	X	X												X			X					X					
27.27	55								X						X			X					X					
27.62	55		X												X			X					X					
27.88	0								X						X			X					X					
28.05	5	X							X						X			X					X					
28.12	60	X							X						X			X					X					
28.16	5	X				X									X			X					X					
28.25	90								X						X						X		X					Minor white calcite veining
28.40	55	X							X						X			X					X					
28.1 - 32.35	85-90								X						X						X		X					Axial parallel fracture, surfaces partially coated with white calcite
28.81	15	X							X						X			X					X					
28.90	20	X							X						X			X					X					
29.05	30	X							X						X			X					X					
29.35	10	X							X						X			X					X					
29.40	60	X							X						X			X					X					
30.00	5	X							X						X			X					X					
30.30	40	X							X						X			X					X					
30.38	10	X				X									X			X					X					
30.50	10	X							X						X			X					X					

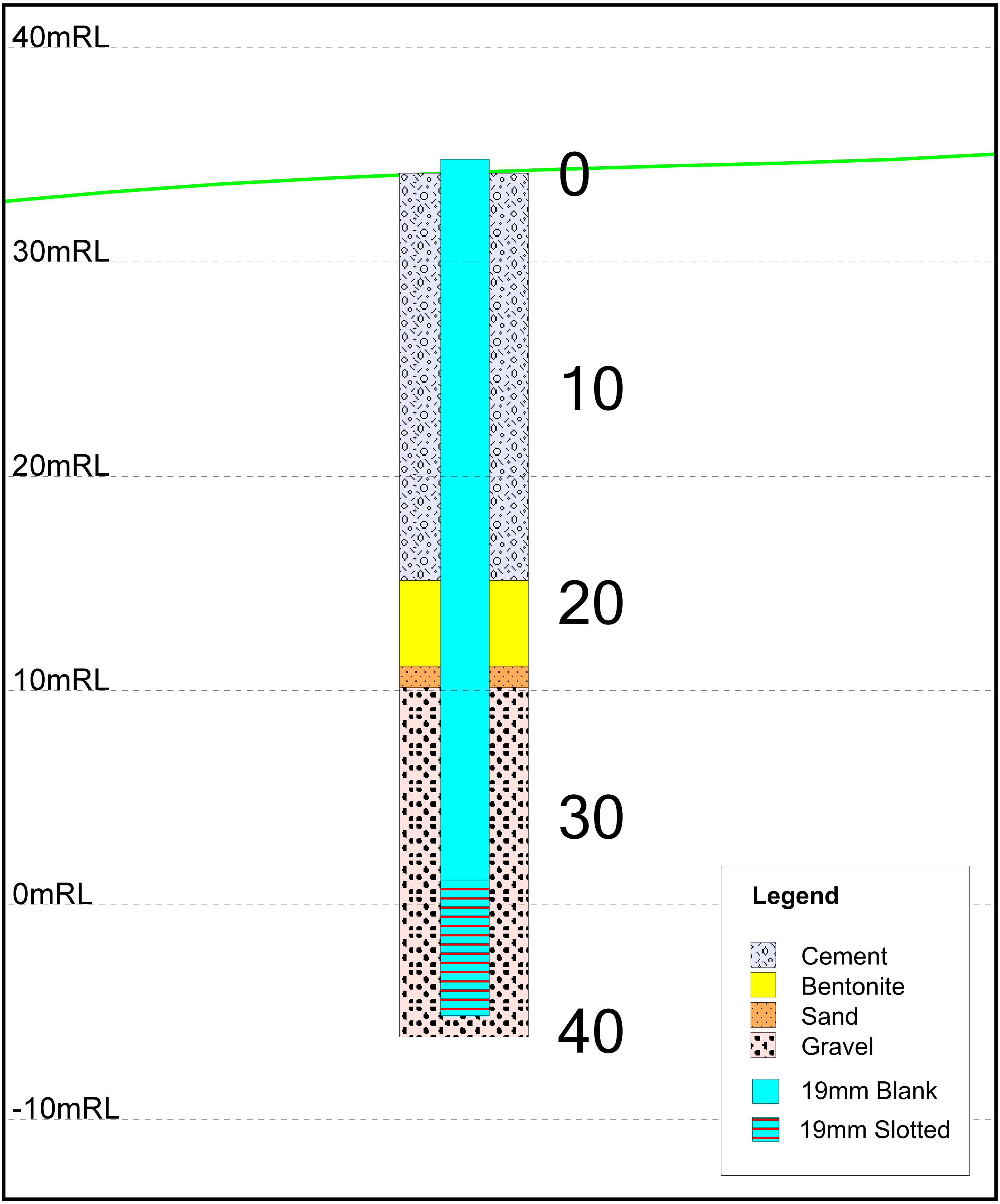
PROJECT NAME Lackagh Quarry		**REPORT NO:**	
CLIENT: Galway County Council		**HOLE NO:**	**BH-05**
ENGINEER: ARUP		**LOGGED BY:**	**Dave Blaney**

Depth of Discontinuity (m BGL)	**Orient.to Short Core Axis**	**Non Intact? (NI)**	**Roughness**										**Aperture**					**Filling**					**Weathering**					**Comments**
			Stepped			**Undulating**			**Planar**			**Other**	**V Open**	**Open**	**Mod Open**	**Tight**	**V Tight**	**Clean**	**Staining**	**% Soil**	**% Mineral**	**Clay**	**X**	**Sl**	**Mod**	**High**	**Comp**	
			R	**Sm**	**St**	**R**	**Sm**	**St**	**R**	**Sm**	**St**		**>10mm**	**2.5-10**	**0.5-2.5**	**0.1-0.5**	**<0.1**											
30.78	10	X							X						X			X					X					
30.90	35	X							X						X			X					X					
31.30	50	X							X						X				X					X				
31.60	70	X							X						X				X					X				
31.90	45	X							X						X			X					X					
32.07	35								X						X			X					X					
32.24	5								X						X			X					X					
32.85	15								X						X			X					X					
32.91	20								X						X			X					X					
33.30	5								X						X			X					X					
33.55	5								X						X			X					X					
33.80	5								X						X			X					X					
33.94	10					X									X			X					X					
34.55	10								X						X			X					X					
34.73	45								X						X			X					X					
34.9 - 37.2	85					X									X				X			X		X				Locally stepped aspect, trace clay coating surfaces, slight Fe staining over top 1.5m
34.90	20								X						X			X					X					
35.00	45	X							X						X			X					X					
35.23	20	X		X											X			X					X					
35.37	10	X							X						X			X					X					
35.54	15	X							X						X			X					X					
35.63	10								X						X			X					X					
35.73	10								X						X			X					X					
36.10	5	X							X						X							X		X				Minor clay, slight Fe Staining
36.40	20	X							X						X			X					X					
36.47	10								X						X			X					X					
36.88	45	X							X						X			X					X					
37.20	30					X									X							X	X					Traces of orange brown clay
38.05	10								X						X			X					X					
37.95 - 40.0	85					X									X							X		X				Minor clay smearing surfaces and localised Fe staining
38.64	10	X							X						X			X					X					
39.64	10	X							X						X			X					X					
39.75	55	X							X						X			X					X					
39.90	65	X							X						X			X					X					

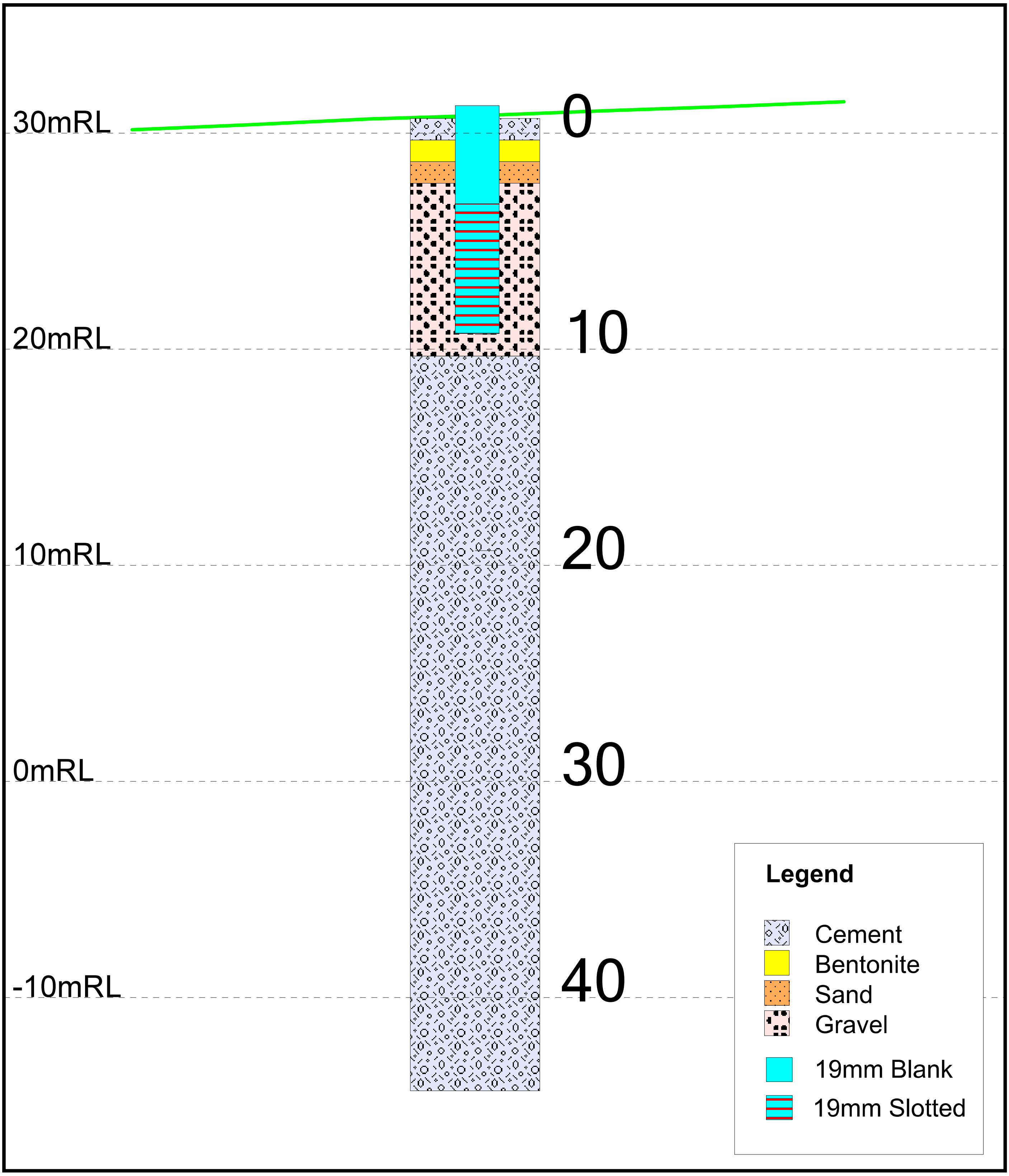
APPENDIX IV



Piezometer Installation BH04



Piezometer Installation BH05



Piezometer Installation BH06

APPENDIX V

R13/16

Report on Geophysical Surveys completed at Lackagh Quarry Co. Galway for Arup

Graham Reid P.Geo.

Project Number:	**R13/16**
Author(s):	Graham Reid P.Geo,
BRG Ltd.	Arup
Date of Report:	January 2016

Private & Confidential

THE DATA PRESENTED IN THIS REPORT WAS ACQUIRED FROM GEOPHYSICAL NON-INVASIVE TECHNIQUES CARRIED OUT AT SURFACE. INTERPRETATIONS ARE DERIVED FROM A COMBINATION OF GROUND CONDITIONS, TYPICAL GEOPHYSICAL RESPONSES AND THE KNOWLEDGE/EXPERIENCE OF THE AUTHOR. BRG LTD HAS COMPILED AND INTERPRETED THE DATA TO BEST INDUSTRY STANDARDS AND WITH ALL REASONABLE SKILL AND DILIGENCE IN RELATION TO THE TECHNIQUES AND RESOURCES APPLIED IN AGREEMENT WITH THE CLIENT. ANY FUTURE USE OF THIS REPORT SHOULD TAKE ITS INTERPRETIVE NATURE INTO CONSIDERATION.

Report Number	Author	Checked By	Version	Date
R13/16	Graham Reid P. Geo	Dave Blaney P. Geo	V1	18/01/2016
Signed				

R13/16

Report on Geophysical Surveys at Lackagh, Co. Galway

Graham Reid, January 2016

Contents

List of Figures

1. Executive Summary

BRG Ltd completed geophysical surveys in an area to the west of the abandoned Lackagh Quarry, Menlo, Co. Galway as part of the Priority Drilling Ltd preliminary site investigation for the proposed new road alignment through this area. The geophysical surveys consisted of 2D Electrical Resistivity Tomography (ERT) and Microgravity across an initial area of roughly 300*30m, subsequently extended to better define the extent of a deep weathering/karst zone.

The surveys were designed to test for subsurface details and bedrock depths in advance of follow up rotary core drilling. Information on potential karst features were of particular interest to the client. The bedrock exposed in the quarry and outcropping to the west consists of strong, thickly bedded Visean limestones dipping gently to the south-west. A thin Tuff band is reputed to control a local aquifer, with more thinly bedded limestones and thin shaley bands developed beneath.

Outcrop to the west of the quarry consists of well-developed limestone pavement extending c,80-100m to the west, which gives way to grass fields across the remainder of the survey area.

Resistivity sections from the 2D ERT and gravity data show a marked contrast from high resistivity bedrock in the east with a sharp contact into very low resistivity zones to the west. The western region has a low gravity response coincident with the low resistivity. The base of the initial ERT lines did not penetrate below 30m in the west suggesting that this area could be a deep overburden/weathered zone, possibly a karst filled sinkhole or more shaley unit.

The work was completed over three separate periods:

- 6 day period from 27th October to 3rd November 2015.
- 1 day, 25th November
- 3 days, 13-15th January

2. Introduction

BRG was hired by Priority drilling Ltd. to acquire 2D ERT and microgravity data along a planned potential route for the new Galway ring road located to the west of Lackagh Quarry.

The Quarry is located to the north of Galway city with easy access off the Coolagh Road. The quarry is abandoned and fenced off and site access was organised through Sean Ross of Arup. The work was completed mainly across fields and limestone pavement to the west of the quarry and outside the quarry footprint. A rough track running from inside the quarry bounds allowing access into the fields. Loose cattle including a bull were running free within the fields and surrounding scrub, however these were fenced out of the fields when ERT lines were being acquired. A minor microgravity grid was also added on the first bench within the quarry over the area where the proposed horizontal borehole was drilled.

Figure 1: Aerial Photograph Site Location Map

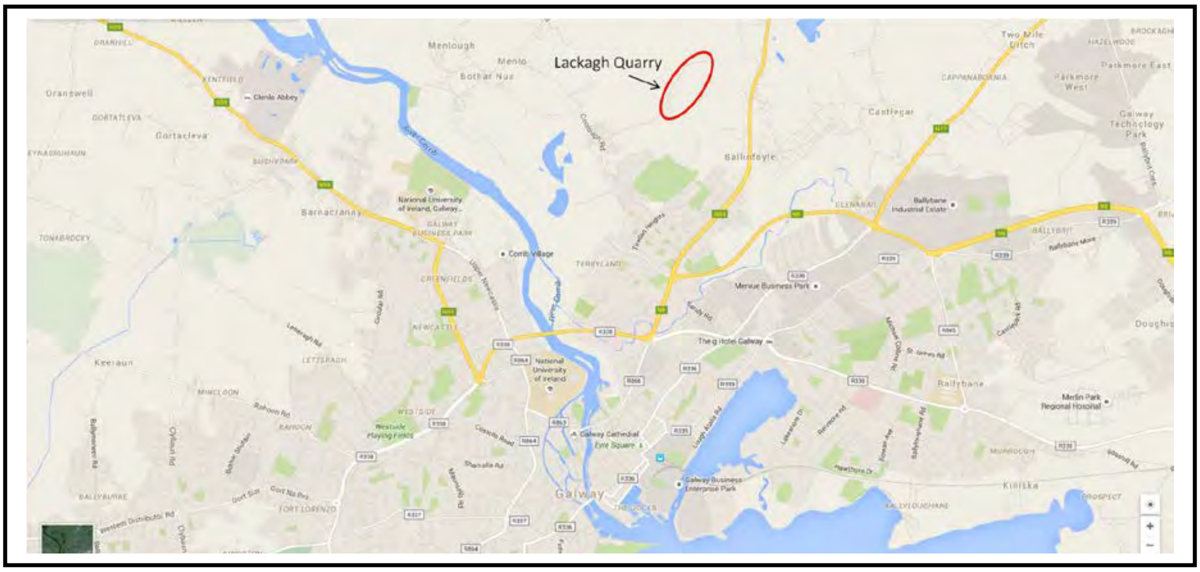


Figure 2: Location Map

2.1 Survey Objectives

1) Acquire 2D Resistivity and Microgravity data across the specified region within and proximal to the Lackagh Quarry site.

2) Generate Maps and sections showing the geophysical characteristics of the site and generate interpretative maps and sections of the overburden/bedrock model over the chosen areas.

3) Outline potential areas for future intrusive investigations (in particular to assist with locating follow up rotary drilling)

3. Geological setting

The mapped geology from the Geological Survey of Ireland (1:100,000) shows the site to be underlain by undifferentiated Visean limestones / shaley limestones. The rocks are well exposed within the quarry and to the west as outcropping weathered limestone pavement. These limestones are massive, thickly bedded micritic / grainstone units, generally strong and dipping to the southwest. Overburden appears to be mostly clay and gravels and most likely glacially derived soils (the site walk over noted rounded granite boulders scattered across the limestone pavement, these are probably glacial erratics). A pronounced Tuff band clearly exposed in the quarry underlies the massive limestones and is thought to control a local aquifer. It also appears to host minor sulphides (pyrite) with iron staining developed on the surface of the underlying, slightly argillaceous, limestones.

4. Survey Equipment and methodology

The geophysical surveys were chosen to provide detailed overburden/bedrock profiles along the chosen lines (ERT) and to identify any significant anomalous zones that could be a result of faults/fractures or karst development (ERT and Microgravity).

The depth mapping potential with the ERT is limited by the length of each spread so that individual spreads were capable of surveying to from 22m b.g.l. in Line 5 to a maximum of 60m b.g.l. with Line 6. Equipment consisted of an Allied Associates Tigre system which has the potential for up to 128 electrode takeouts. 2m station spacing was initially used to get the required detail along the chosen lines, with 3m intervals on the long lines (6, 7 & 8). Data was measured using a Wenner array, controlled by an Imager2006 programme with a laptop computer. Saved data was inverted using the Geotomo Res2Dinv programme and exported as an image file displaying a cross section of the inverted Resistivities with elevation data. The resultant resistivity sections were subsequently interpreted and an interpreted geological model developed.

Microgravity data was acquired with measured sites along the centre line and 15m either side of the proposed tunnel section. These lines were measured with nominal station spacing of 10m, with gaps where scrub hawthorn was too thick. Extra stations were measured within the quarry on the first bench at 5-10m intervals. Measurement was taken using a Lacoste & Romberg model G gravity meter. Instrument drift was monitored by returning to a locally established base station at hourly intervals.

Stations were topographically surveyed using a Trimble GeoExplorer 6000 RTK GPS system corrected through phone modem link for both the ERT and the gravity surveys. The drift corrected gravity data was corrected for elevation, latitude, and reduced to Bouguer 2.67g/cm^3 to allow for local average rock densities. It was then gridded and exported for display and interpretation in the MapInfo GIS system.

All points were surveyed in Irish Transverse Mercator (ITM) projection.

5. Discussion of Results (Figures 3-16)

The 2D ERT data defines a marked contrast between the resistive massive limestones to the east and exposed within the quarry and a narrow, deep, conductive response that was detected to the west. This contact is clearly seen on lines 1 (at station 114) & 2 (station 134) where it is shown as steep westerly dipping feature. Lines 3 & 4 are almost entirely mapping the lower resistivity unit which is greater than 14m deep. This conductive zone could represent a combination of thicker overburden and underlying weathered bedrock. Line 5 was surveyed entirely on the edge of the

outcropping limestone pavement and displays a thin conductive overburden layer over resistive bedrock.

Line 6 was extended N-S perpendicular to the long axis of the fields with the aim of mapping the edges of the deep overburden feature – this line was surveyed while BH3 was still in progress, with the inversion model shows the hole located within a significant deep overburden (low resistivity) feature. The southern contact of the deep overburden feature is mapped as being sub-vertical with the overburden depth increasing from <1.0m to >55.0m within a few meters. The northern side of the deep overburden feature exhibits a steeped nature with a rapid shallowing at station 210 to a depth of c.35m bgl, and the northern edge seen at station 275 where the overburden depth shallows rapidly.

Lines 7 & 8 were surveyed along similar locations to 2 & 1 respectively; however they were surveyed at 3m electrode spacing and extended to the west. Line 7 exhibits a strange higher resistivity shallow zone to the west of station 96 with lower resistivity below – this most likely reflects the line location proximal to the southern contact of the deep overburden feature resulting in the inversion model displaying some “edge” effects.

Lines 9 & 10 were also designed to map the edges of the deep overburden feature, and this has been successfully achieved along the southern contact and only partially successful in the north (where thick hawthorn bush in an environmentally sensitive area restricted access to extend the lines). These lines were surveyed using a 2m electrode spacing.

The microgravity data shows the same general scenario as the resistivity data. Higher density and more coherent limestones in the east give way to a lower density zone to the west with an irregular sinuous contact between the two. Measurements on the bench within the quarry give the same relatively high density limestone situation as seen at the area underlain by limestone pavement. However, the lower gravity readings located in zones along the edges of the quarry faces are interpreted as the effect of terrain factors

The geophysical interpretation (Figure 16) is derived from a combination of both the Microgravity and 2D ERT methods. This outlines the contact zone at about 530,130E between shallow limestones to the east and deeper overburden/weathered zone to the west. The original ERT lines and microgravity provided limited definition of the contact zones and these have been refined by the extended 3m interval lines. The rotary drilling has shown that the ERT models correlate well with the underlying geology. The mapped low resistivity zone closely follows the field outline. Completed drillholes have been located on the model sections, with those annotated as “offset”

projected from up to 10m away onto the sections (N.B. there is some slight discrepancy between the plotted holes and the modelled section inversion as the holes have been extrapolated from up to 10m off line)

The unusual nature of these grass fields and where they sit within the surrounding limestone pavement would also support the possibility that they reflect the surface expression of an infilled topographic feature such as a slot canyon.

ERT Line Locations

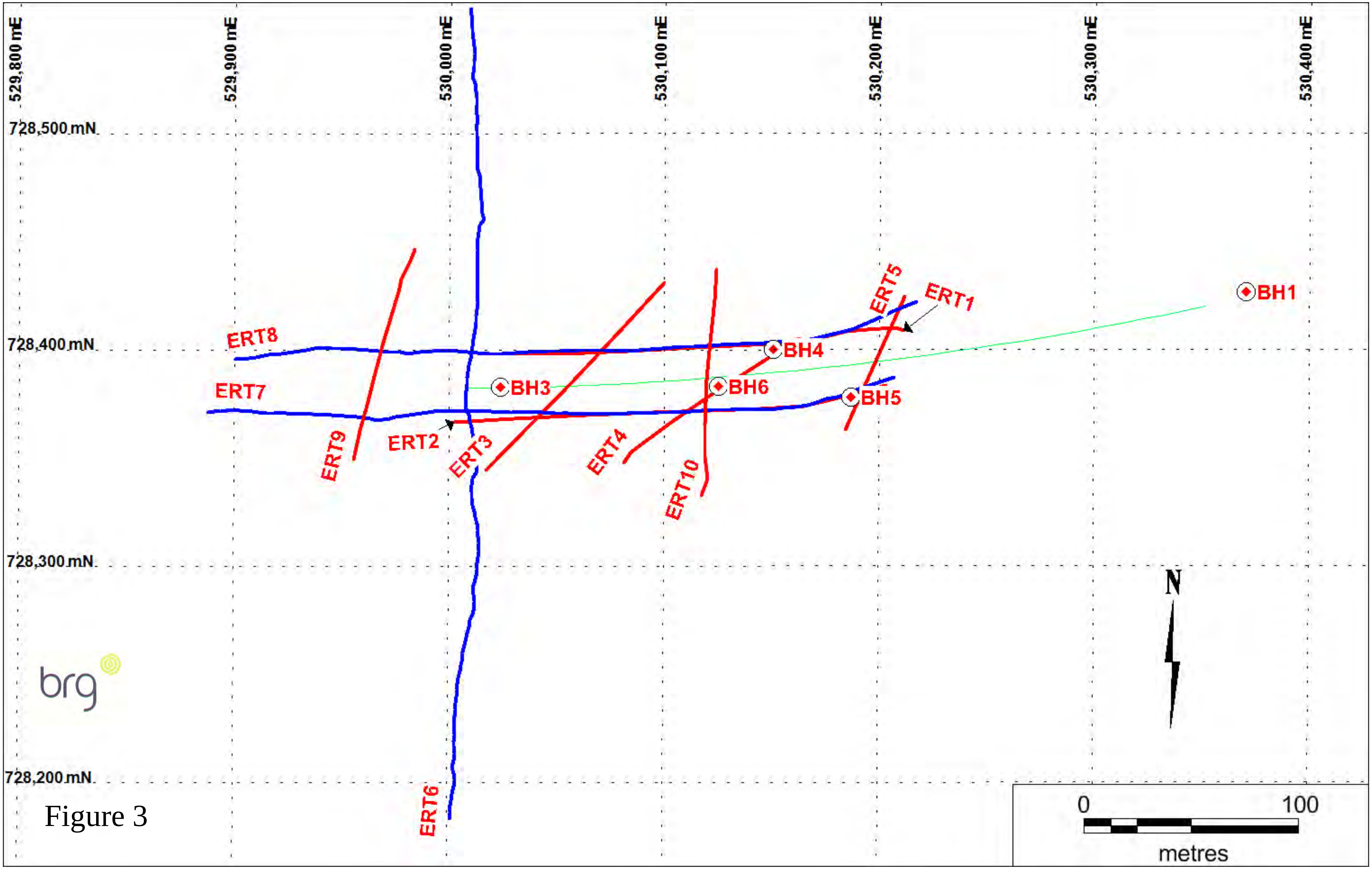


Figure 3

Resistivity – ERT Line 1

West

2m Electrode Takeouts

East

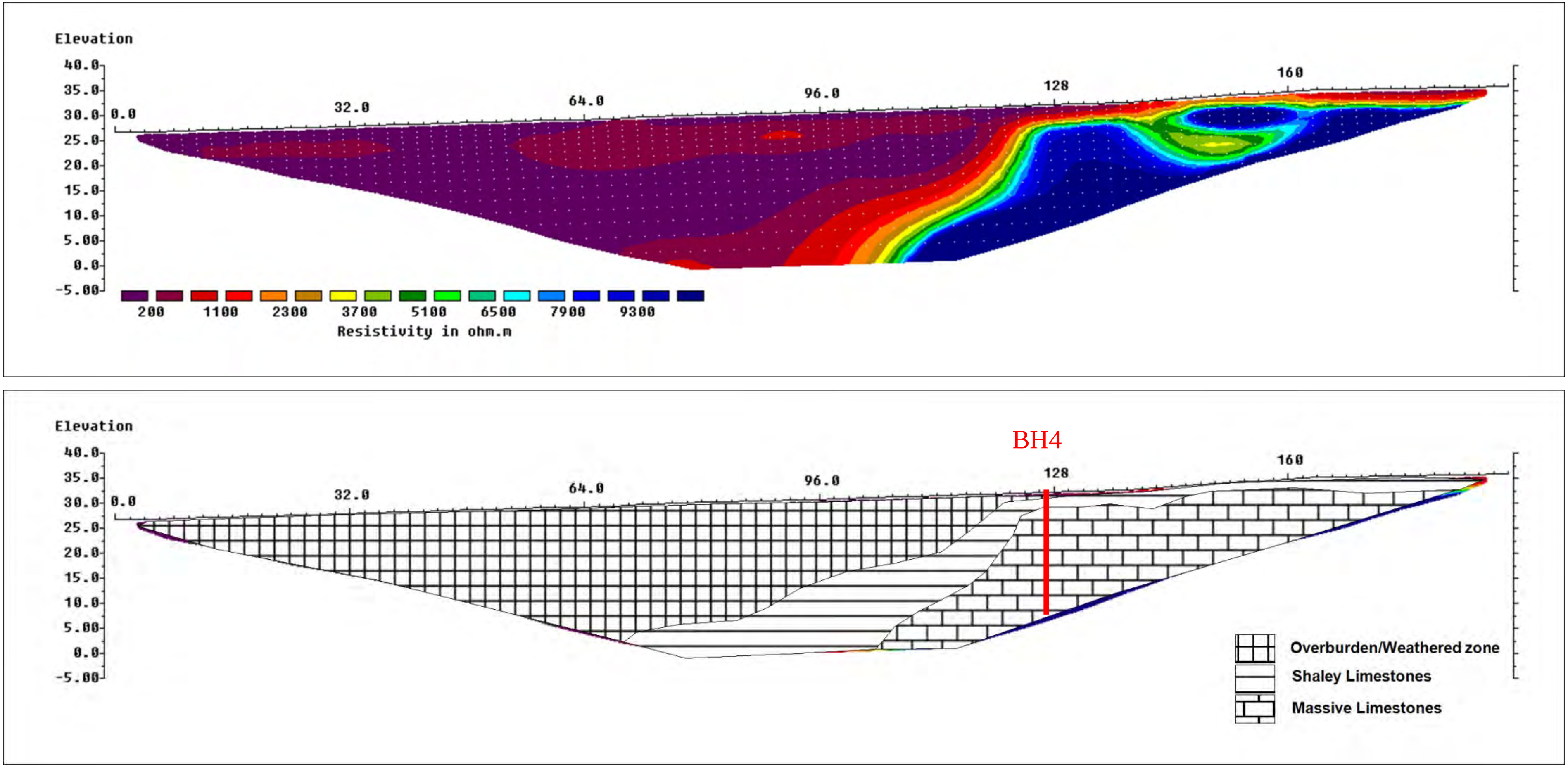


Figure 4

Resistivity – ERT Line 2

West

2m Electrode Takeouts

East

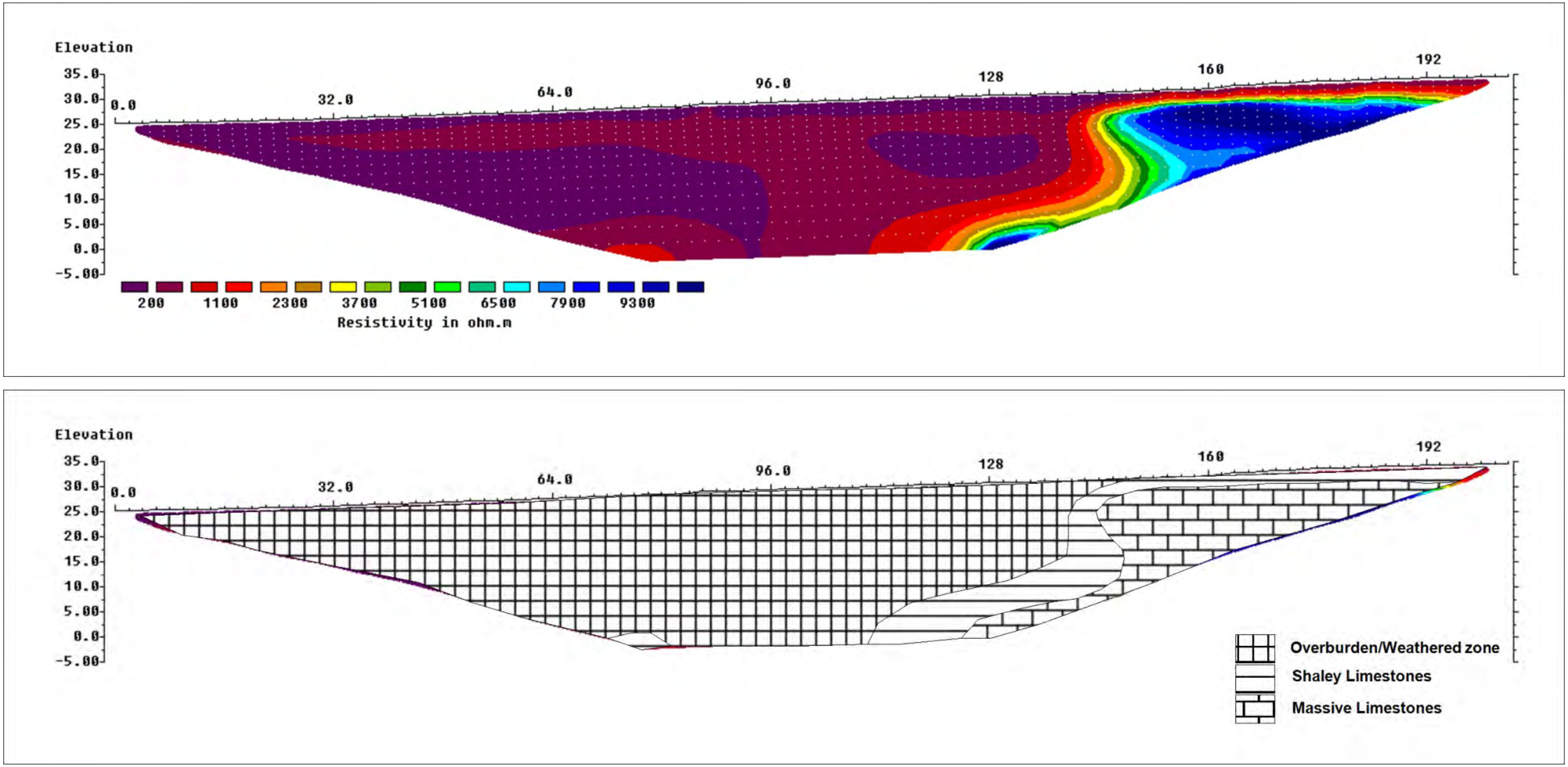


Figure 5

Resistivity – ERT Line 3

2m Electrode Takeouts

SW

NE

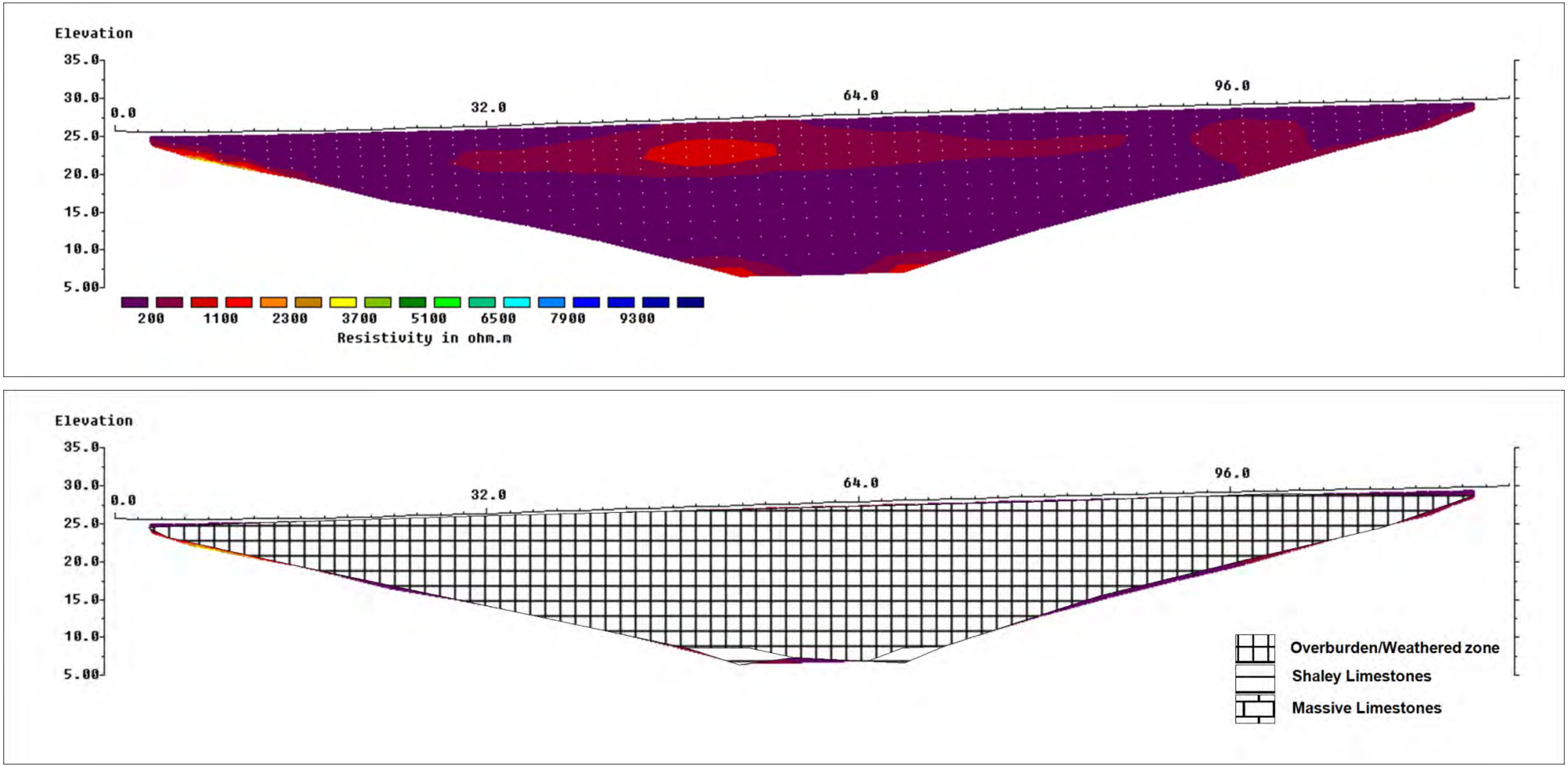


Figure 6

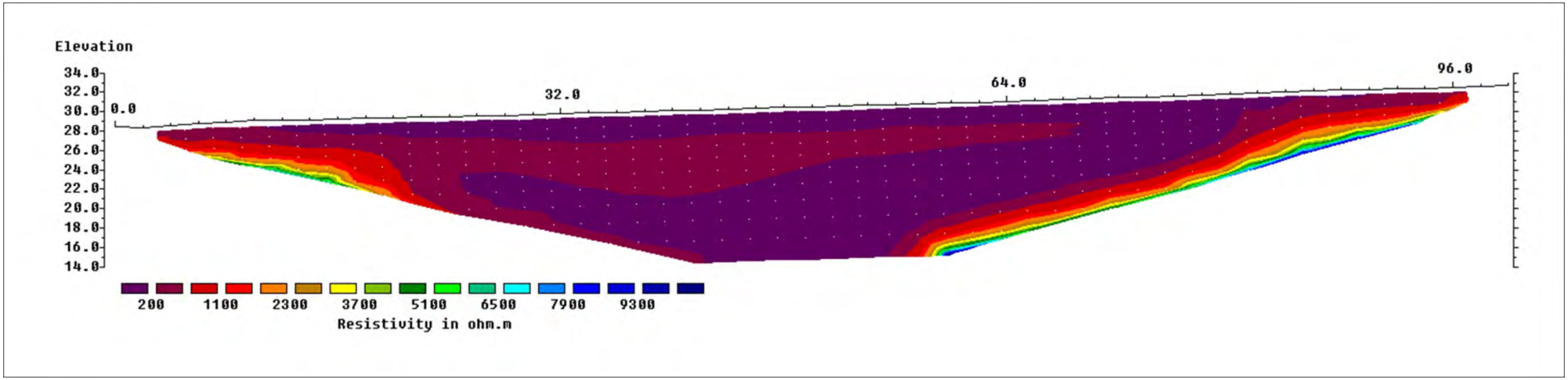
brg

Resistivity – ERT Line 4

2m Electrode Takeouts

SW

NE



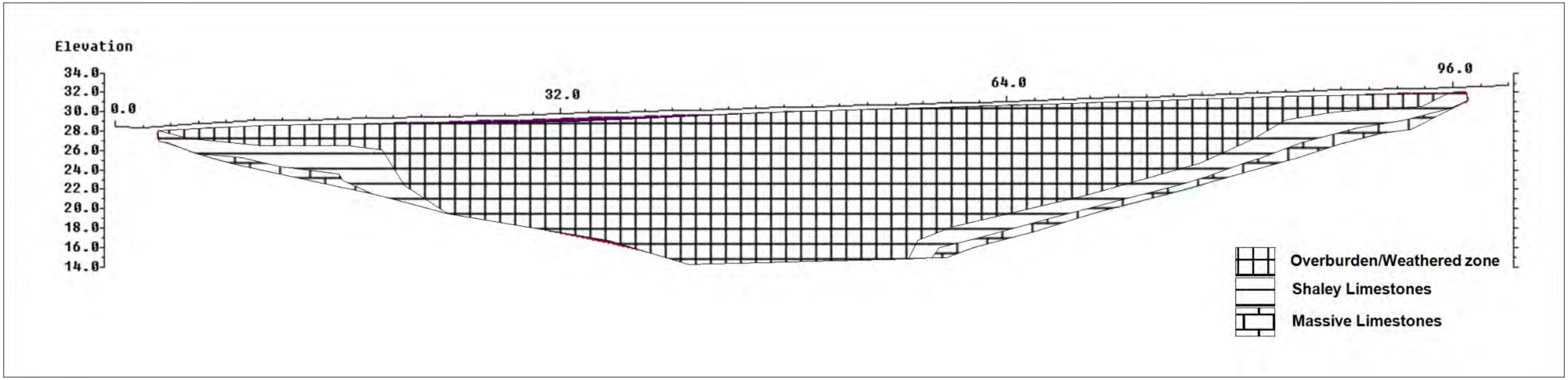


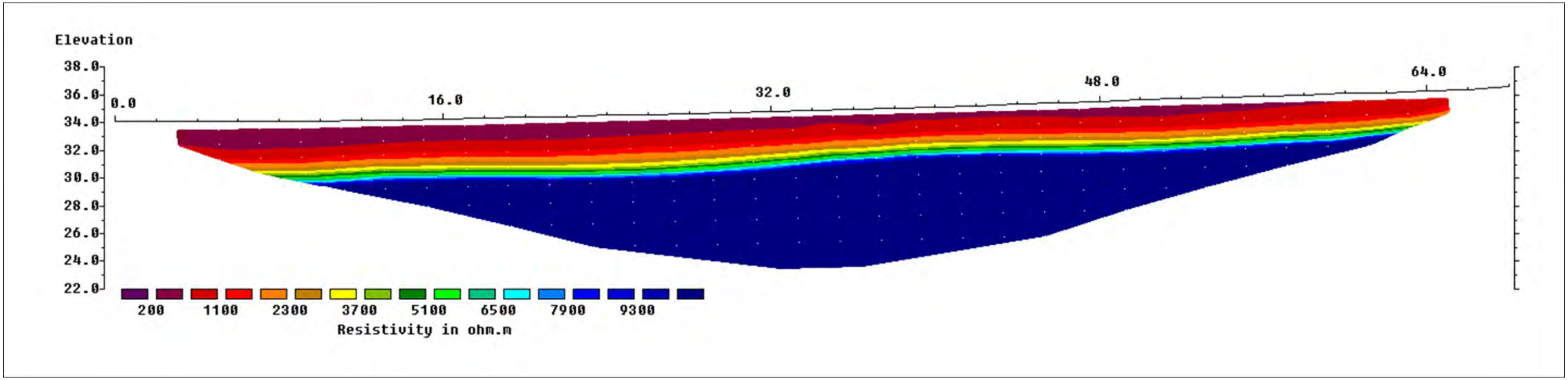
Figure 7

Resistivity – ERT Line 5

2m Electrode Takeouts

SW

NE



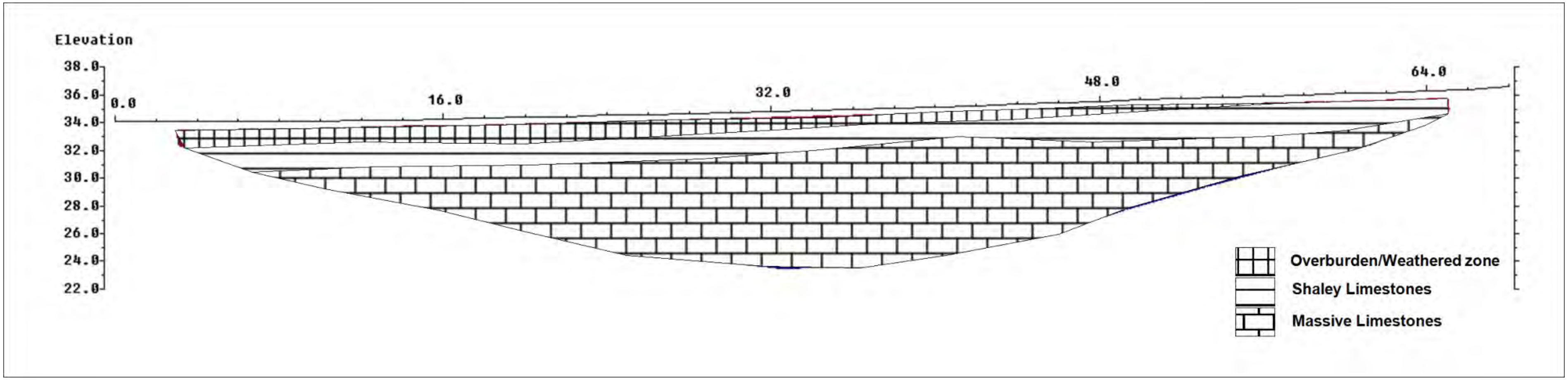


Figure 8

Resistivity – ERT Line 6

3m Electrode Takeouts

S N

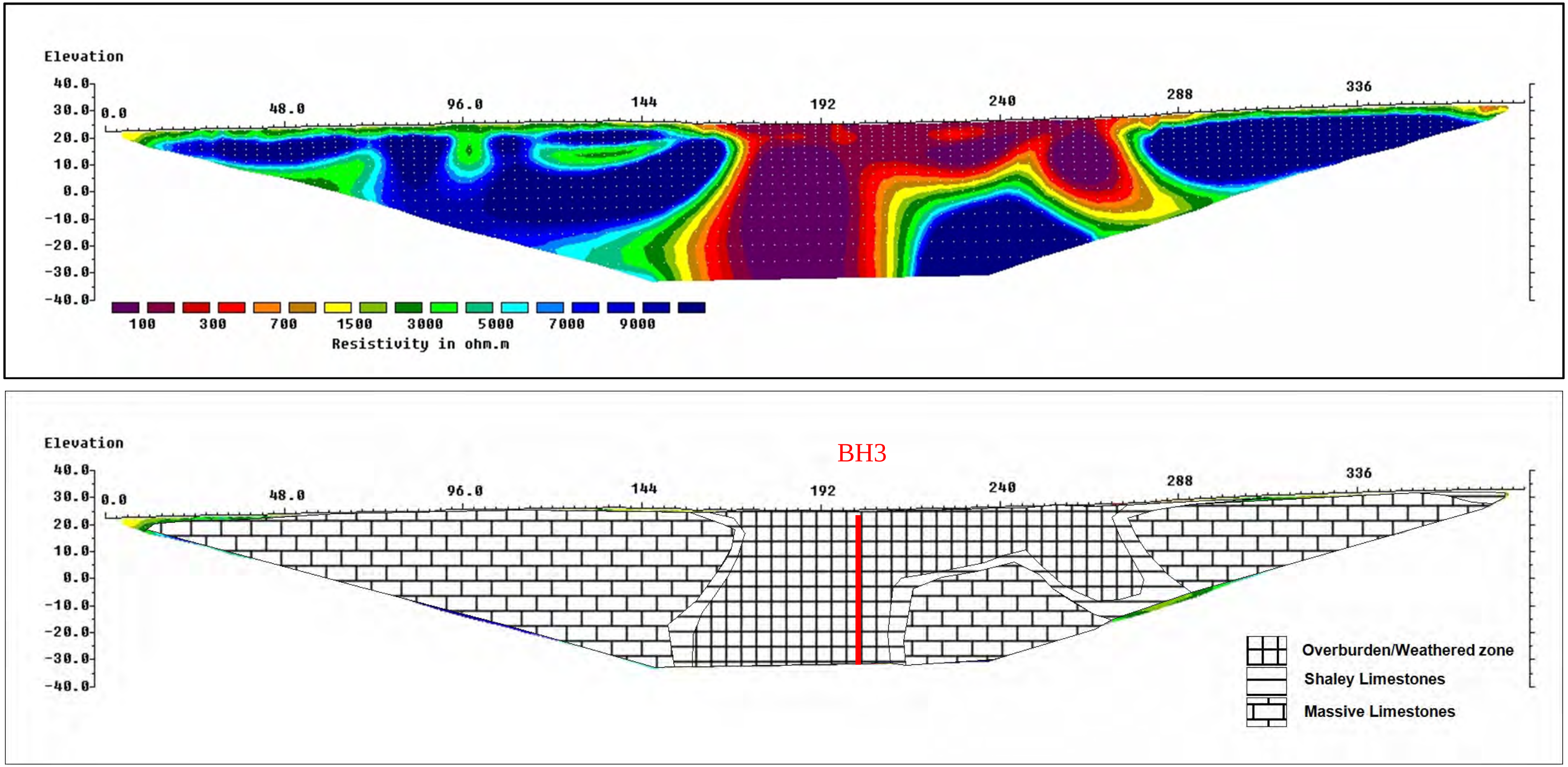


Figure 9

Resistivity – ERT Line 7

3m Electrode Takeouts

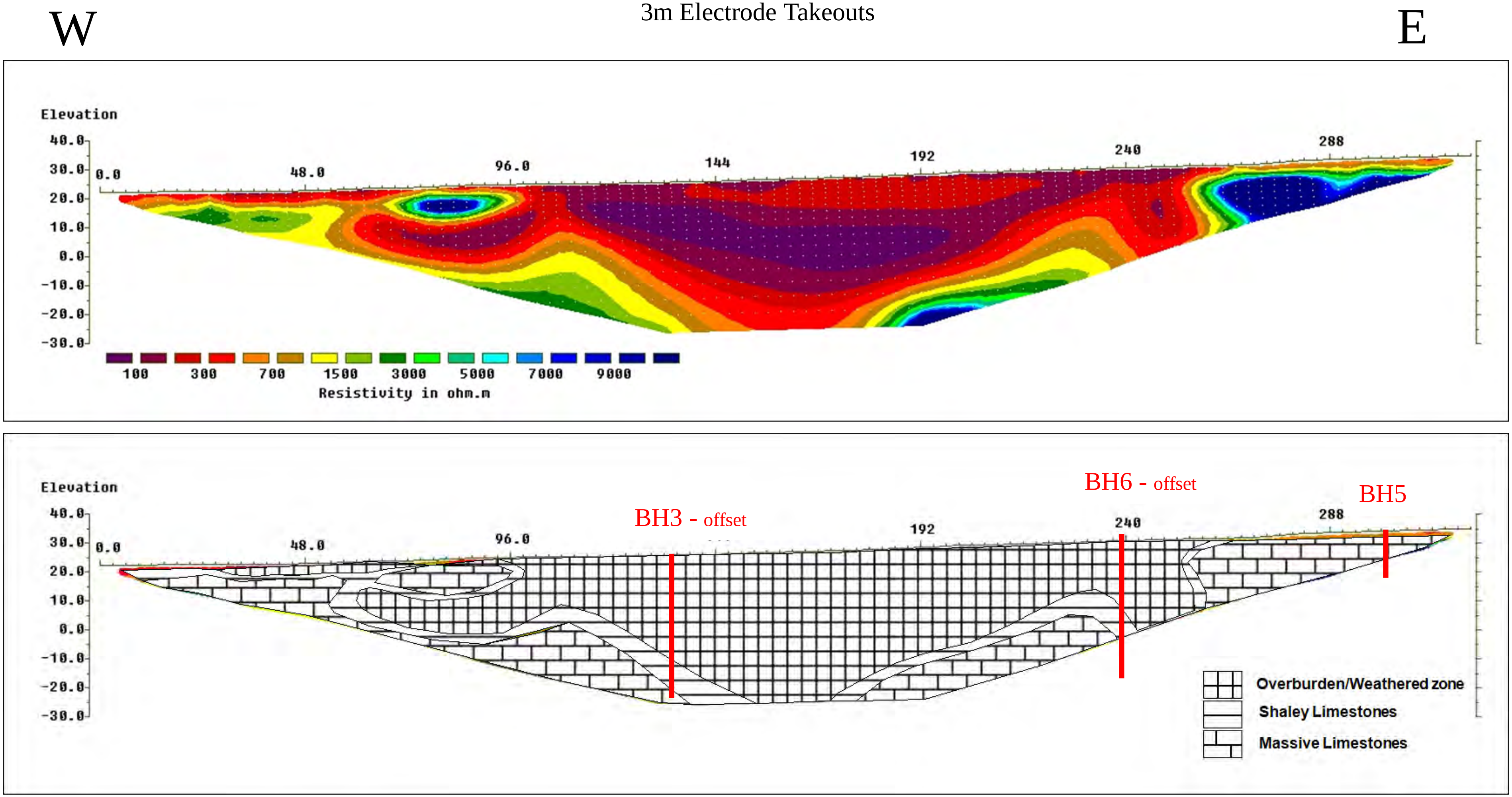
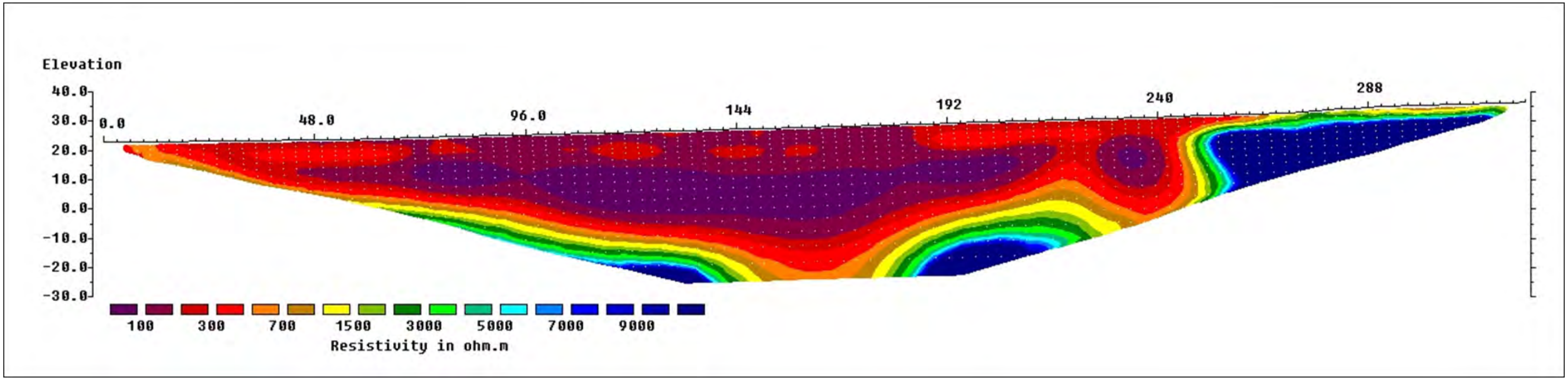


Figure 10

Resistivity – ERT Line 8

3m Electrode Takeouts

W E



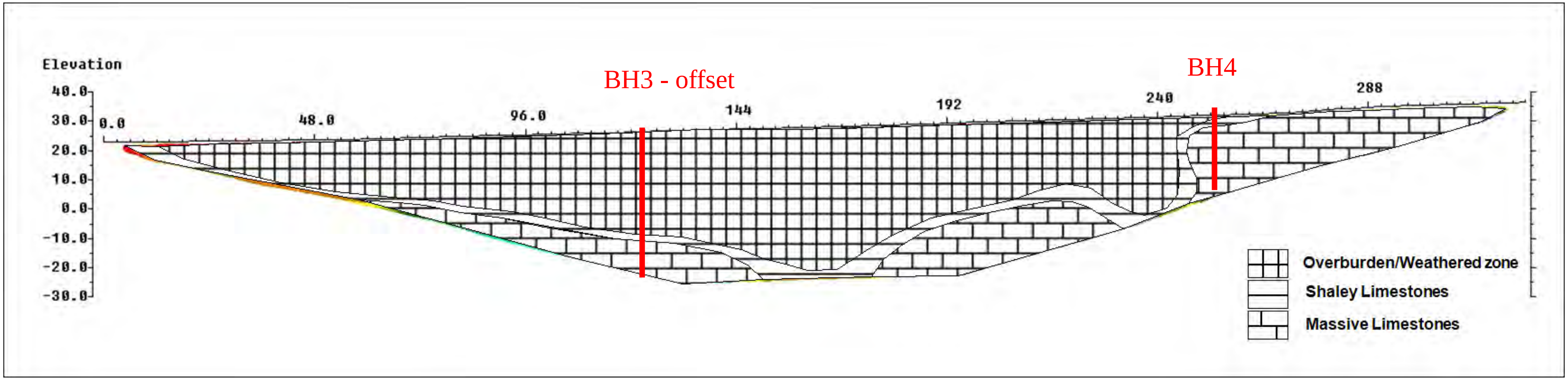


Figure 11

Resistivity – ERT Line 9

2m Electrode Takeouts

S N

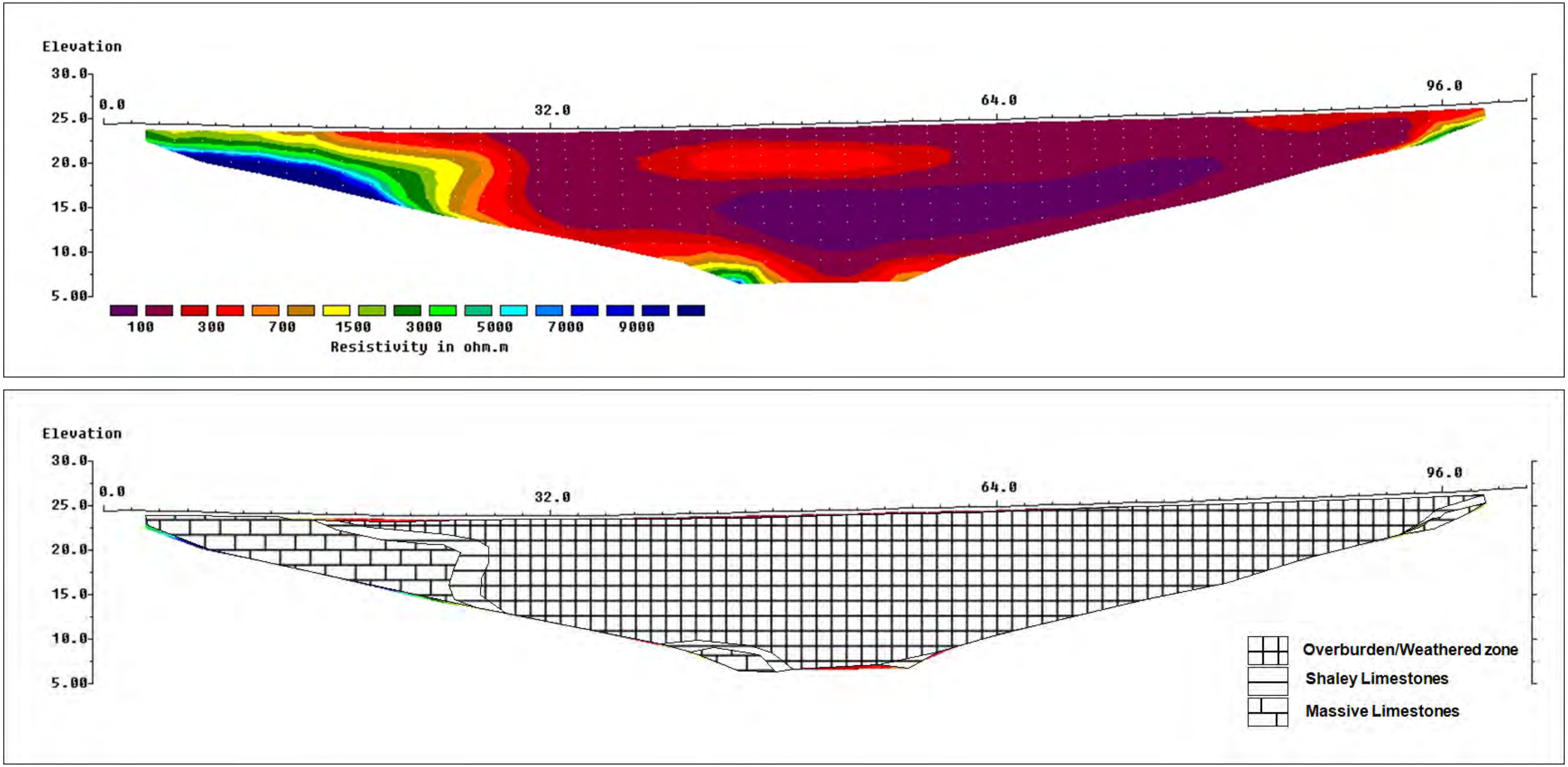


Figure 12

Resistivity – ERT Line 10

2m Electrode Takeouts

S

N

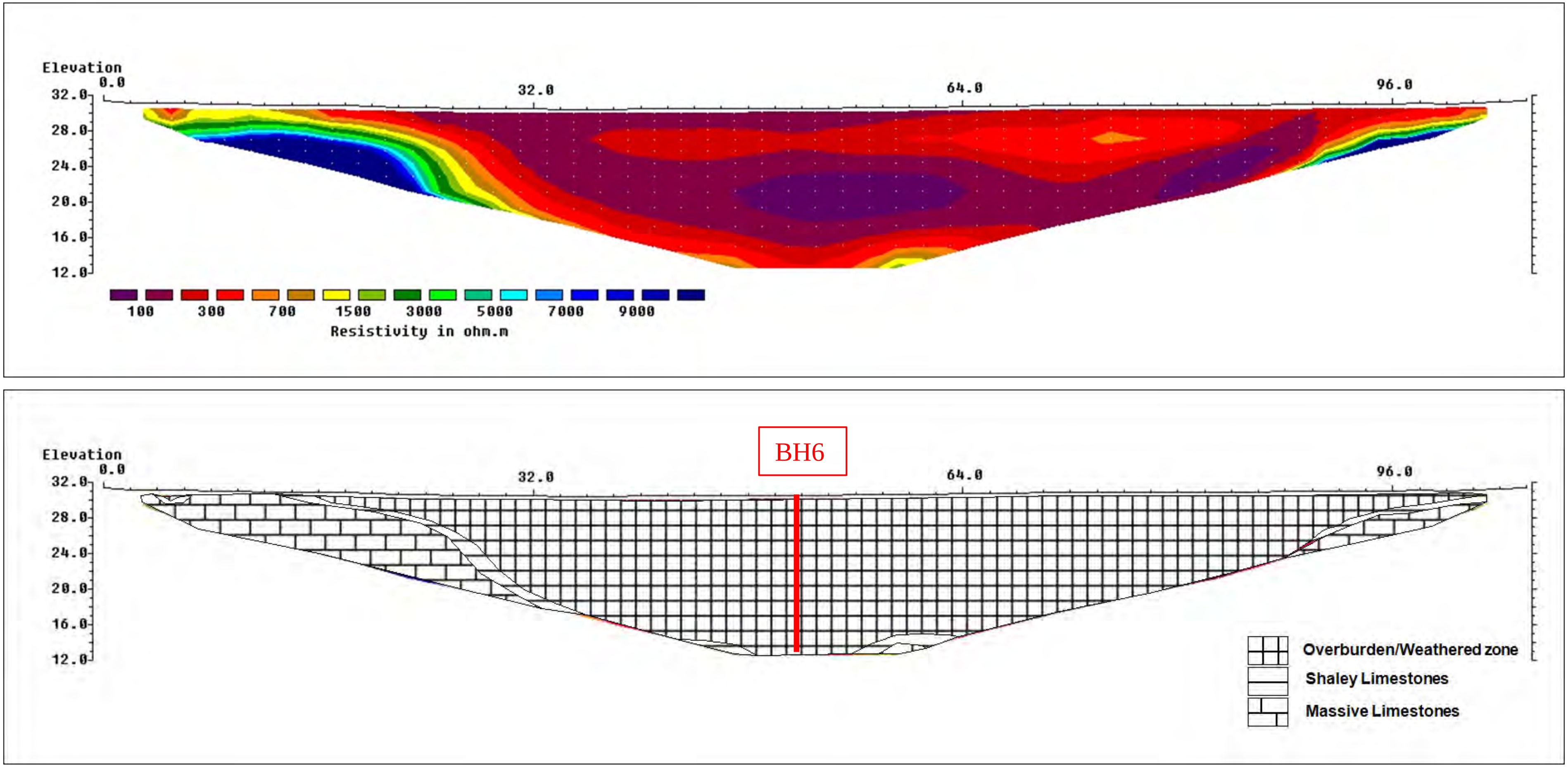


Figure 13

Microgravity Station Location Map

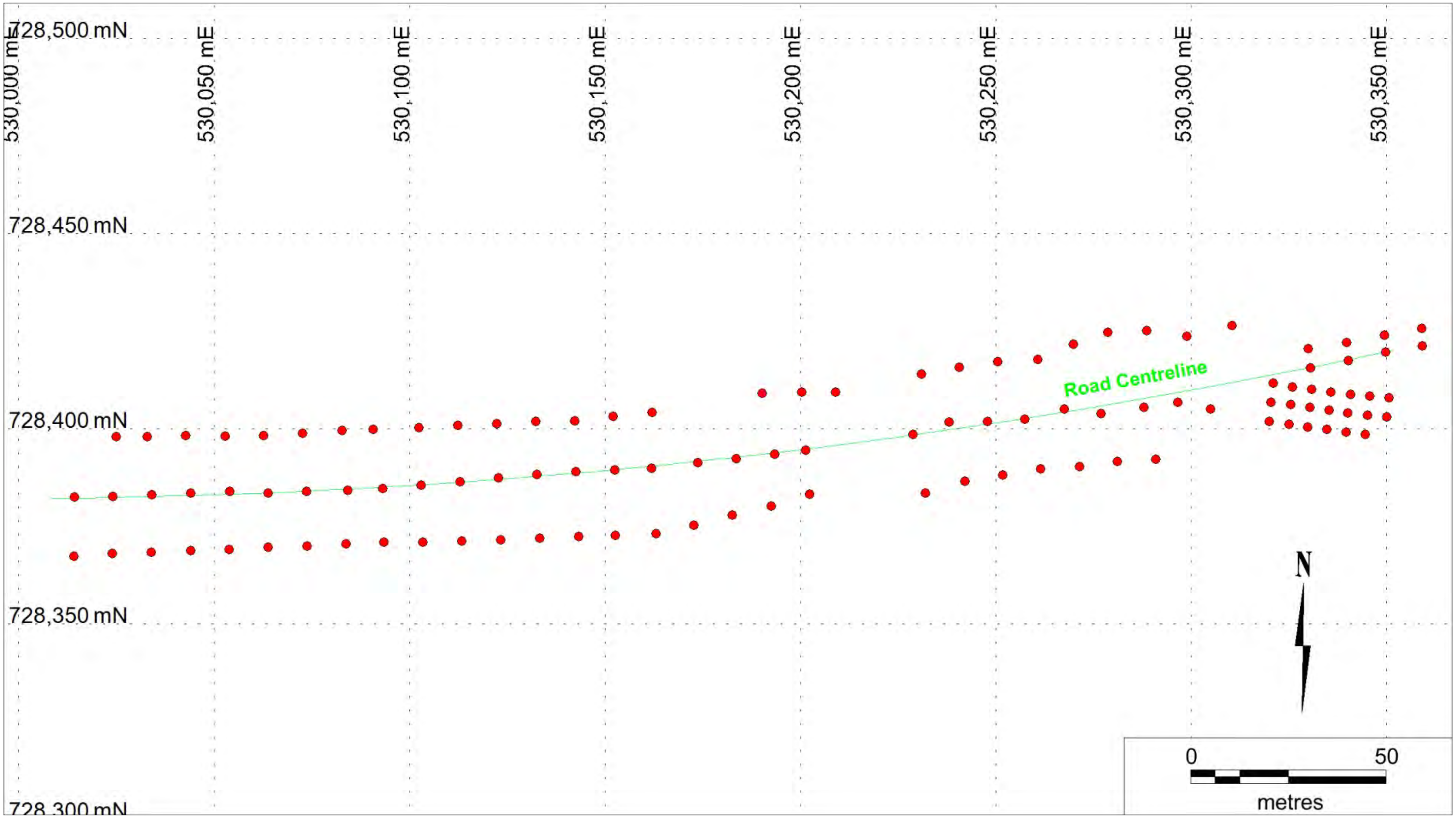


Figure 14

Microgravity Bouguer Gravity Map

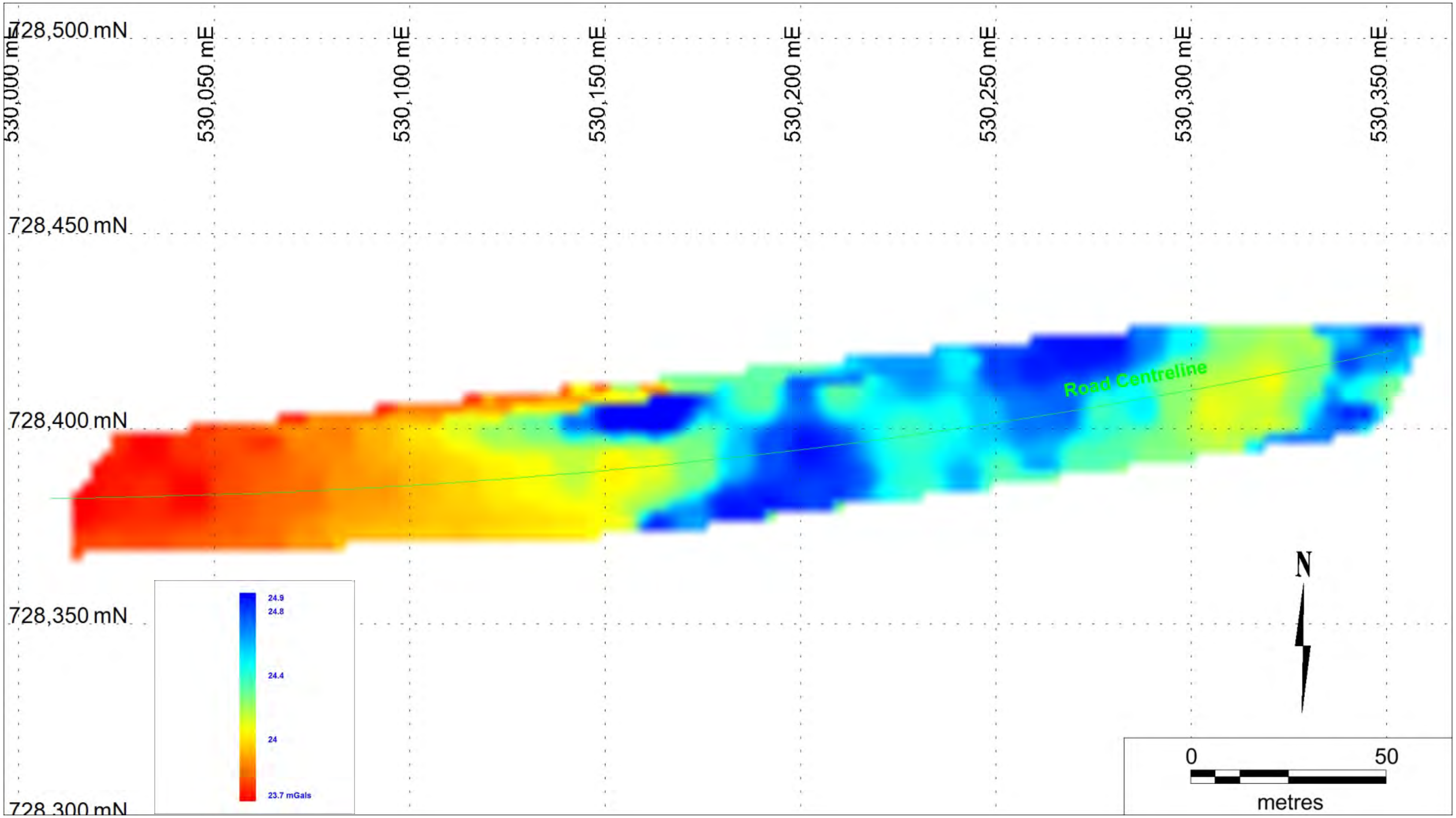


Figure 15

Geophysical Interpretation Map

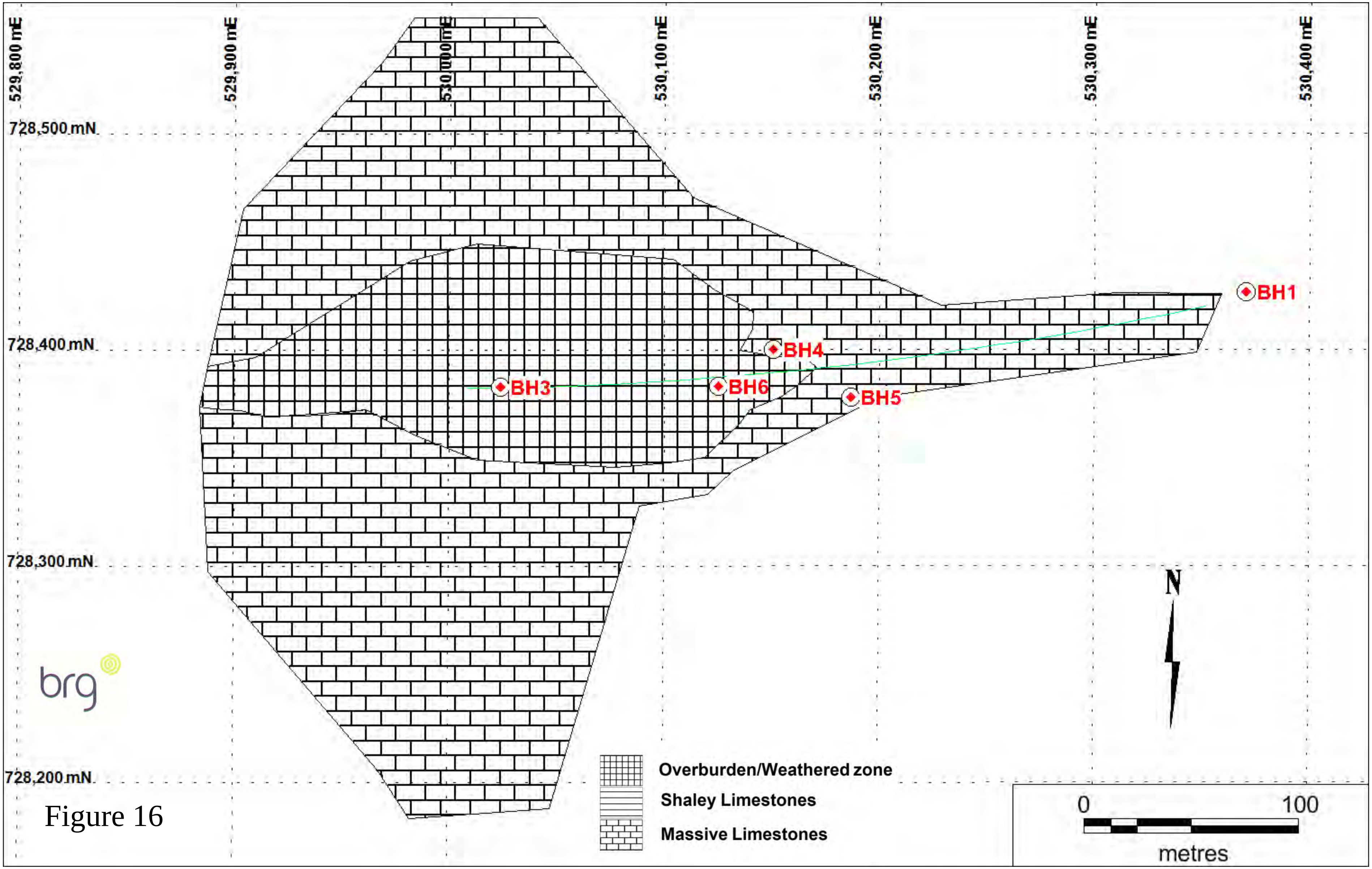


Figure 16

APPENDIX VI

EUROPEAN GEOPHYSICAL SERVICES

REPORT ON THE

GEOPHYSICAL LOGGING

OF TWO BOREHOLES

AT

LACKAGH QUARRY

Prepared For:

Priority Drilling Ltd.
Killimor, Ballinasloe,
Co. Galway, Ireland

PRIORITY DRILLING

JAN 2016/PRIO1502_ rpt/IRL

	Name	Date
Logged by:	Rhys Powell	8/9.12.15
Report by:	Rhys Powell	4.1.16
Checked by:	James Whitford	6.1.15

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CONTENTS

LIST OF FIGURES

1.0 INTRODUCTION

At the request of Priority Drilling Ltd., borehole imaging and geophysical logging was carried out in two boreholes at Lackagh Quarry, Co. Galway, Ireland.

The work was carried out by European Geophysical Services on the 8th and 9th of December 2015.

The following logs were run:-

BH	Logs	From (m)	To (m)
4	Optical Imager, Acoustic Imager	3.1	34.0
4	Fluid Temperature and Conductivity, Natural Gamma, Caliper	3.1	34.2
4	Impeller Flowmeter	16.0	33.7
4	Focused Resistivity	15.5	34.0
4	Full Wave Sonic	15.5	34.0
4	Pumped Temperature and Conductivity	18.8	34.2

BH	Logs	From (m)	To (m)
5	Optical Imager, Acoustic Imager	1.0	39.9
5	Fluid Temperature and Conductivity, Natural Gamma, Caliper	1.0	40.0
5	Impeller Flowmeter	17.6	40.0
5	Focused Resistivity	17.6	40.0
5	Full Wave Sonic	17.6	40.0
5	Pumped Temperature and Conductivity	24.1	40.0

2.0 THE GEOPHYSICAL LOGGING METHODS

The Equipment and Field Procedure

A fully digital logging system with a 600m capacity motorised winch mounted in a Land Rover was used.

All logging data was recorded digitally for reprocessing and archiving purposes.

With the exception of the fluid logs, all logs were run from the bottom of the boreholes upward.

The optical imager survey was carried out first to avoid the disturbance of the fluid by the geophysical logs which may affect water clarity.

Fluid Temperature (T)

There is a natural geothermal gradient of increasing temperature with depth. This gradient varies with the thermal conductivity of the geological formation and is modified by water flowing in, out or vertically though the borehole.

This log is used to determine any flow pattern within the borehole and to identify flow zones.

Differential logs are produced over a one metre spacing, these are an interpretative aid to detect gradient changes.

Fluid Conductivity (EC or EC25)

The electrical conductivity (EC) of the water is related to its salinity and dissolved solids and is therefore a measure of the quality of the borehole water. The shape of the log trace can indicate zones of inflow.

Using data from the temperature log the electrical conductivity is corrected to 25°C (EC25).

This log is used to identify different zones of water quality.

Differential logs are produced over a one metre spacing, these are an interpretative aid to detect gradient changes.

2.0 THE GEOPHYSICAL LOGGING METHODS

Optical Borehole Imager (Optical)

A precision-machined prism and CCD camera assembly permits a high definition video image of the borehole wall to be captured in a variety of horizontal and vertical resolutions. The resulting image is digitised in the sonde for transmission to the surface acquisition system.

The image is then orientated to Magnetic North and displayed as an unwrapped image log. This enables a detailed structural interpretation to be made if required.

For the best results the optical imager should be run above the water level or in clean, clear fluid. The logging tool is centralised during data acquisition by two sets of bow springs. The bow springs are adjusted to a variety of borehole diameters prior to acquisition. The image is recorded on the way down the borehole to limit disturbance to the clarity of the water in the borehole by the logging tool.

Images and associated data are viewed in real time during the data acquisition.

The orientation system employs a flux gate magnetometer and therefore the recorded data within approximately one metre of magnetic steel casing is un-orientated. This is corrected manually during the post-processing stage

Acoustic Borehole Imager (Amplitude and Travel Time)

This tool scans the borehole wall through 360 degrees and records the acoustic reflection of the resulting signal in terms of amplitude and transit time (the travel time from the tool to the borehole wall). This technique requires a fluid filled borehole with a minimum of suspended solids, polymers or muds within the fluid column.

This sensitive technique responds to small diameter changes, rugosity and the acoustic nature of the borehole wall. It is primarily used for detecting fractures and other discontinuities. The resultant images are orientated (to magnetic North) 0° through 90°, 180° and 270° back to 0°.
The logging tool is centralised during data acquisition by two sets of bow springs. The bow springs are adjusted to a variety of borehole diameters prior to acquisition. The image is viewed on the way down the borehole to allow fine tuning of the acquisition parameters. The settings are then adjusted and the image recorded on the way up the borehole which ensures a constant line speed during acquisition.

Images and associated data are viewed in real time during the data acquisition.

The orientation system employs a flux gate magnetometer and therefore the recorded data within approximately one metre of magnetic steel casing is un-orientated. This is corrected manually during the post-processing stage

2.0 THE GEOPHYSICAL LOGGING METHODS

Impeller Flowmeter (FV)

This log is used to determine any flow pattern within the borehole and identify flow zones. The tool uses an impeller and is normally run at a constant logging speed against the anticipated flow for the best response. The data is corrected for logging speed and a fluid velocity (FV) log is produced.

Caliper (Cal)

This tool measures the mean diameter of the borehole. It is used to check the integrity of the borehole lining, and where the borehole is unlined to identify zones of washout, breakout or fissures.

Natural Gamma (Gam)

The tool measures the naturally occurring gamma radiation found in rocks and sediments. It is mainly used to detect the clays that contain potassium K^{40}, though the U^{238} series of elements and the Th^{232} series of elements also emit gamma radiation.

The higher the concentration of these clay minerals the greater the responses on the natural gamma log.

Focused Resistivity Log (Res Deep and Res Shallow)

The Focused Resistivity tool uses Guard Electrodes to focus the current into the formation. This gives excellent vertical resolution and good penetration, especially in highly conductive borehole fluids where a Normal Resistivity Sonde would not be as effective.

The tool has two electrode spacing’s to allow a deep and shallow depth of investigation.

The response of this log is a function of porosity, type of formation / mineralogy and its pore water quality. These logs aid in the identification of strata and quality of the pore water.

2.0 THE GEOPHYSICAL LOGGING METHODS

Full Wave Sonic (VDL)

This tool has been specially designed to provide a full wave form recording of sonic signals and uses fixed spaced transmitter – receivers.
The received signals are digitised at a fast sampling rate with high resolution. Data may be sampled at typically 5cm or 10cm intervals dependant upon resolution required.

The data is processed for P wave velocity (or transit time) and amplitude.

This tool can only be used in fluid filled unlined boreholes.

3.0 SITE DETAILS

Site:
Lackagh Quarry

Irish Grid Ref: M 30240 28372

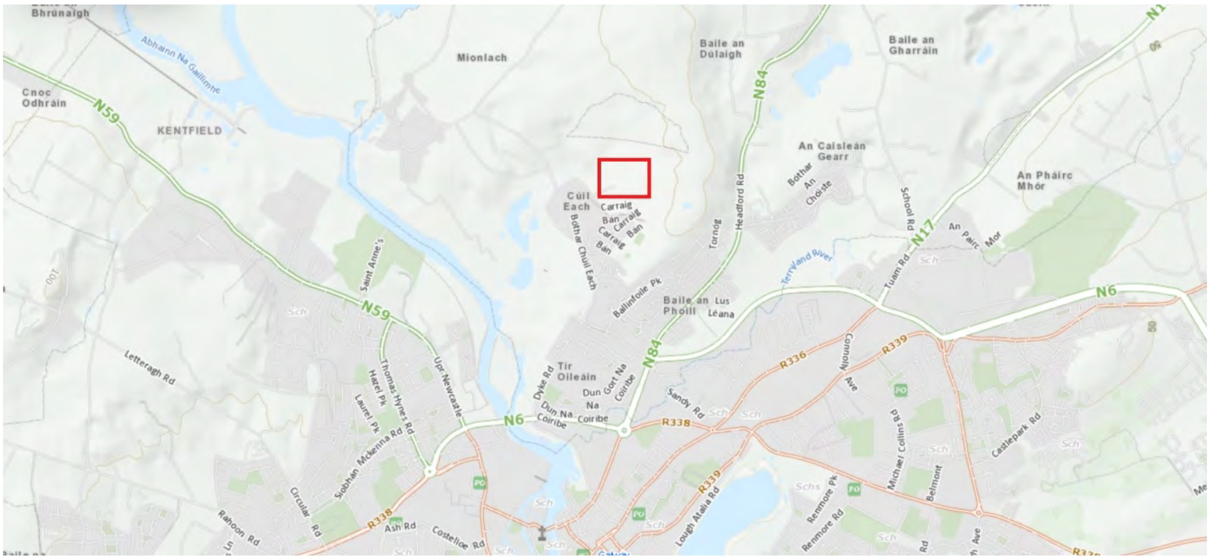


Figure 3.1 Location map showing location highlighted by red circle.
© 2014 Ordnance Survey Ireland.

Figure 3.2 Aerial image showing approximate borehole locations. © Google 2016.

4.0 PROCESSING AND PRESENTATION OF RESULTS

Detailed logs of the imager data have been produced at a vertical scale of 1:10. Composite geophysical logs have been produced at 1:50. Full Wave Sonic results are presented separately at 1:50 with Imager, Natural Gamma and Caliper data to aid interpretation.

Constructional details and information on each borehole are given in the headers of each log.

All images have been referenced to Magnetic North.

The borehole’s azimuth and tilt are plotted alongside the images.

The image of the borehole wall is presented in an unwrapped form with a horizontal scale marked 0° - North, through 90° - East, 180° - South, 270° - West, back to North.

Structural features and discontinuities have been picked from the images in the form of colour coded sinusoidal projections - see Appendix 1 for details. This ‘Discontinuities’ log is also presented with a horizontal scale marked 0° - North, through 90° - East, 180° - South, 270° - West, back to North.

Structure picking is not a definitive analysis of all the features within a borehole. Only the discontinuities that have a linear dip and direction are ‘picked’ and used in the analysis of the discontinuities. Features that do not have a regular sinusoidal shape do not have a linear dip and direction, ‘best fit’ picking of these features is done if approximately 80% coverage of the sinusoid can be achieved. Below this percentage the inaccuracy of the picking is too great and if included in any structural analysis may adversely skew the results. Vughs, solution holes, and angular break outs are examples of features not picked.

The apparent azimuth and apparent dip (i.e. relative to the borehole’s azimuth and tilt) of the discontinuities are calculated using the diameter of the borehole and the geometric parameters of the sinusoids overlaid on the discontinuities. The final processing stage is to correct these apparent values to true azimuth (in relation to Magnetic North) and true dip (from horizontal) by correcting for the borehole’s azimuth and tilt.

The final results are presented as a ‘tadpole’ plot (Discontinuities - True°). The horizontal position of the tadpole’s head gives the defect’s true dip angle and its tail points in the direction of the defect’s azimuth. These logs are presented with a horizontal scale in degrees. By convention the top of the page is North (Magnetic) and the right hand edge of the paper is East.

The true structural data has been presented in digital format as an excel file (xls).

5.0 BOREHOLE LOGGING CONSTRAINTS

- **Vehicle access restrictions**
  Poor ground conditions, soft ground access to borehole locations

- **Tool access restrictions**
  None

- **Borehole conditions / risk to equipment**
  Drill rods left in boreholes prior to logging to prevent collapse. Highly fractured rock below casing in BH4.

- **Lack of fluid filled column / cloudy fluid**
  Optical and Acoustic run in both boreholes due to cloudy water. Boreholes pumped dry during pumped TC logging, not possible to run pumped flowmeter.

- **Time constraint**
  None

- **Borehole construction / casing**
  BH4 not cased deep enough – loose rock below casing. No casing in BH5.

Appendix 1

Discontinuity Classification.

Discontinuity	**Colour**	**Classification Parameters**
Major Fracture or Fissure	Blue	An open break in the formation, that is **continuous** across the entire image.
Minor Fracture or Fissure	Turquoise	A thin or closed break in the formation, that is **continuous or discontinuous** across the image.
Vein	Green	That may be **continuous or discontinuous** across the entire image.
Fabric	Red	Defines a feature generally metamorphic, igneous or sedimentary in origin that may be **continuous or discontinuous** across the image, such as bedding and cross-bedding, schistosity or gneissosity.
Intrusions	Purple	Intrusive features such as dykes and sills, generally **continuous** across the image
Unknown	Black	Faint features which **can not** be classified.

Appendix 2

Geophysical Logs

EUROPEAN GEOPHYSICAL SERVICES LTD

Client:	**Priority Drilling**	Log Type: *Composite*
Borehole:	**BH4**	

Location: **Lackagh Quarry** Area: **Co. Galway** Grid Ref: Elevation:

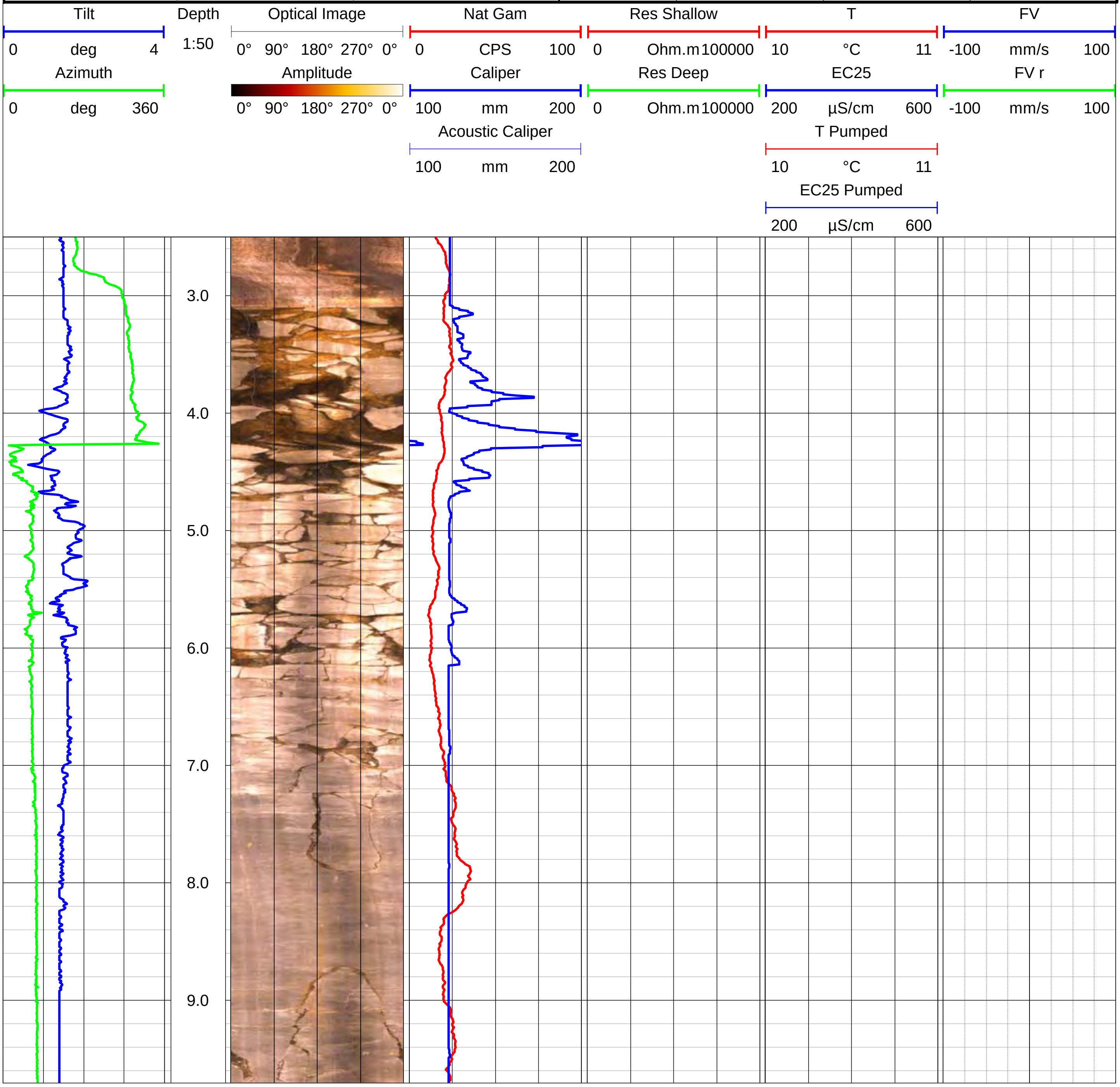
Drilled Depth: (m)	**35**	Date:	**8.12.15 / 9.12.15**
Logged Depth: (m)	**34.1**	Recorded By:	**Rhys Powell**
Logging Datum:	**Ground Level**	Remarks:	Rods pulled immediately before logging.
Logged Interval: (m)	**3.1 - 34.1**		
Fluid Level: (m)	**14.6 / 15.5**	Ref:	

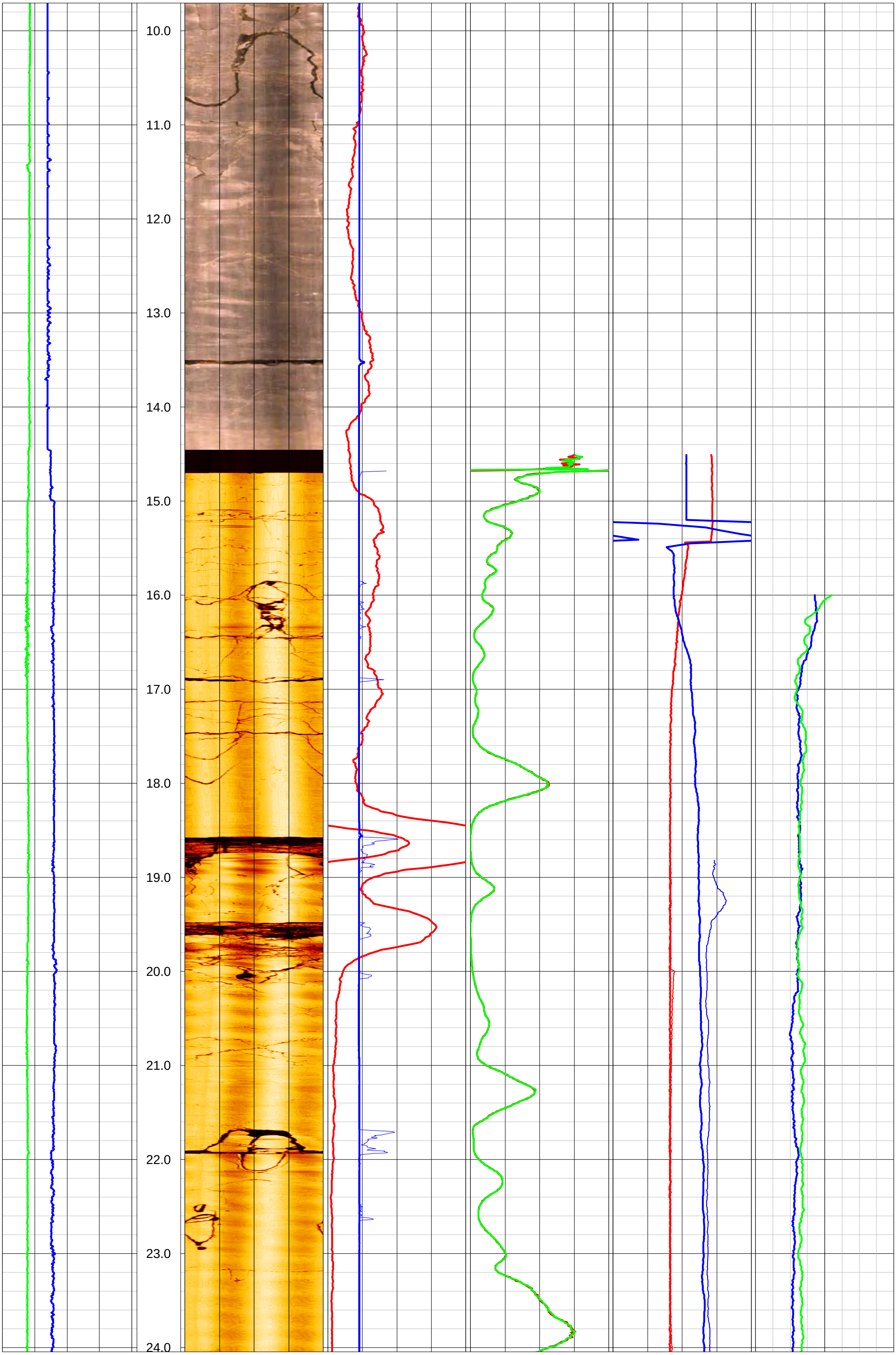
BOREHOLE RECORD

Bit: (mm)	From: (m)	To: (m)
122	**0.1**	**35**

CASING RECORD

Type	Size: (mm)	From: (m)	To: (m)
Steel	**130**	**0.0**	**3.1**

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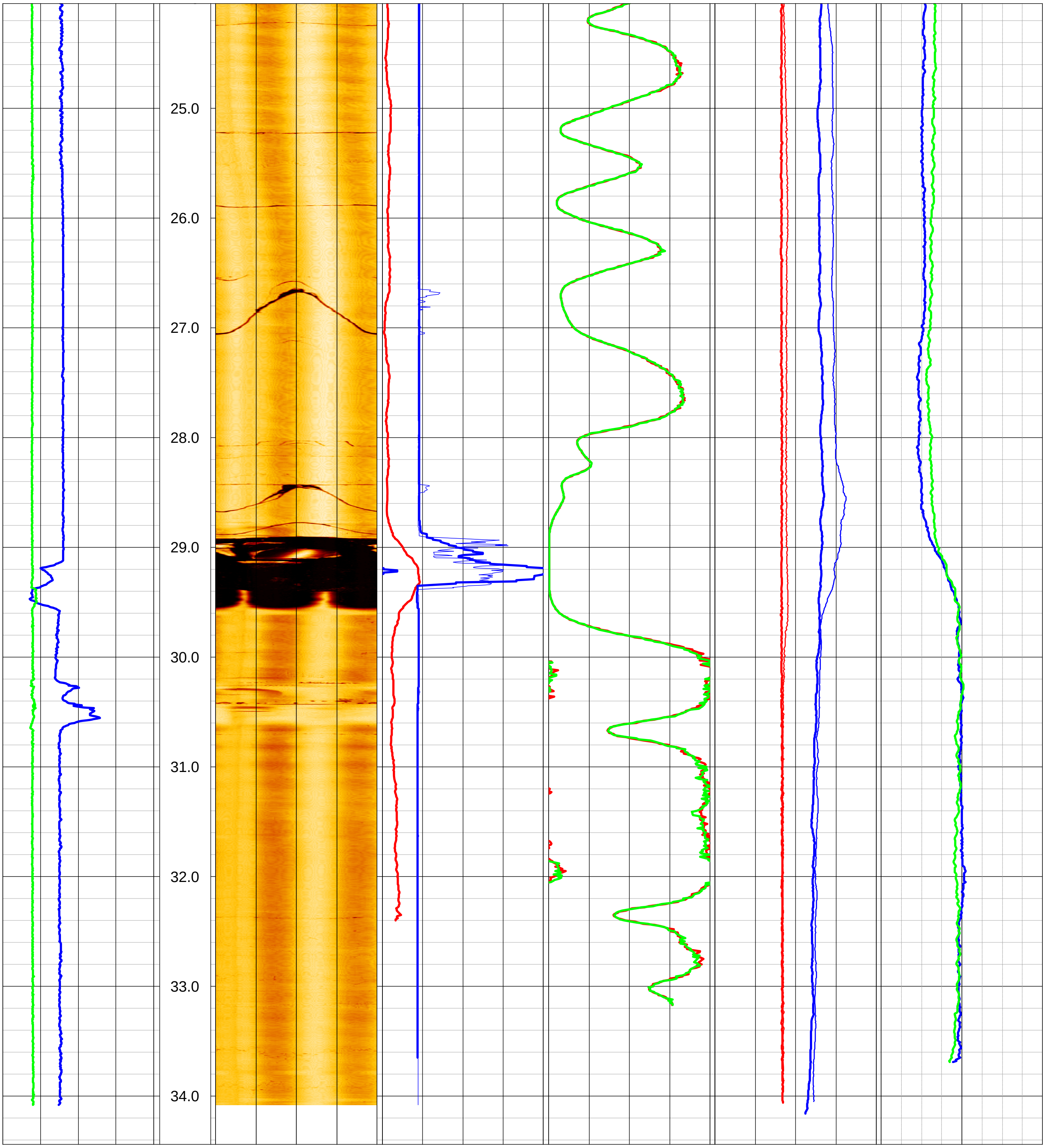
22.0
23.0
24.0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26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0
34.0

EUROPEAN GEOPHYSICAL SERVICES LTD

Client: **Priority Drilling**

Borehole: **BH4**

Log Type: ***Image***

Location: **Lackagh Quarry** Area: **Co. Galway** Grid Ref: Elevation:

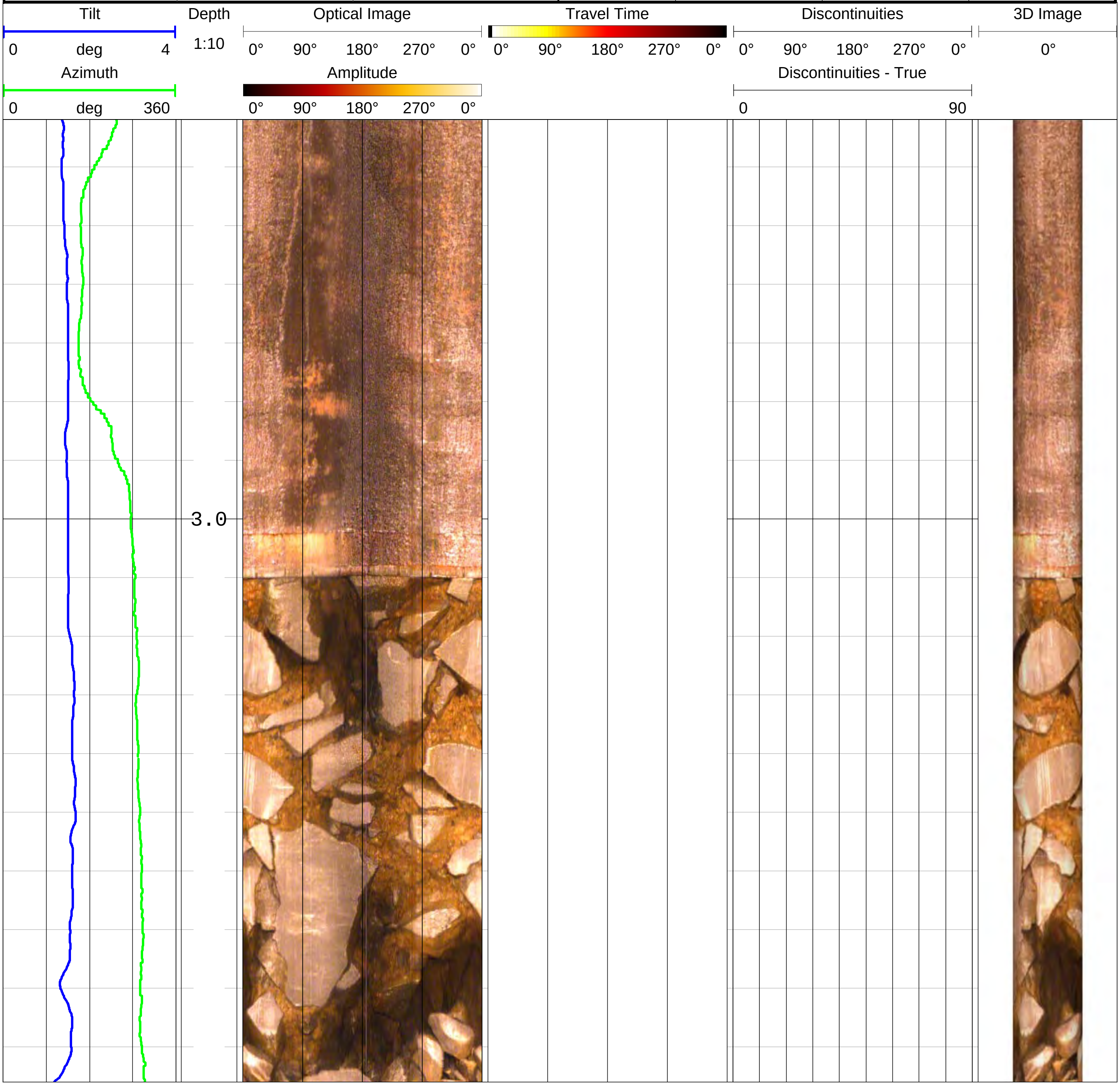
Drilled Depth: (m)	**35**	Date:	**8.12.15**
Logged Depth: (m)	**34.0**	Recorded By:	**Rhys Powell**
Logging Datum:	**Ground Level**	Remarks:	Rods pulled immediately before logging.
Logged Interval: (m)	**3.1 - 34.0**		
Fluid Level: (m)	**14.6**	**Ref:**	

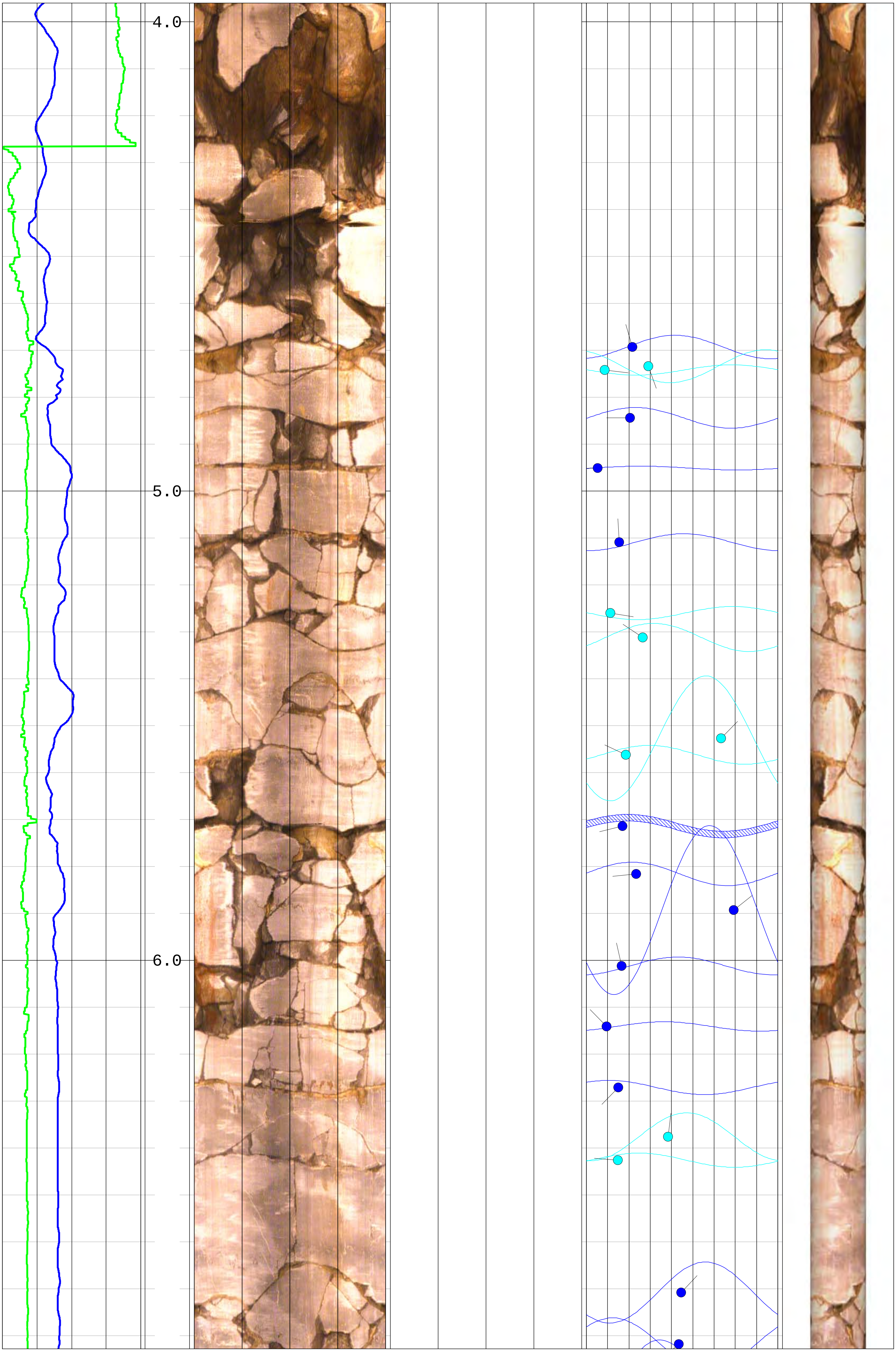
BOREHOLE RECORD

Bit: (mm)	From: (m)	To: (m)
PQ	**0.1**	**35**

CASING RECORD

Type	Size: (mm)	From: (m)	To: (m)
Steel	**130**	**0.0**	**3.1**

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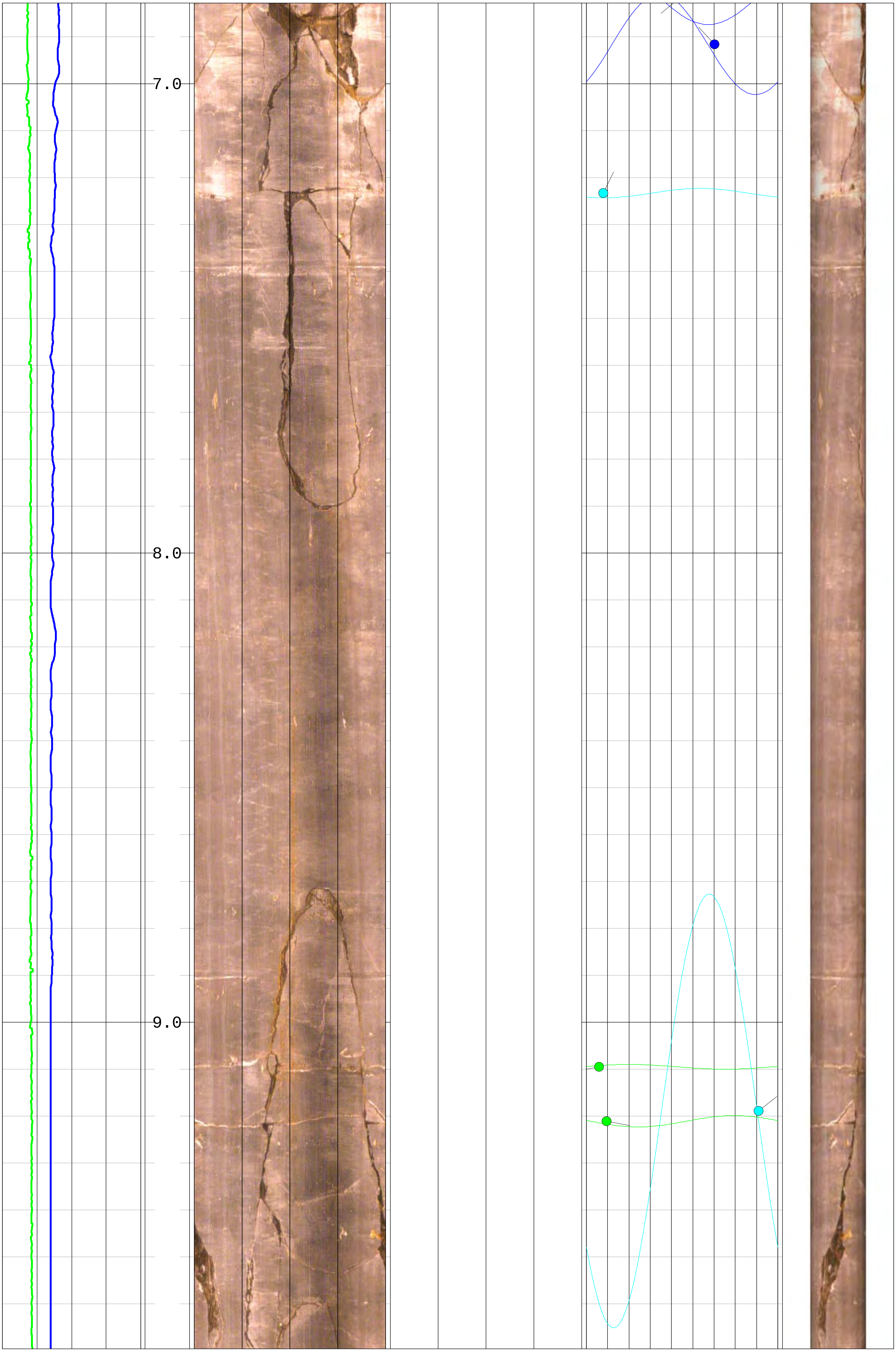
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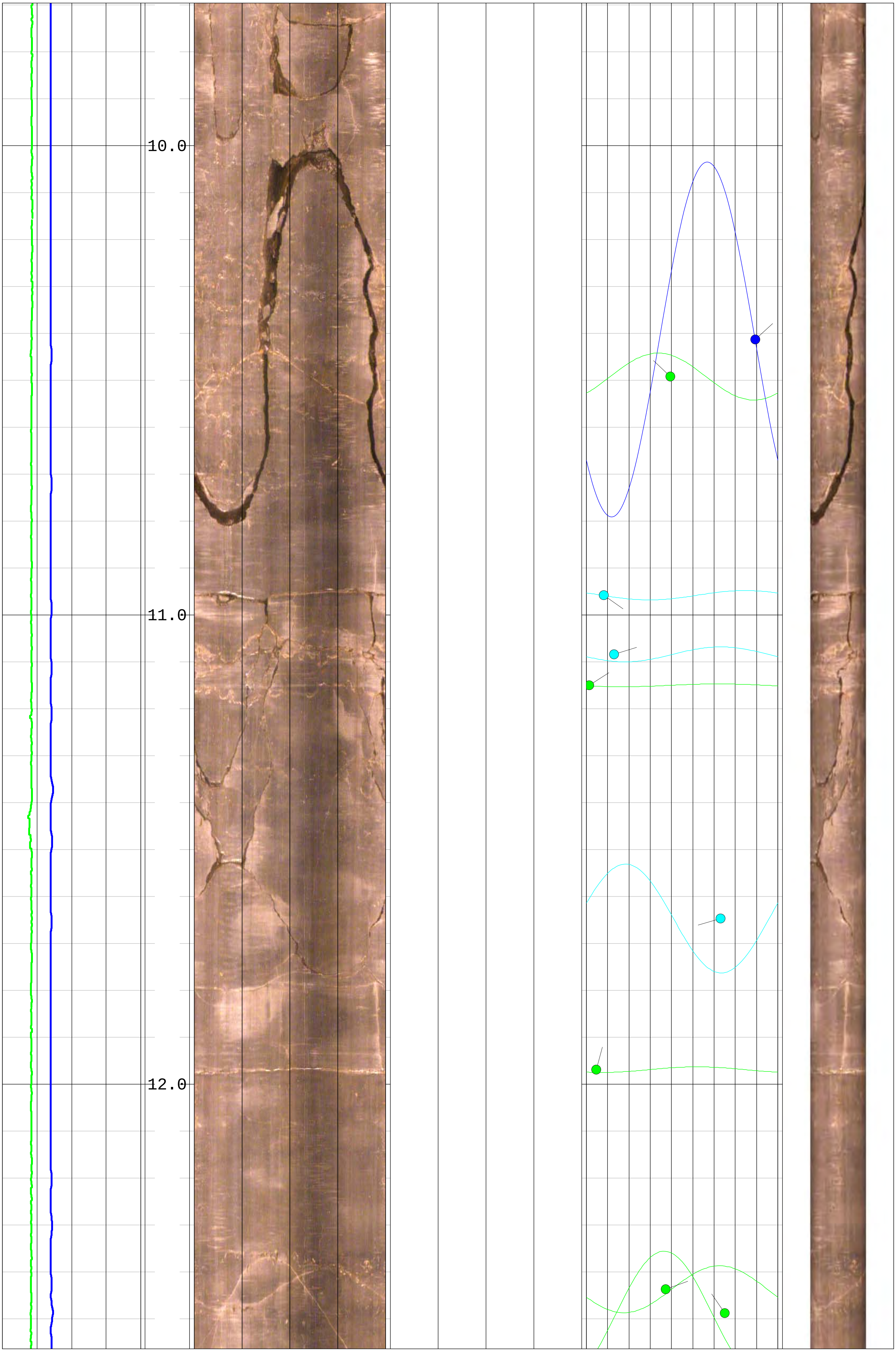
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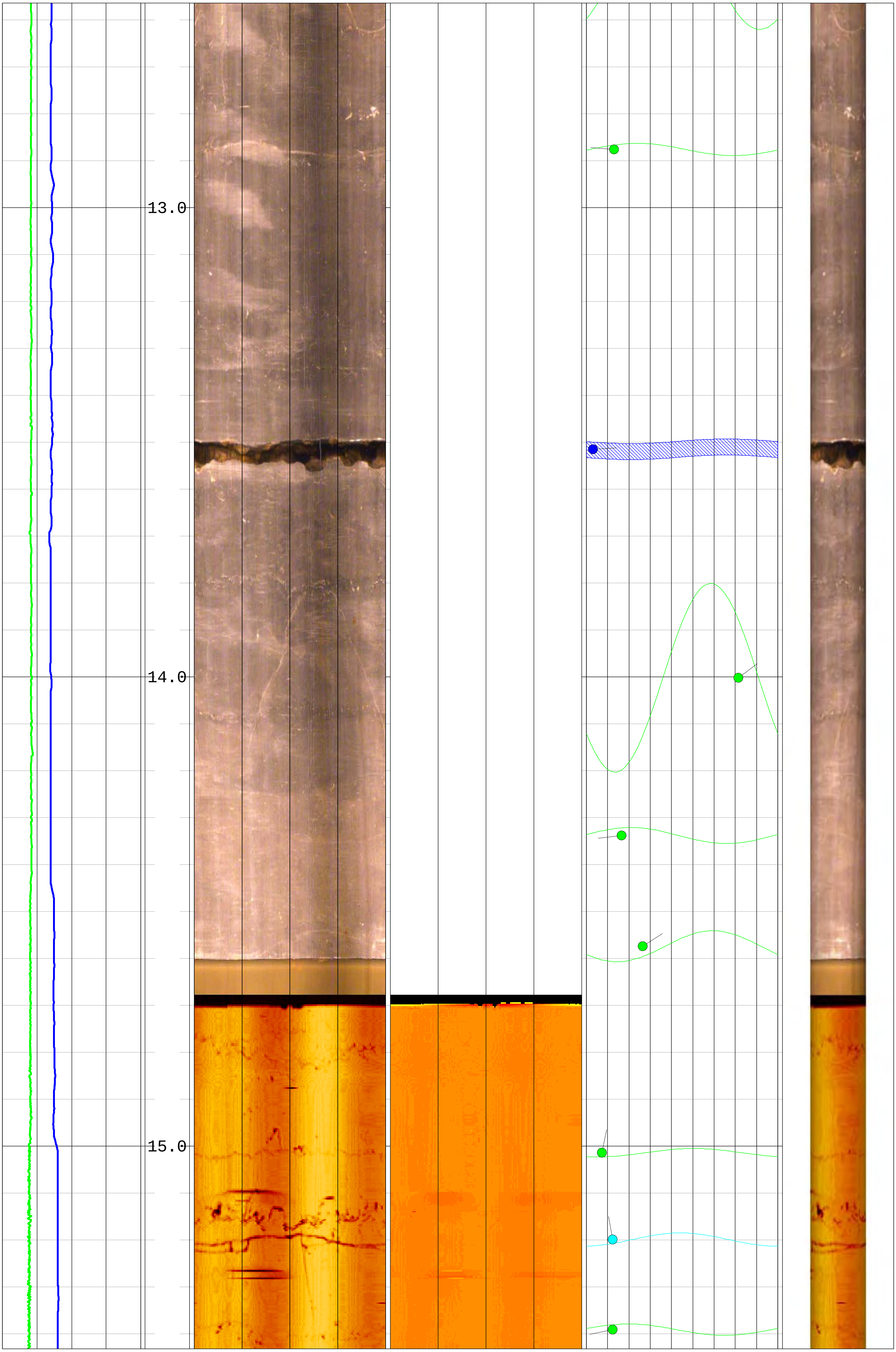
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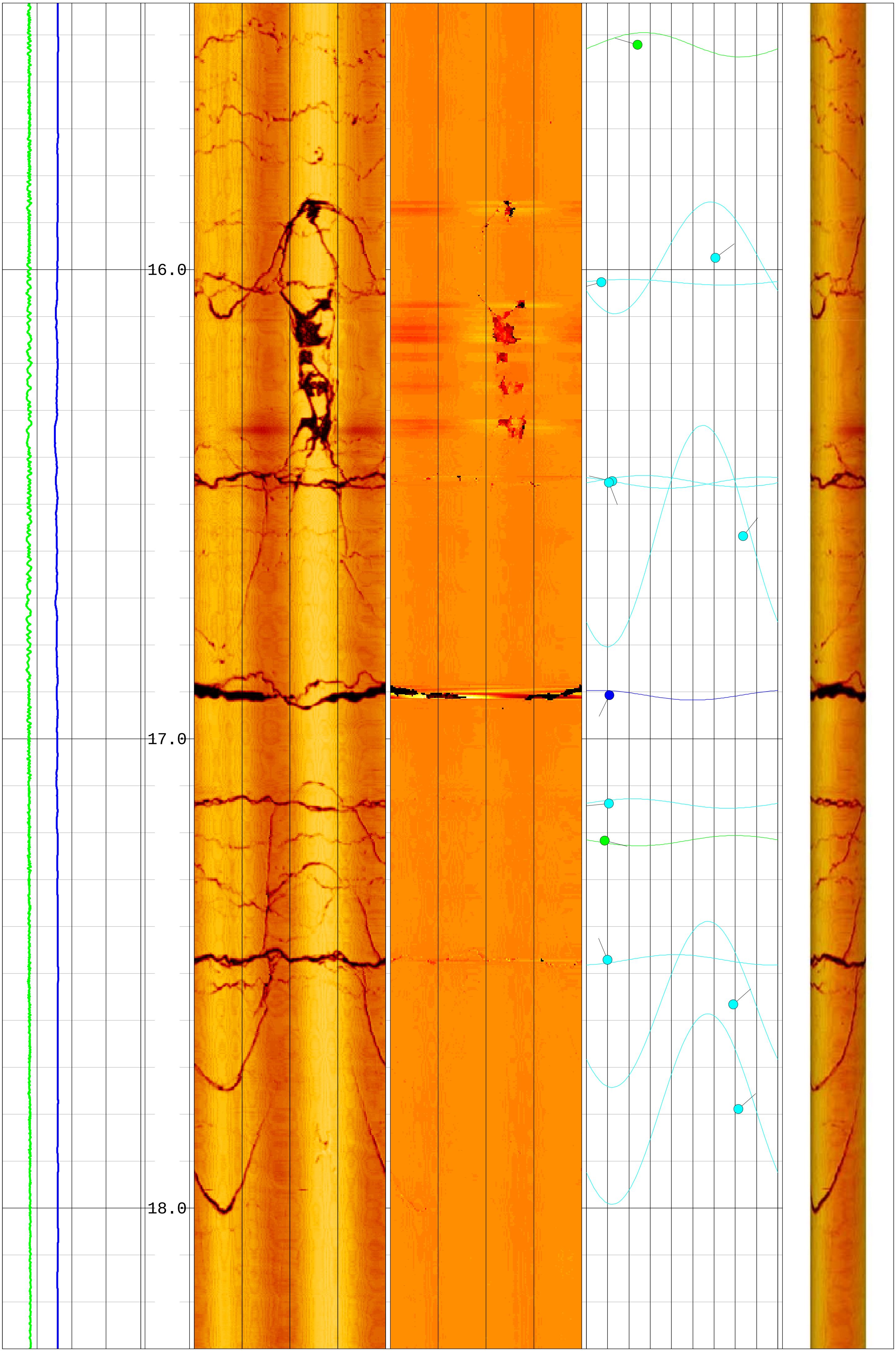
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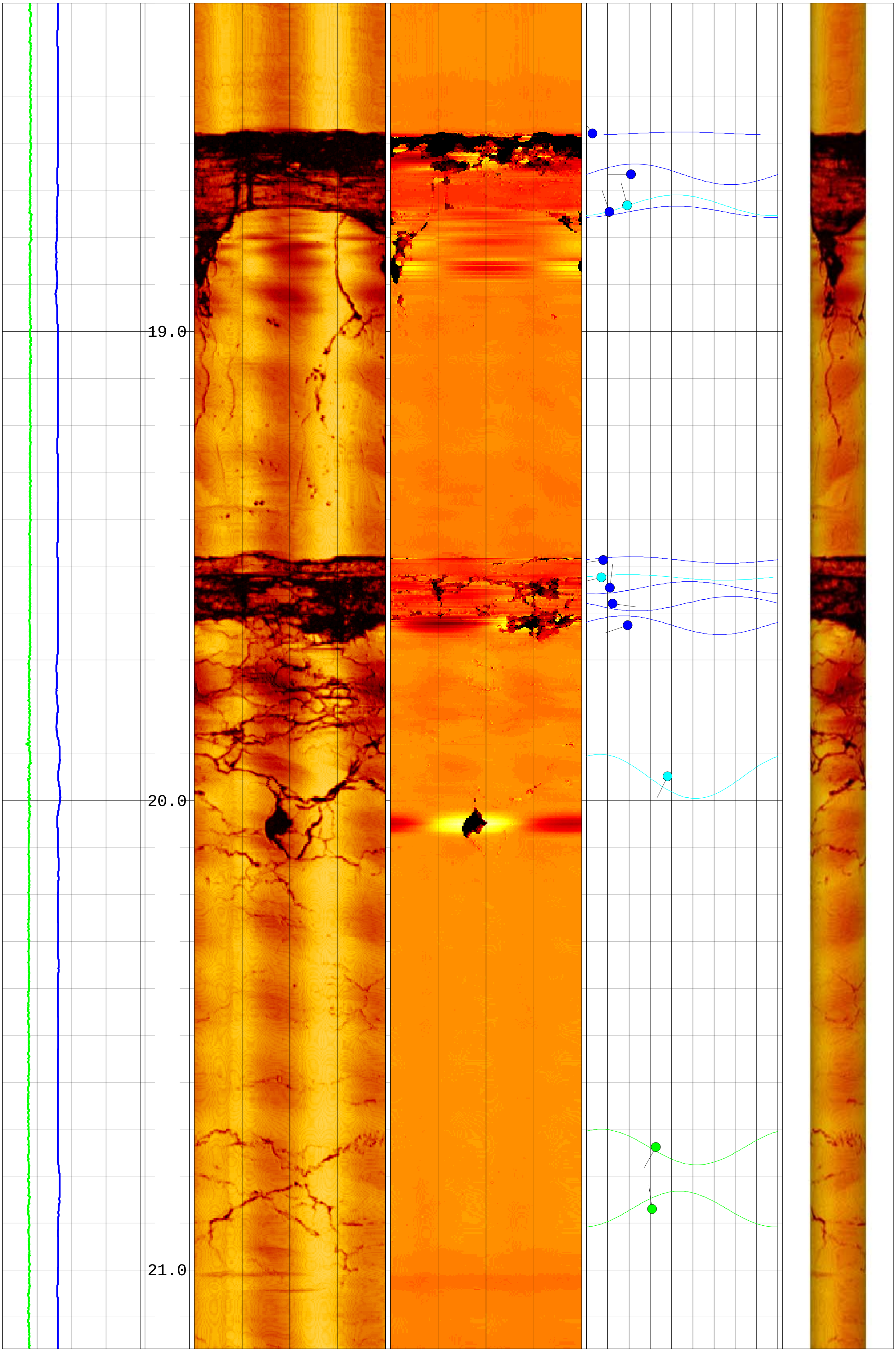
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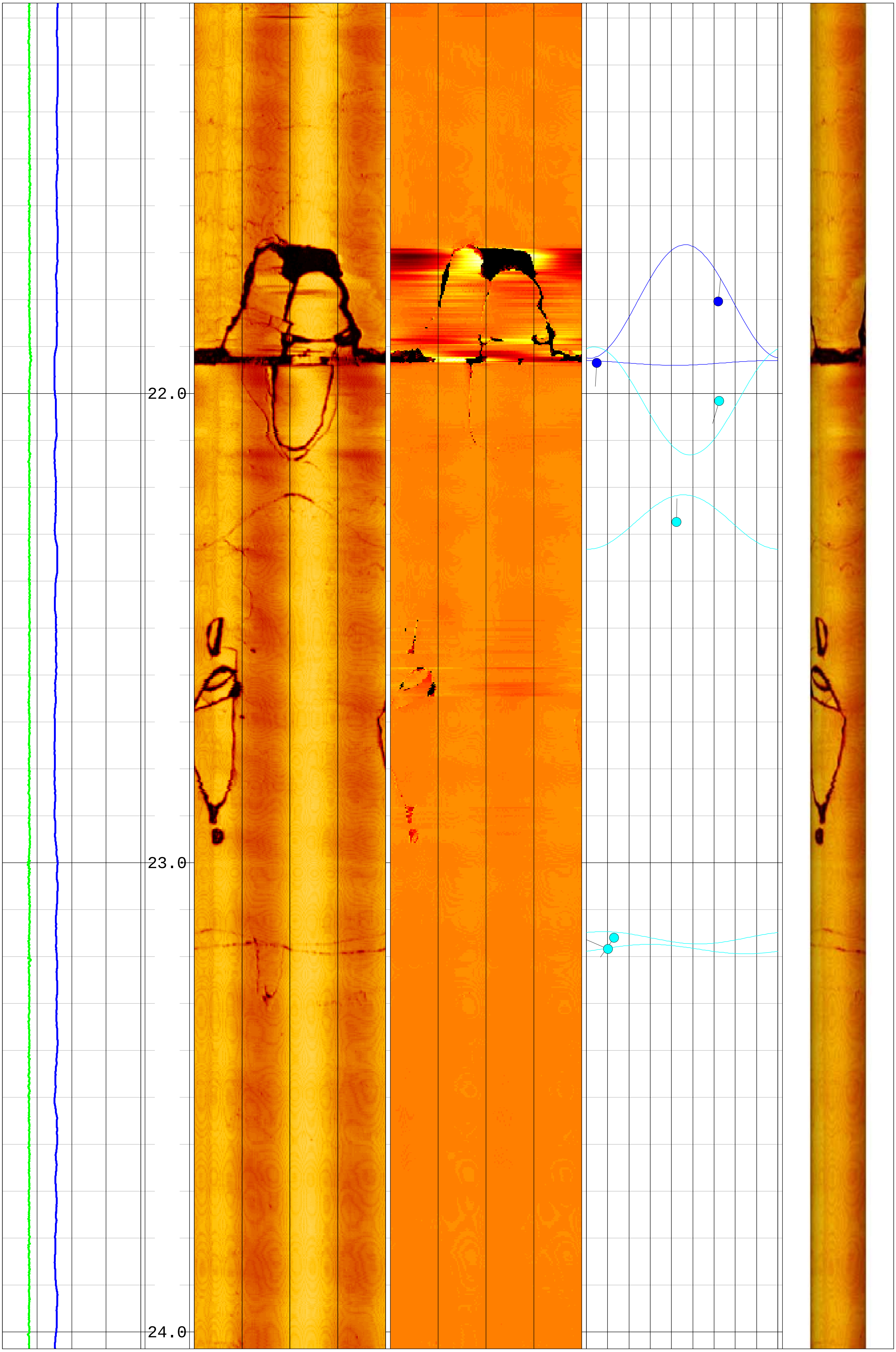
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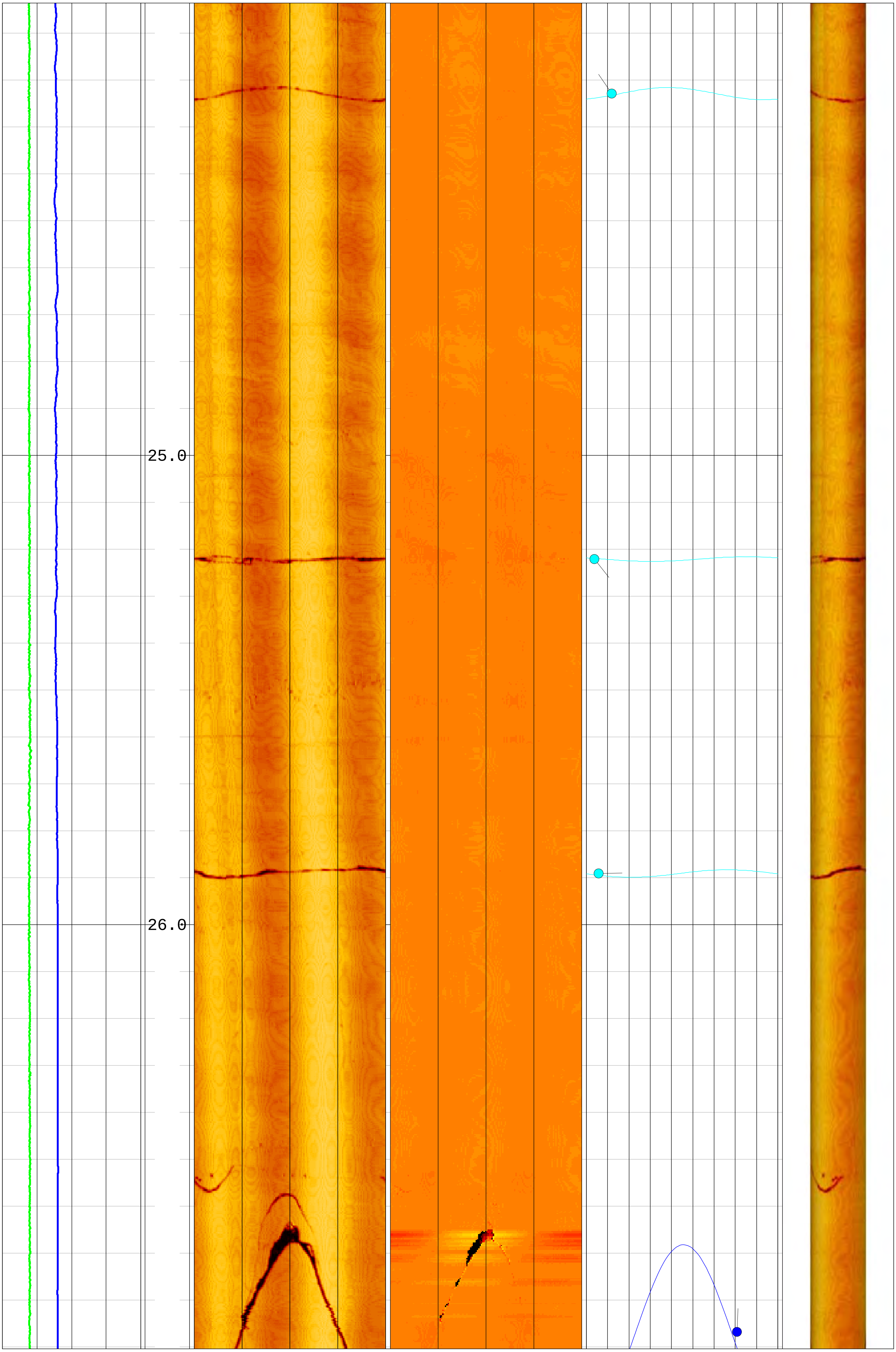
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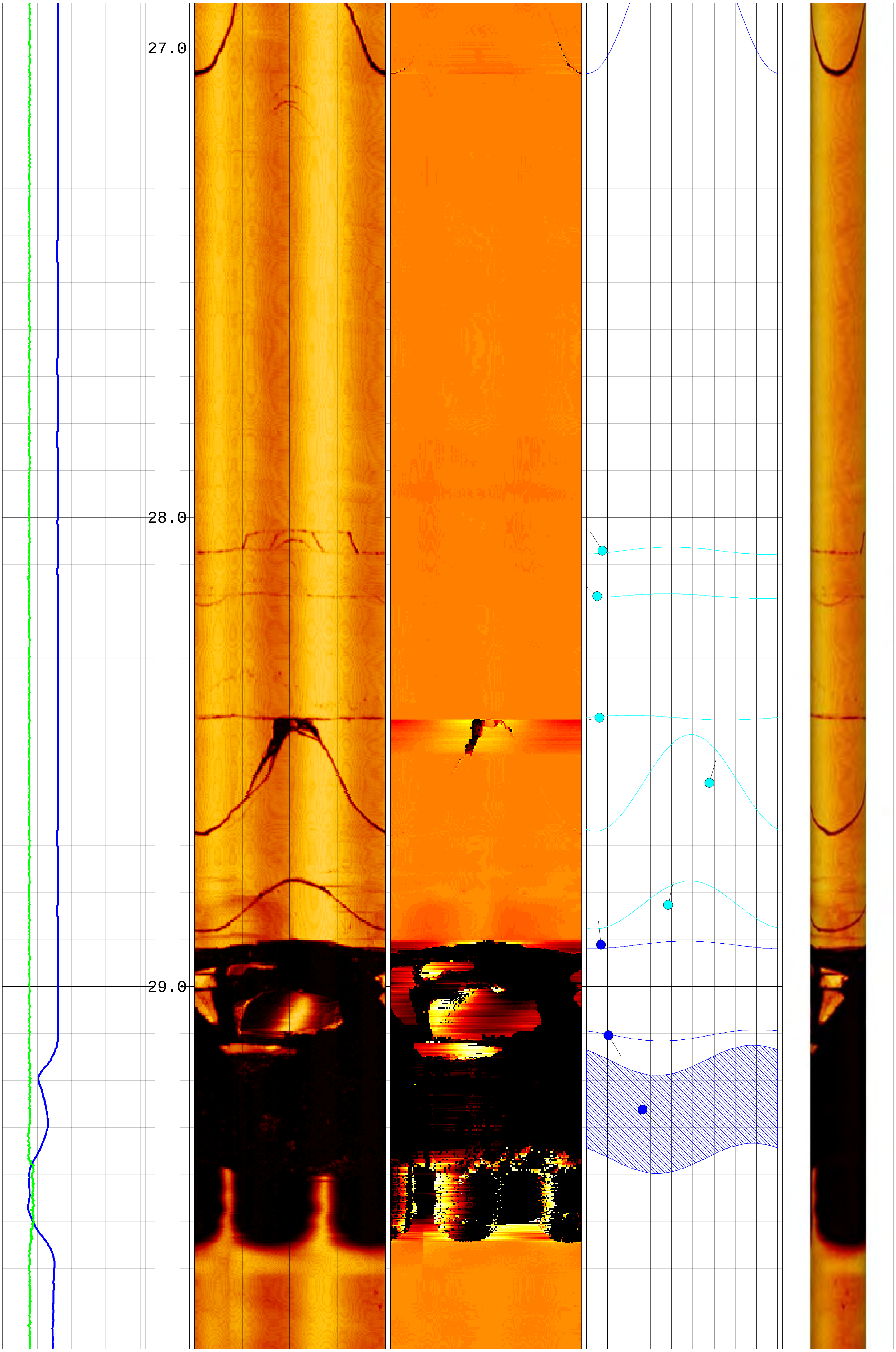
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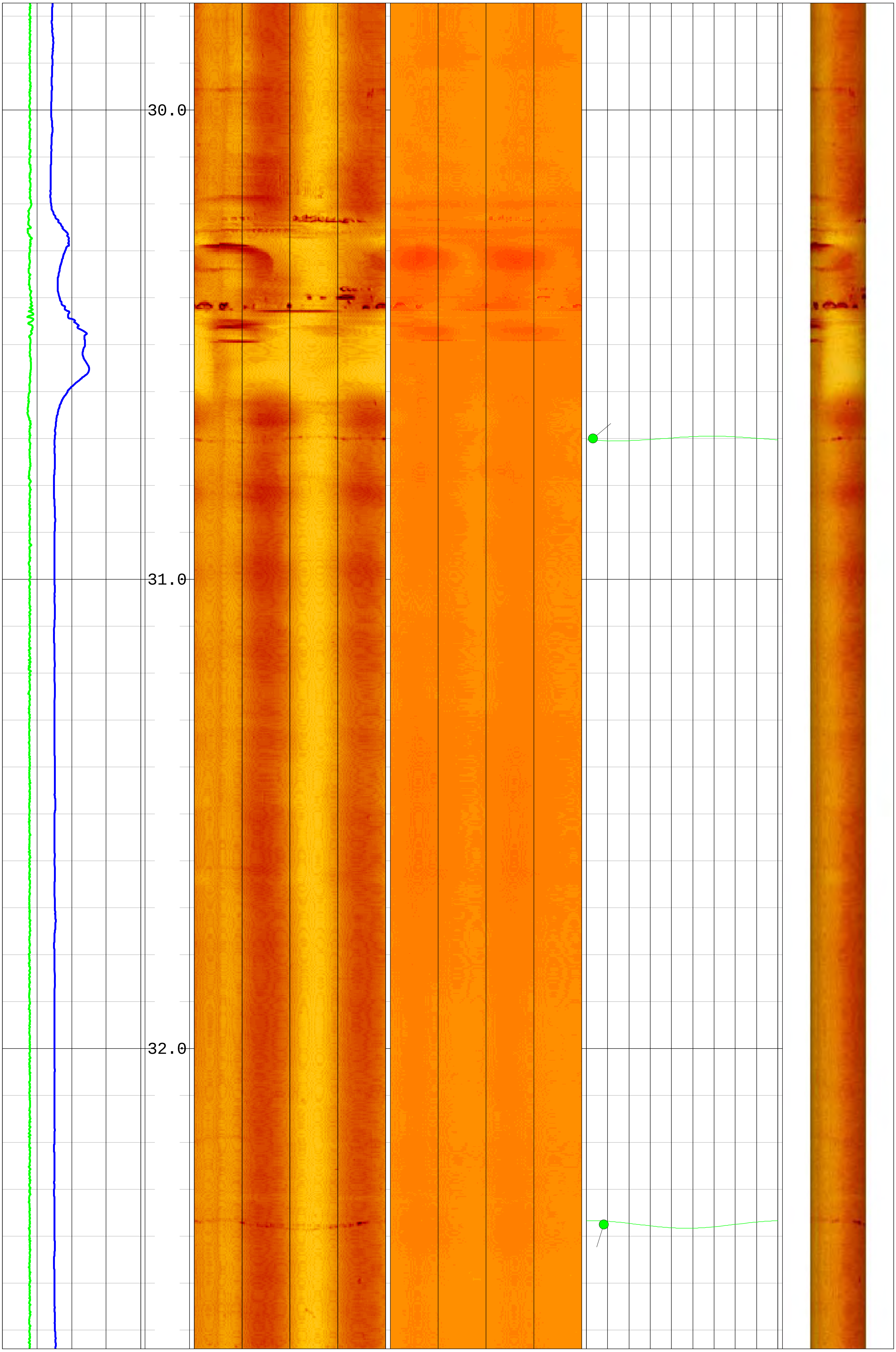
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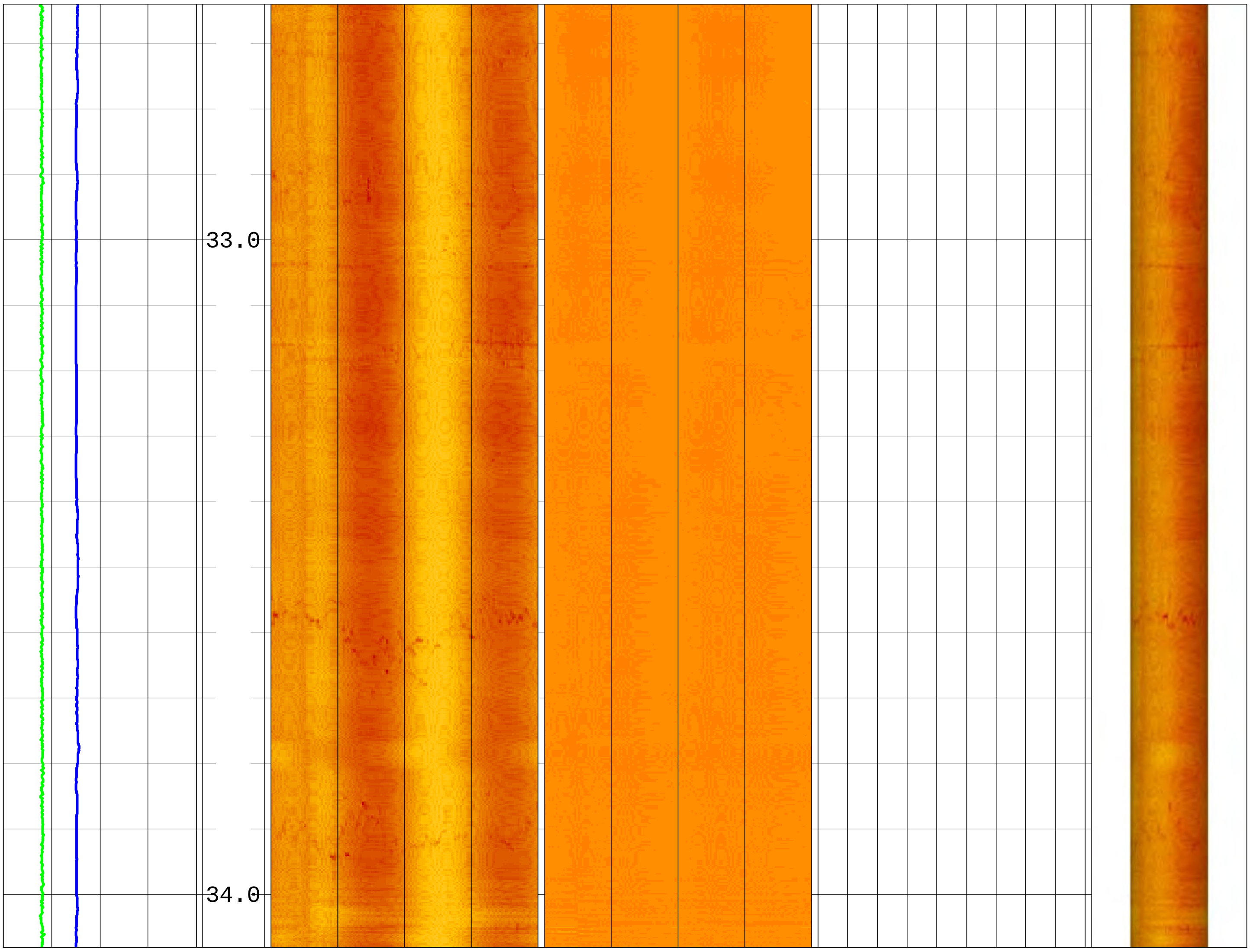

33.0
34.0

EUROPEAN GEOPHYSICAL SERVICES LTD

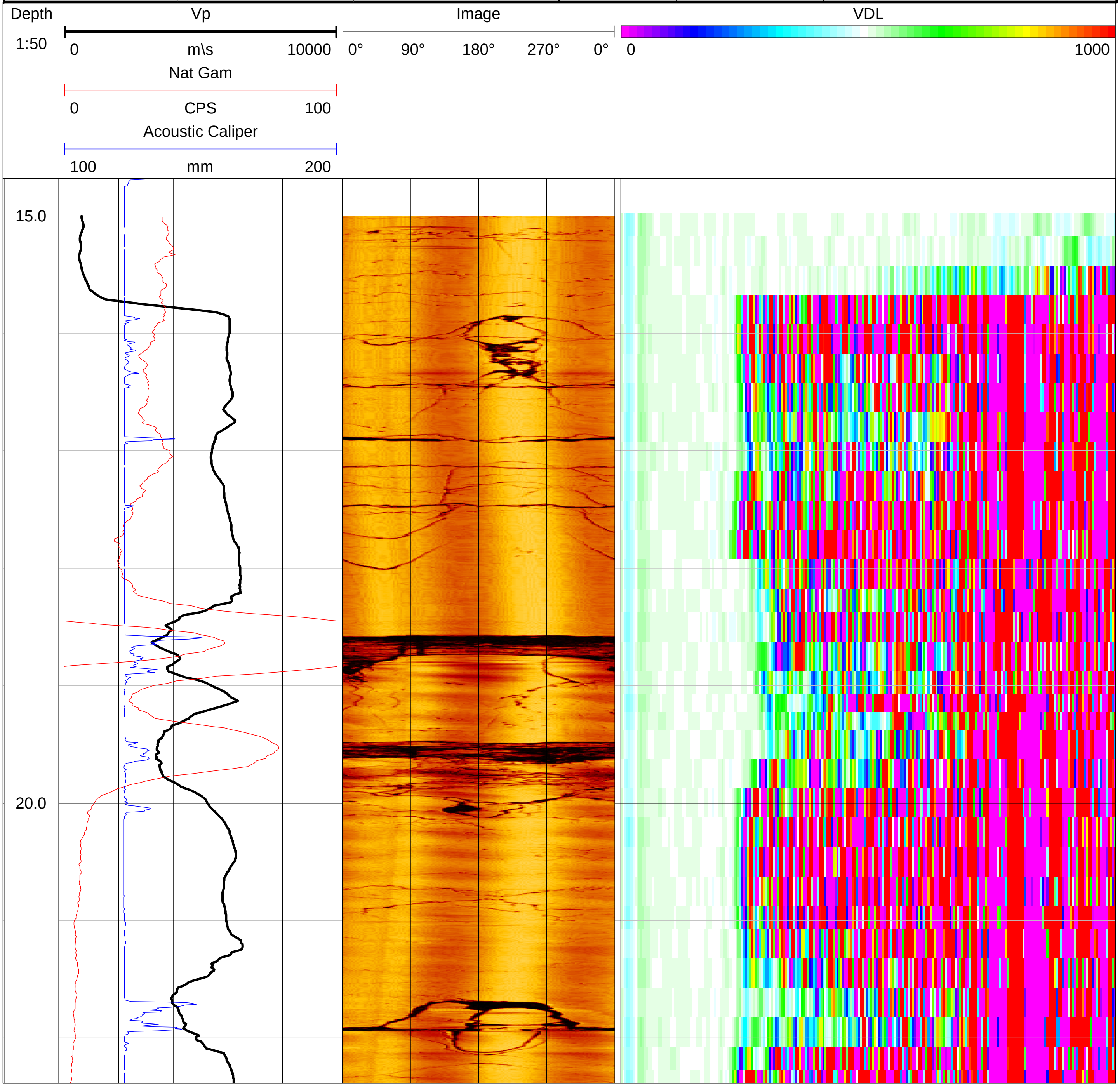
Client:	**Priority Drilling**	Log Type: ***Full Wave Sonic***
Borehole:	**BH4**	

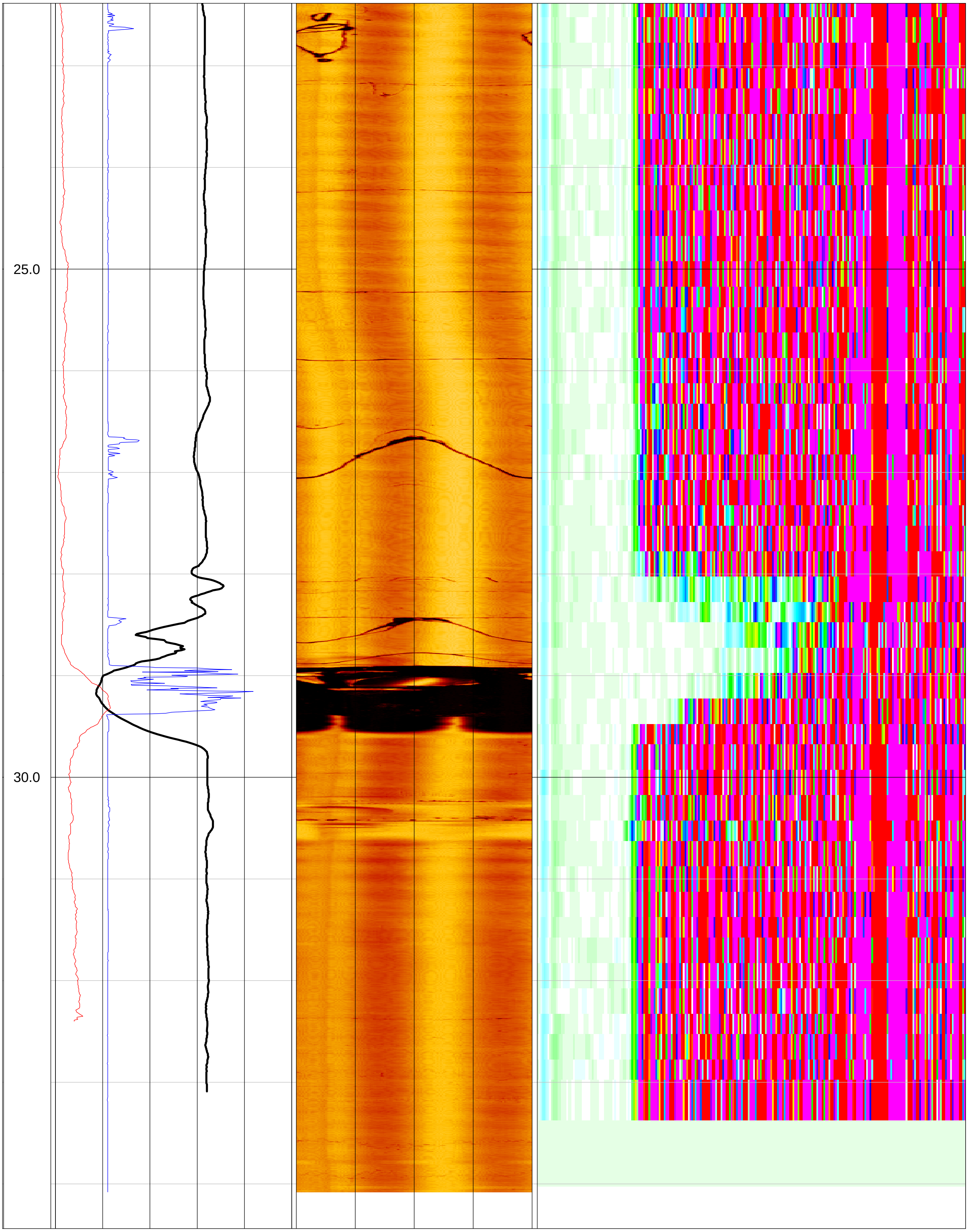
Location: **Lackagh Quarry** Area: **Co. Galway** Grid Ref: Elevation:

Drilled Depth: (m)	**35**	Date:	**9.12.15**
Logged Depth: (m)	**33.5**	Recorded By:	**Rhys Powell**
Logging Datum:	**Ground Level**	Remarks:	
Logged Interval: (m)	**16.0 - 33.5**		
Fluid Level: (m)	**16.0**	**Ref:**	

BOREHOLE RECORD		
Bit: (mm)	From: (m)	To: (m)
122	**0.0**	**35**

CASING RECORD			
Type	Size: (mm)	From: (m)	To: (m)
Steel	**130**	**0.0**	**3.1**




25.0
30.0

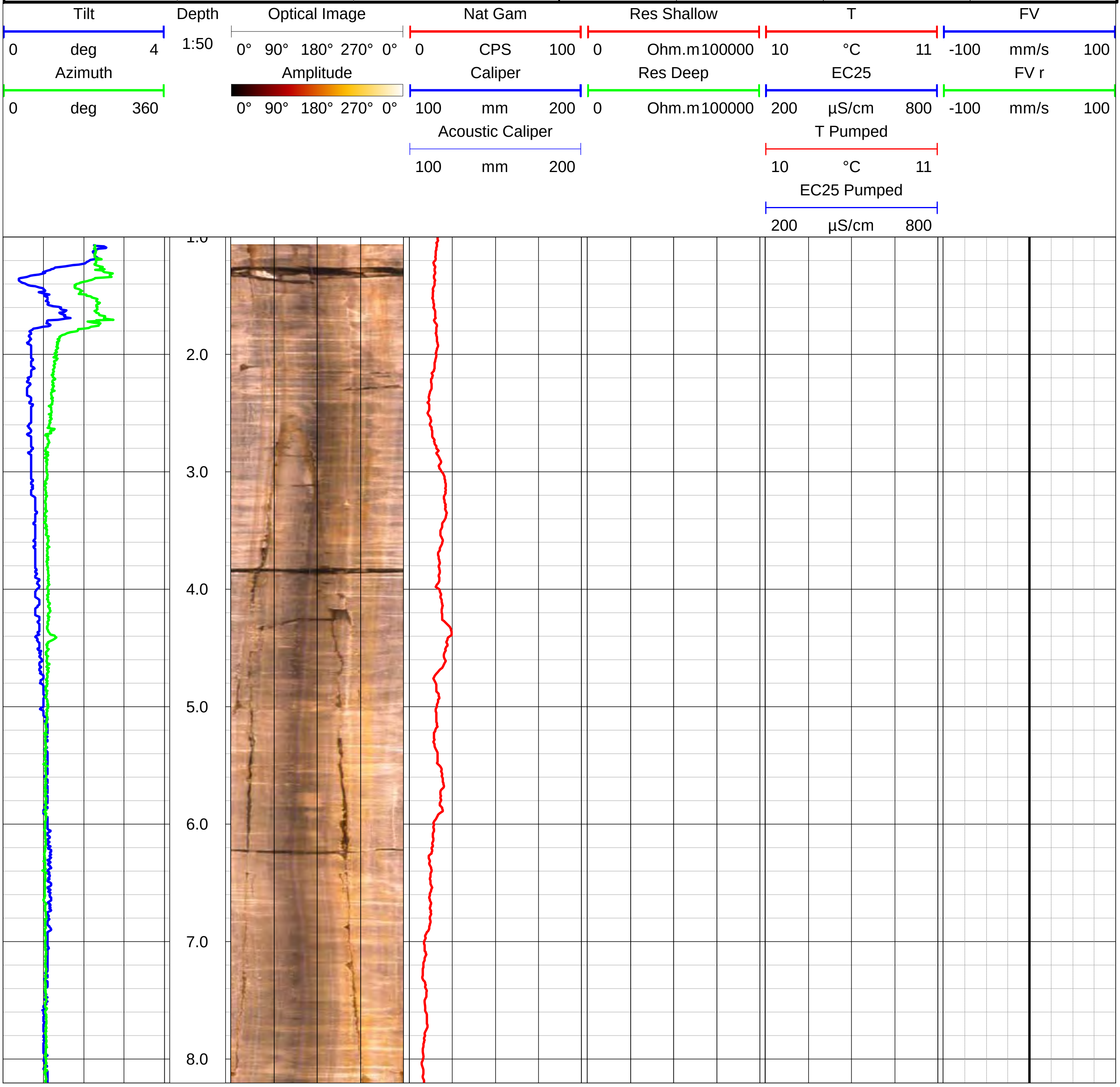
EUROPEAN GEOPHYSICAL SERVICES LTD

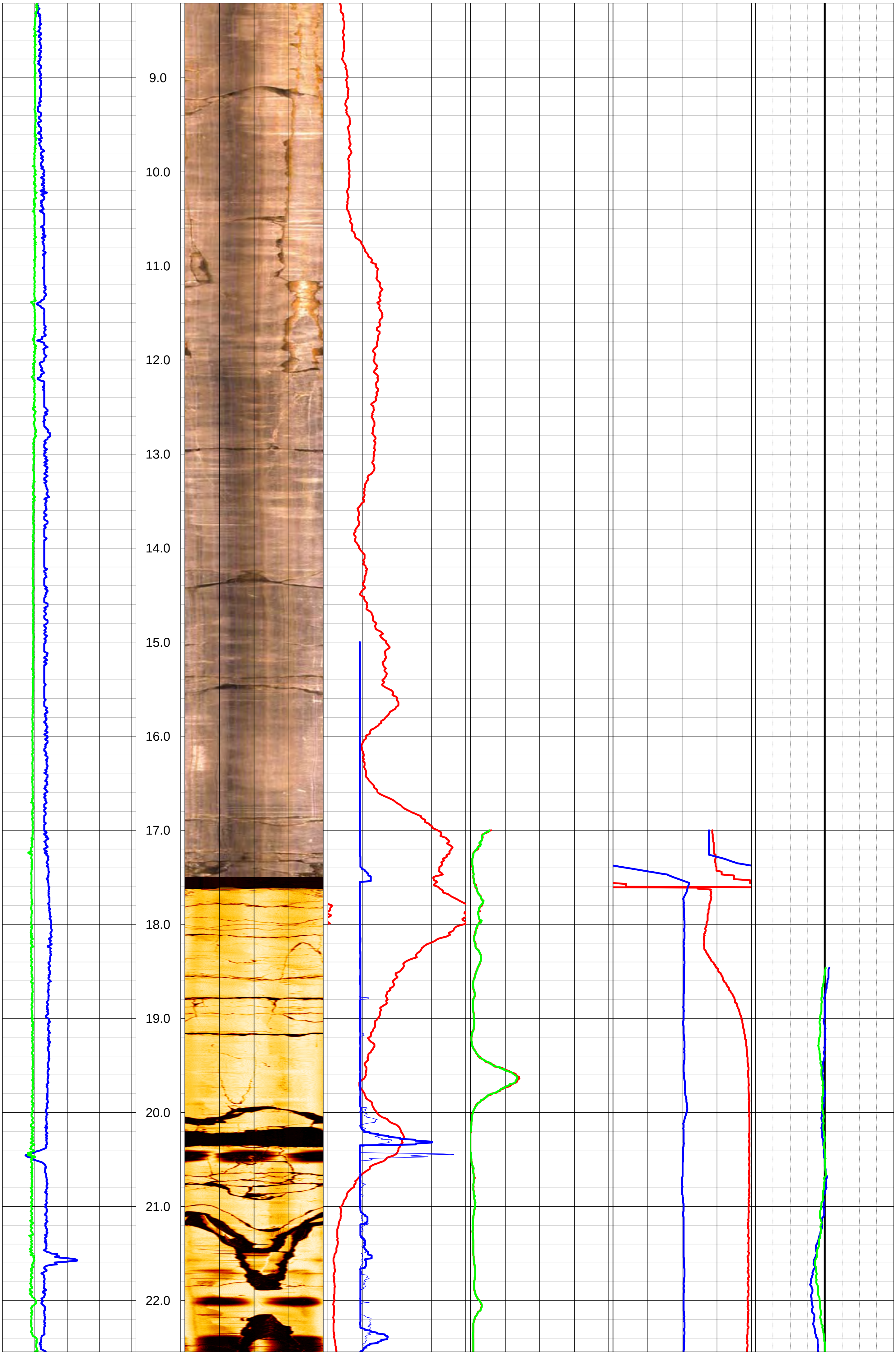
Client:	**Priority Drilling**	Log Type: ***Composite***
Borehole:	**BH5**	

Location: **Lackagh Quarry** Area: **Co. Galway** Grid Ref: Elevation:

Drilled Depth: (m)	**40.3**	Date:	**8.12.15**
Logged Depth: (m)	**40.1**	Recorded By:	**Rhys Powell**
Logging Datum:	**Ground Level**	Remarks:	
Logged Interval: (m)	**1.0 - 40.1**		
Fluid Level: (m)	**17.6**	**Ref:**	

BOREHOLE RECORD			CASING RECORD			
Bit: (mm)	From: (m)	To: (m)	Type	Size: (mm)	From: (m)	To: (m)
PQ	**0.0**	**40.3**	**None**			

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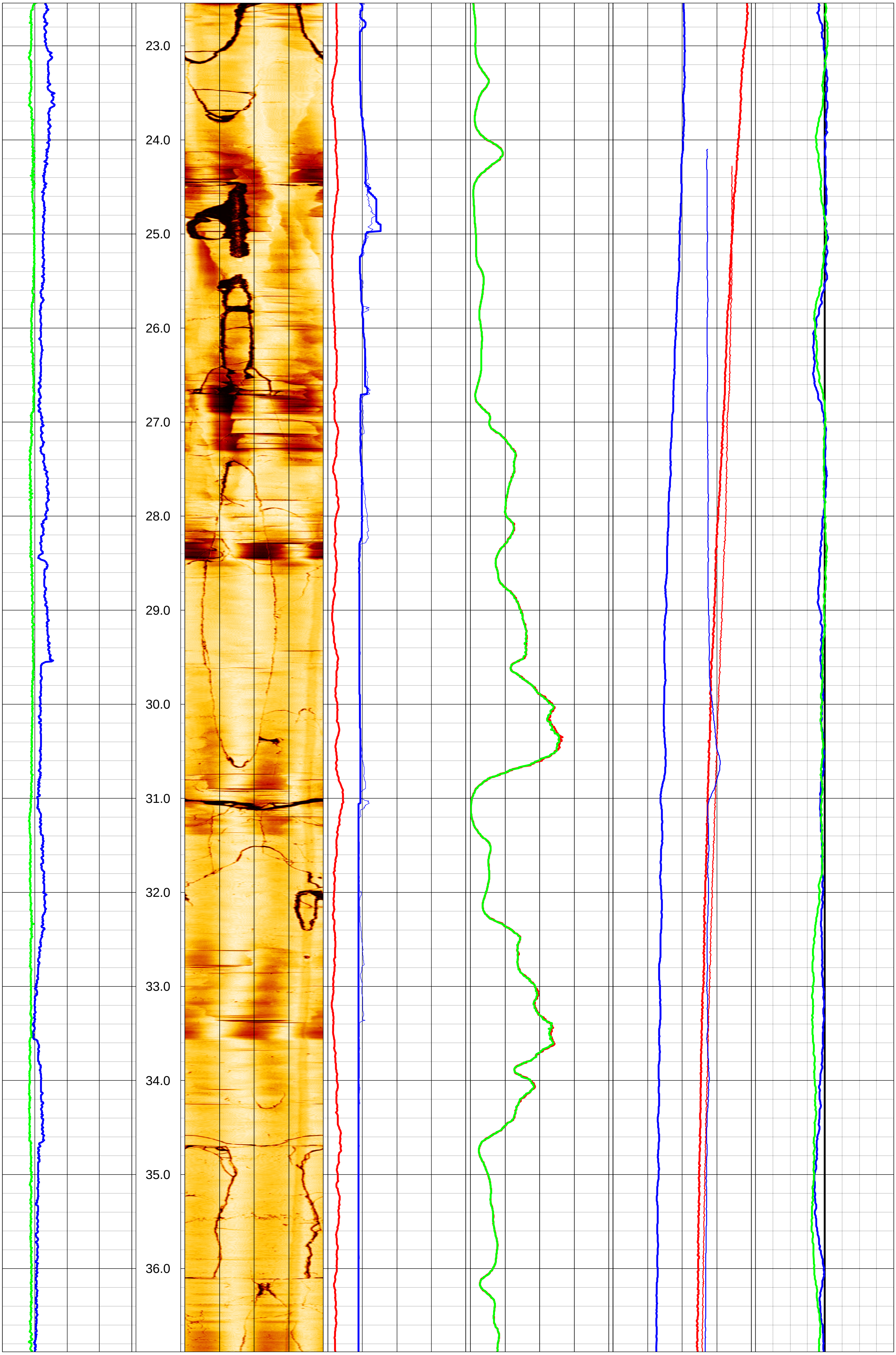
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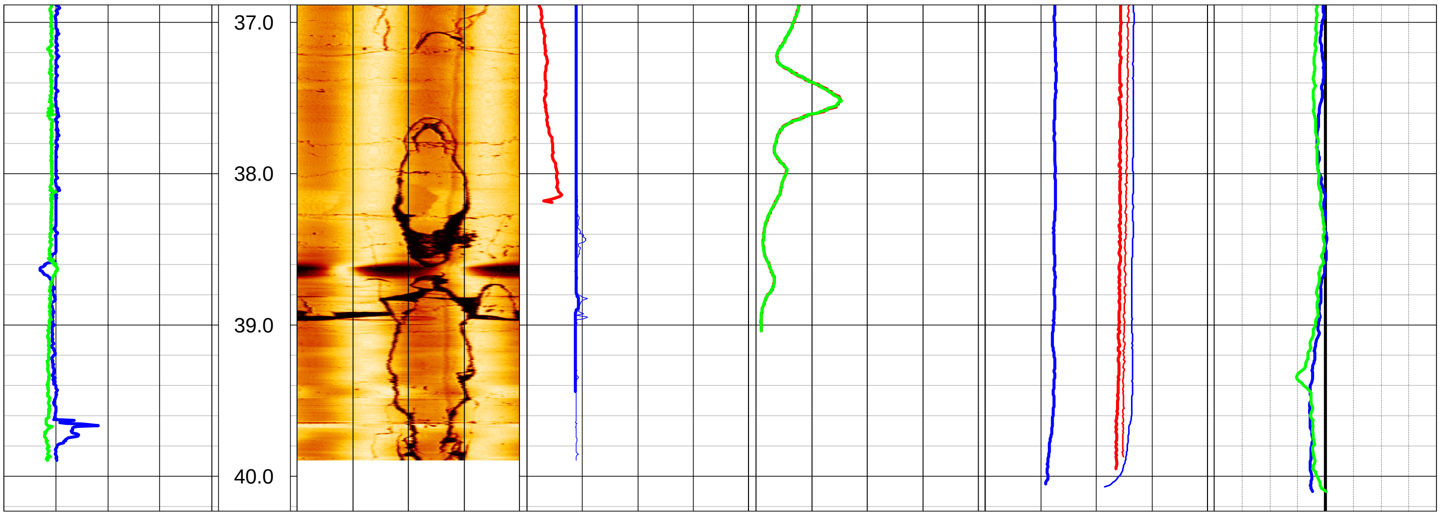
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EUROPEAN GEOPHYSICAL SERVICES LTD

Client:	**Priority Drilling**	Log Type: **_Image_**
Borehole:	**BH5**	

Location: **Lackagh Quarry** Area: **Co. Galway** Grid Ref: Elevation:

Drilled Depth: (m)	**40.3**	Date:	**8.12.15**
Logged Depth: (m)	**39.9**	Recorded By:	**Rhys Powell**
Logging Datum:	**Ground Level**	Remarks: Rods pulled immediately before logging.	
Logged Interval: (m)	**1.0 - 39.9**		
Fluid Level: (m)	**17.9**	**Ref:**	

BOREHOLE RECORD

Bit: (mm)	From: (m)	To: (m)
122	**0.1**	**40.3**

CASING RECORD

Type	Size: (mm)	From: (m)	To: (m)
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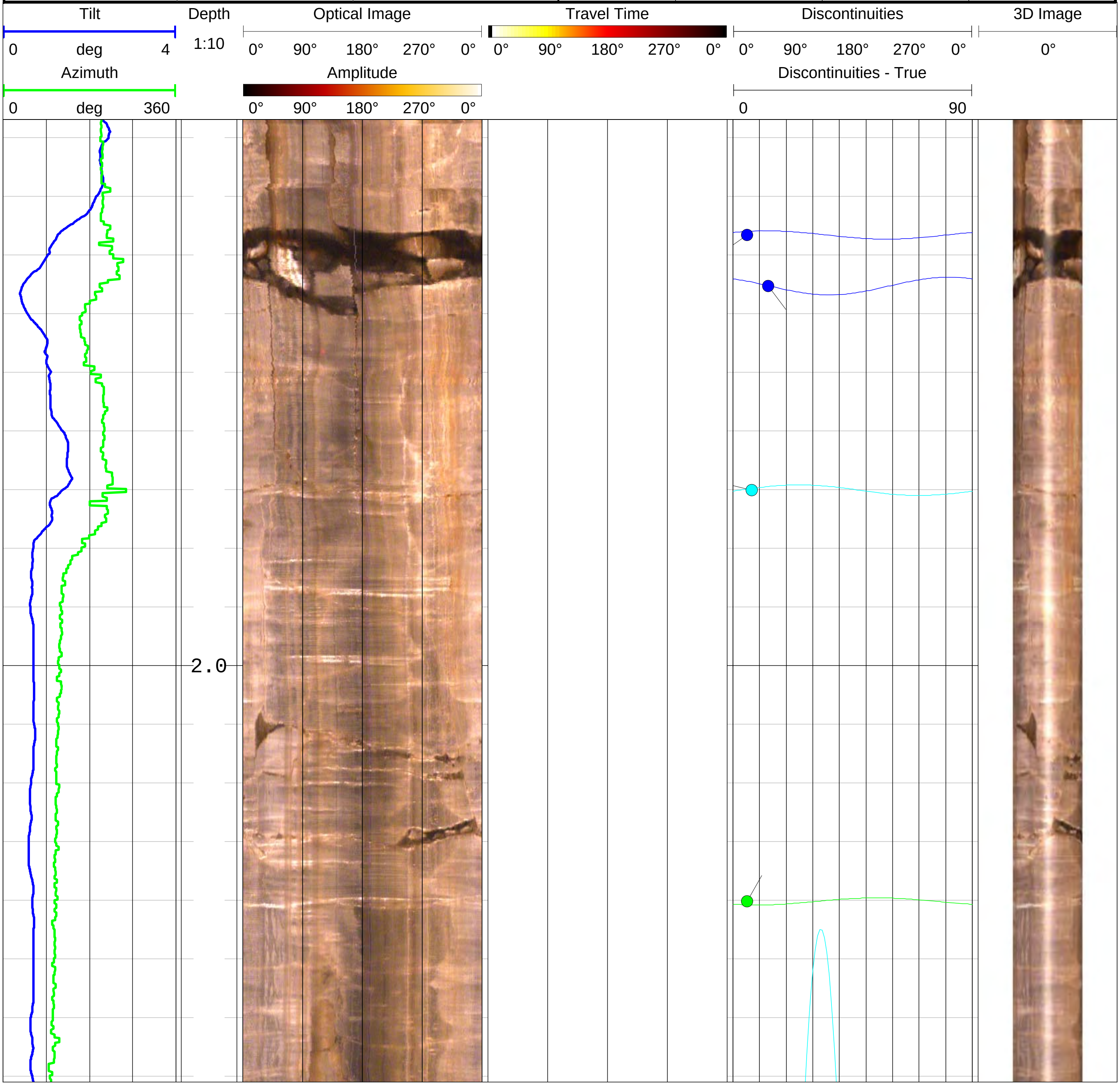

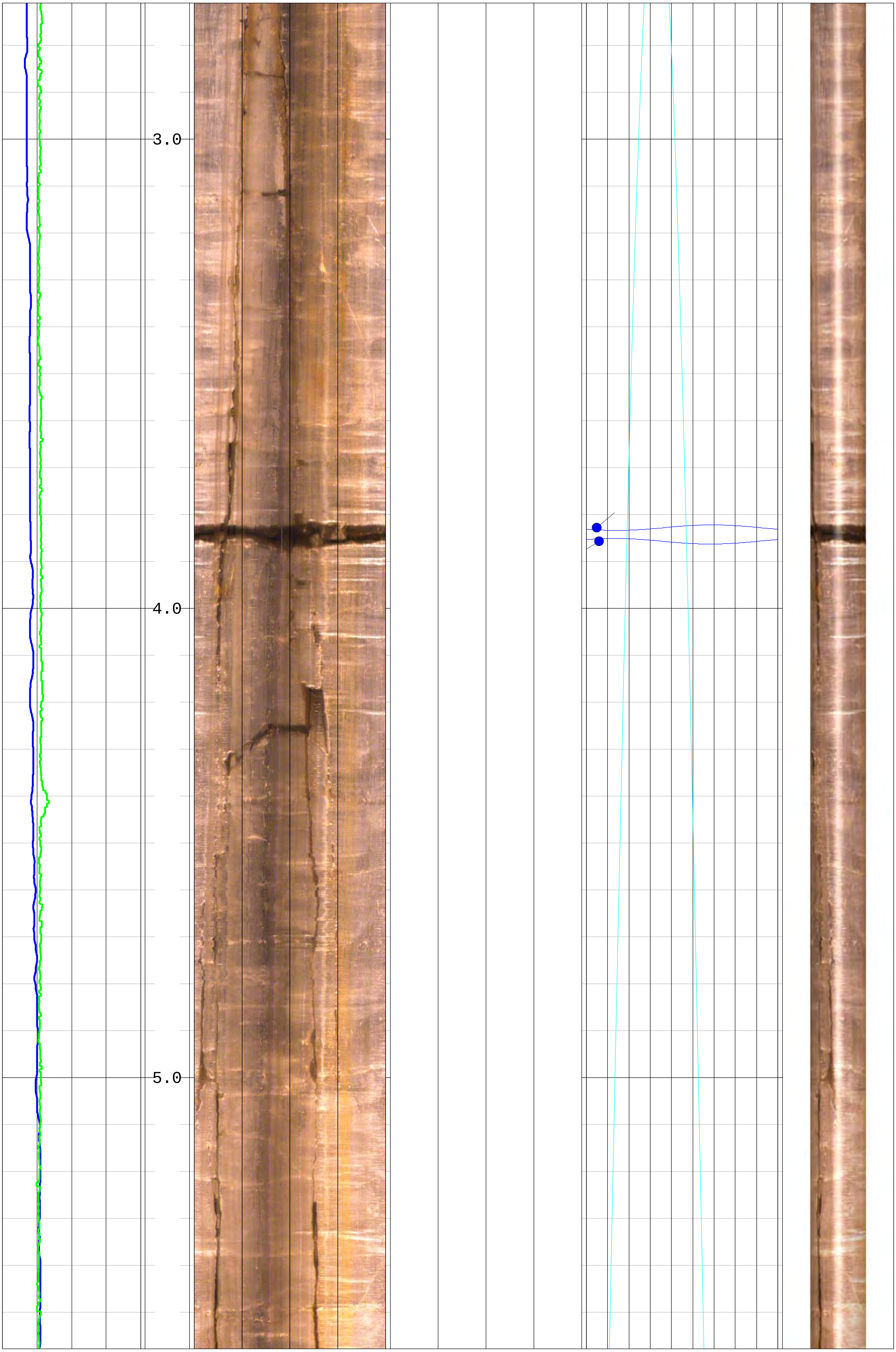
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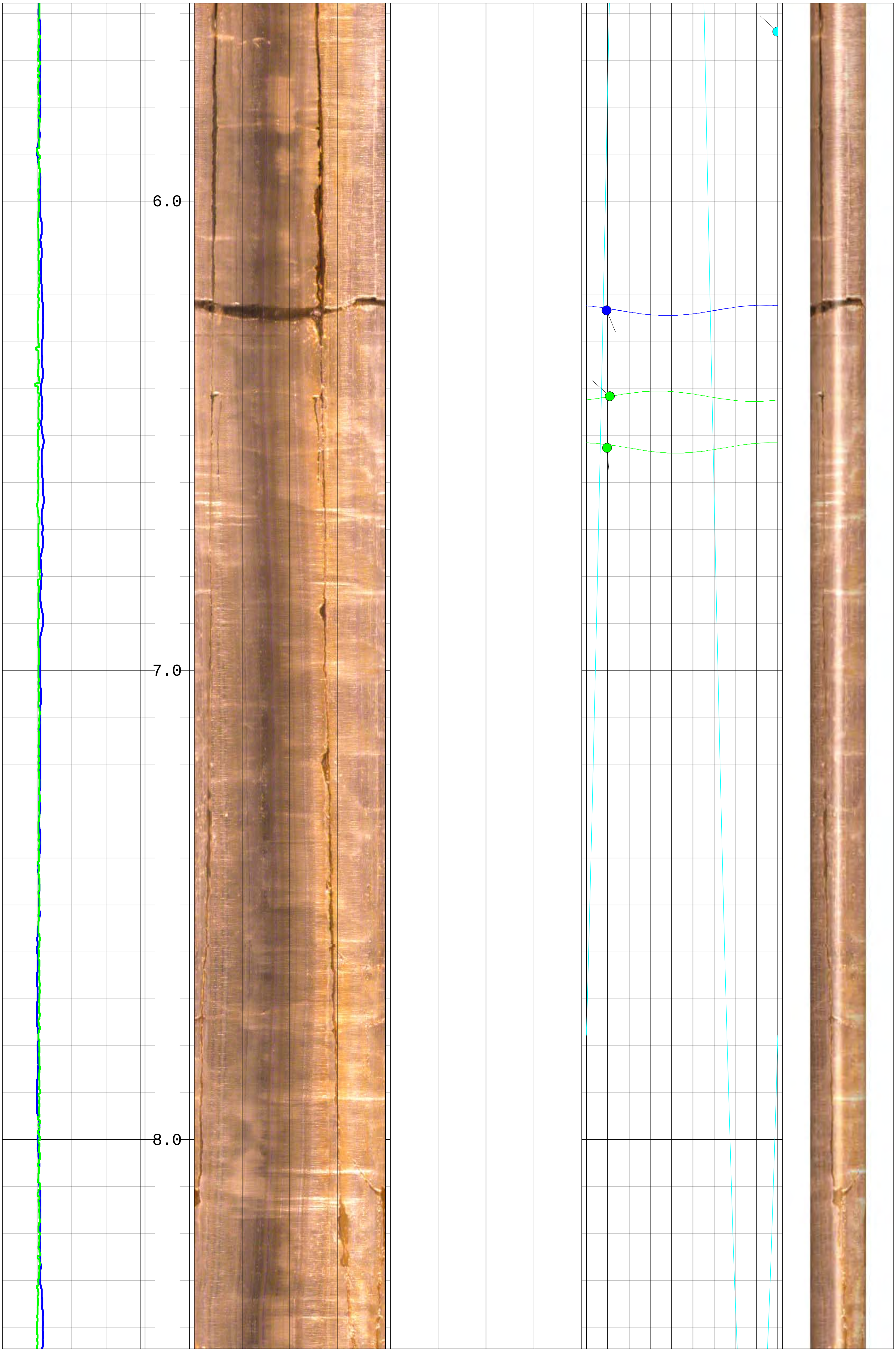
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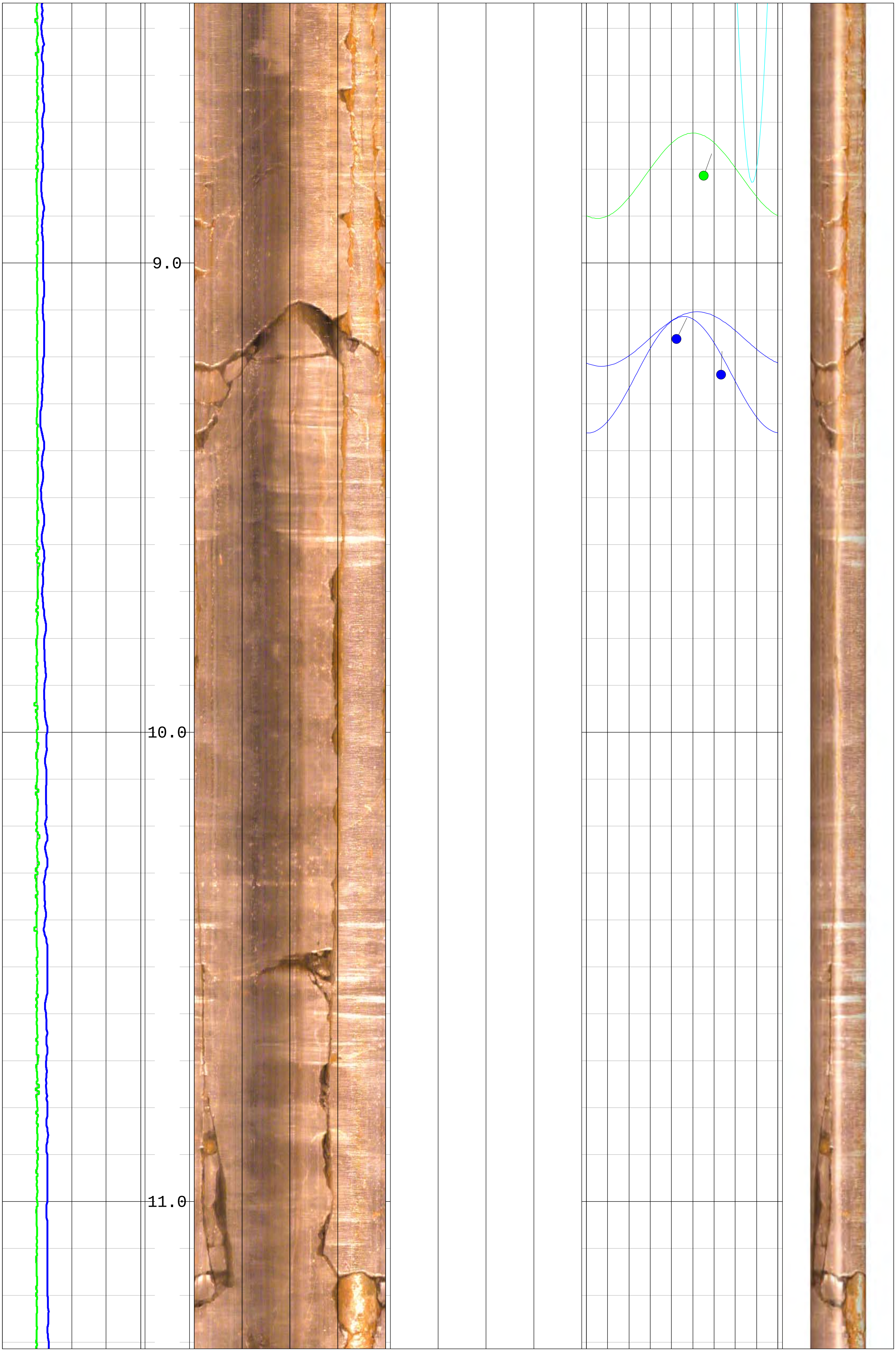
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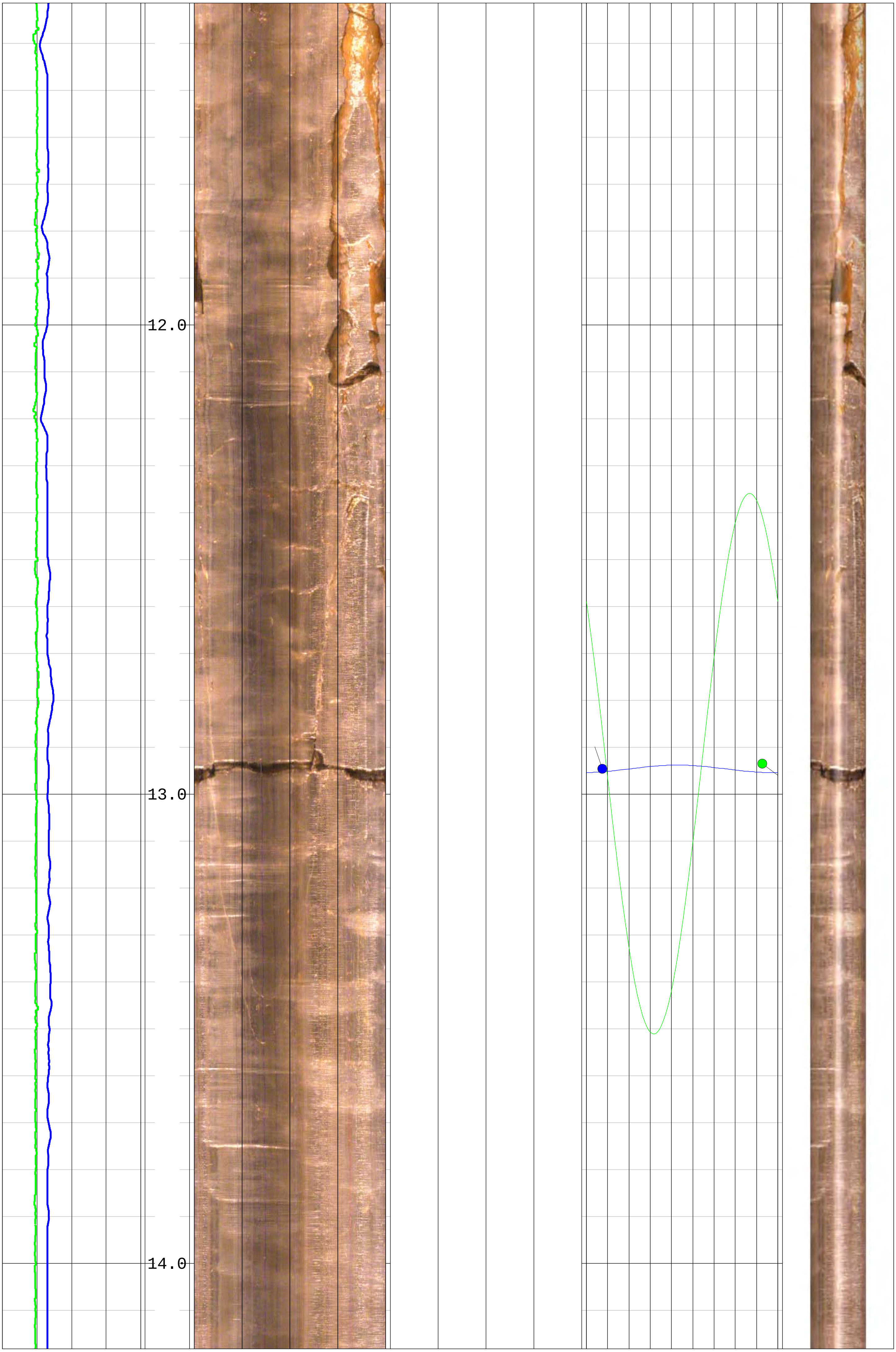
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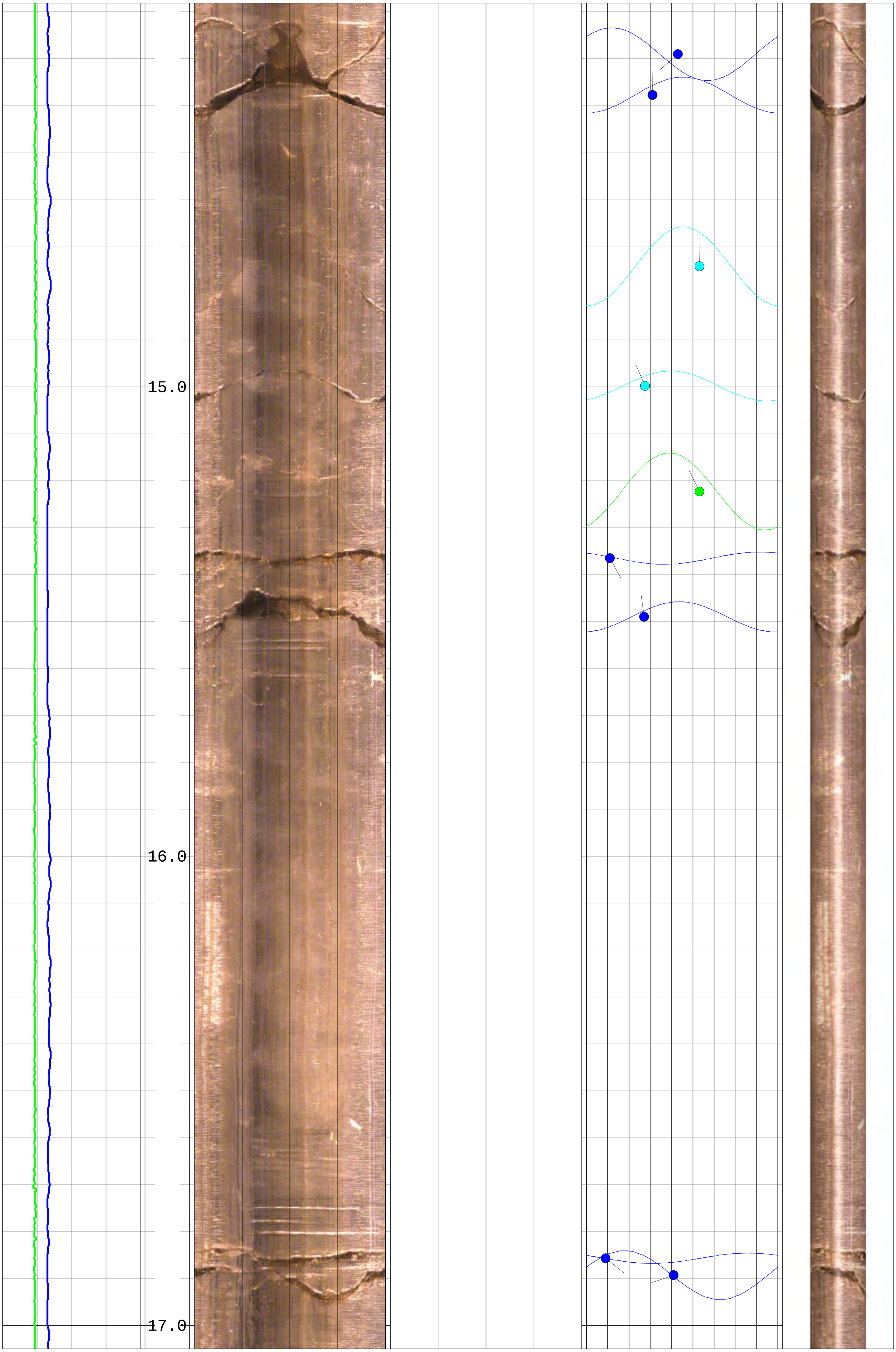
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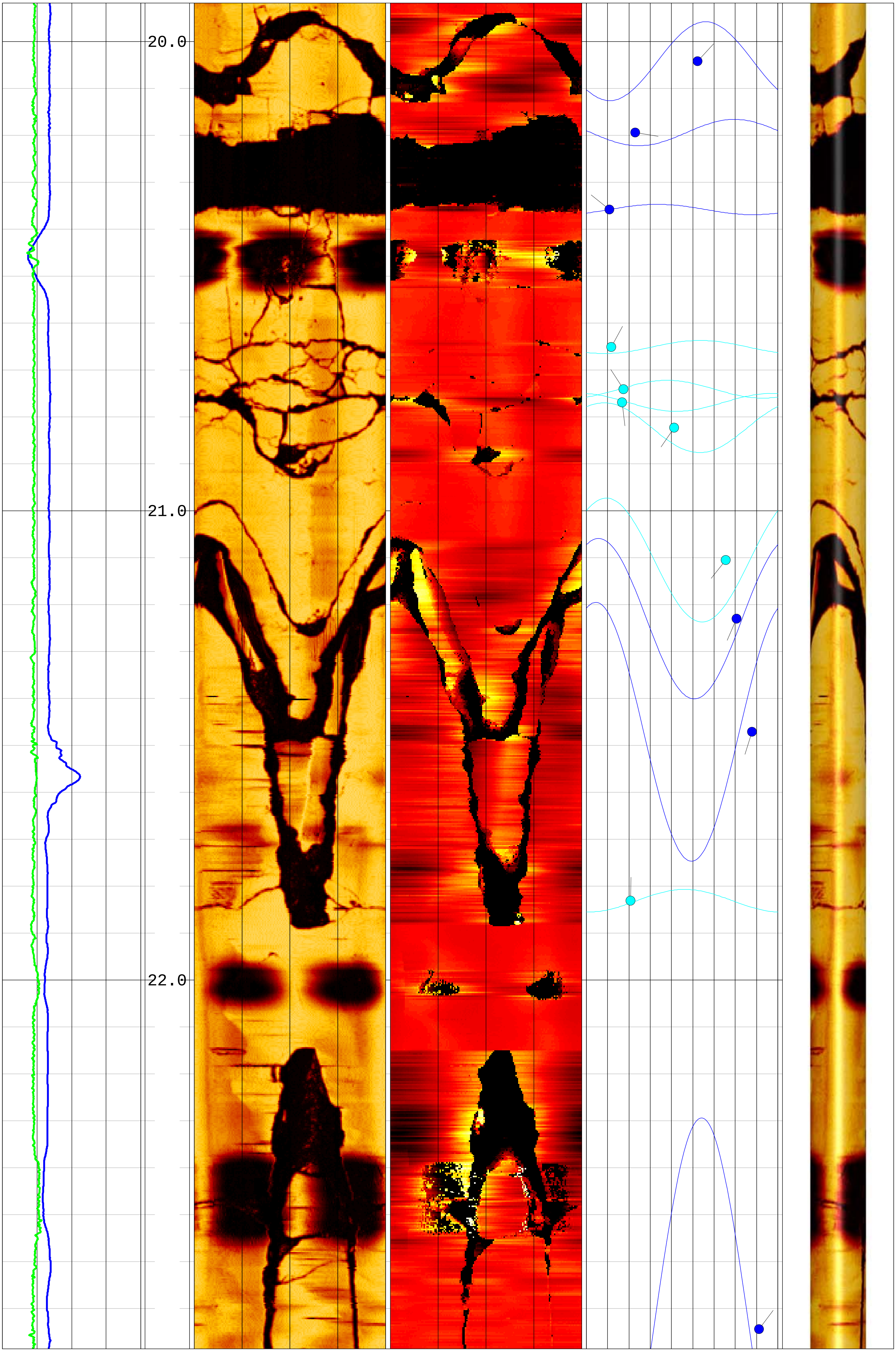
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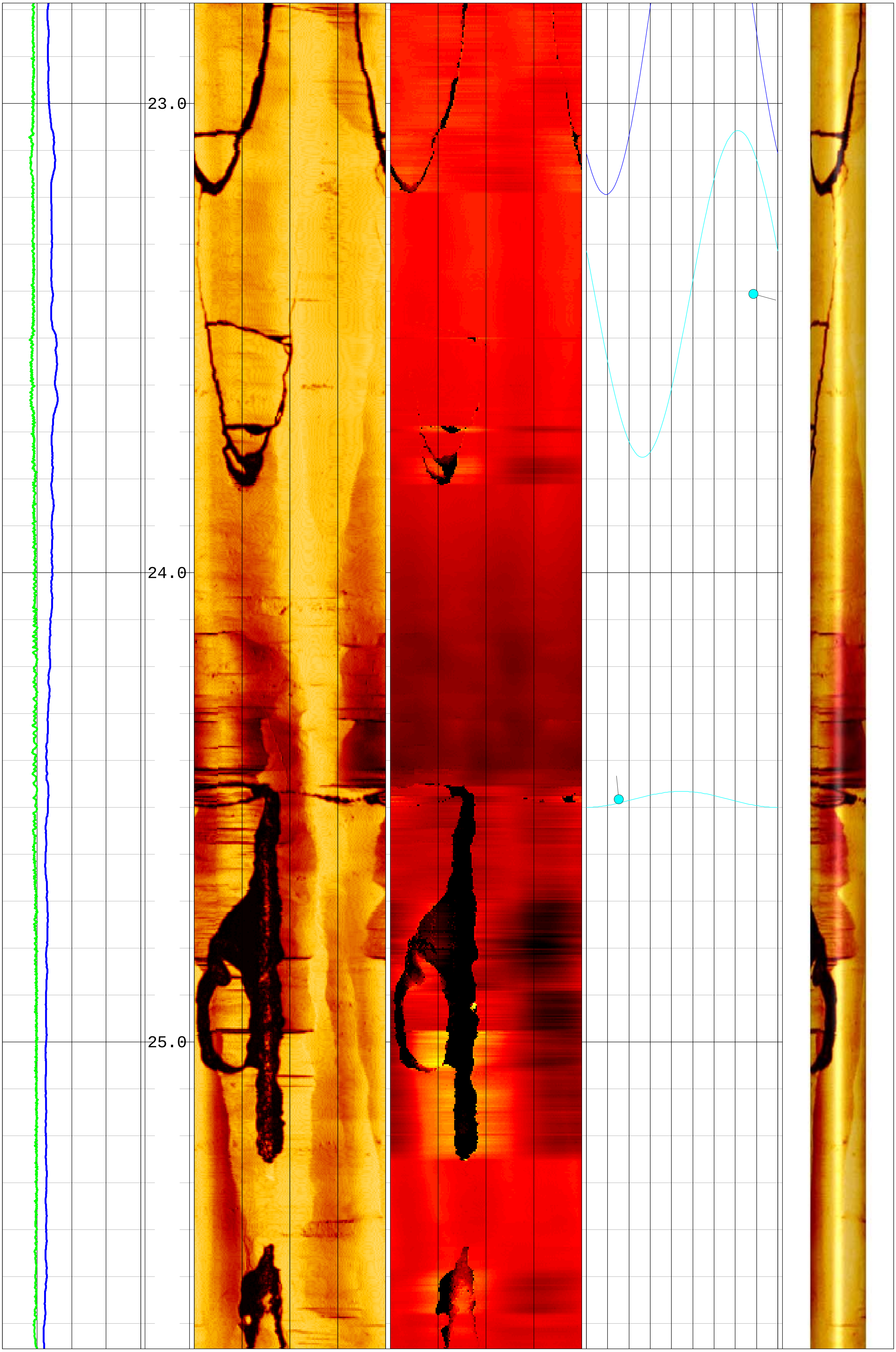
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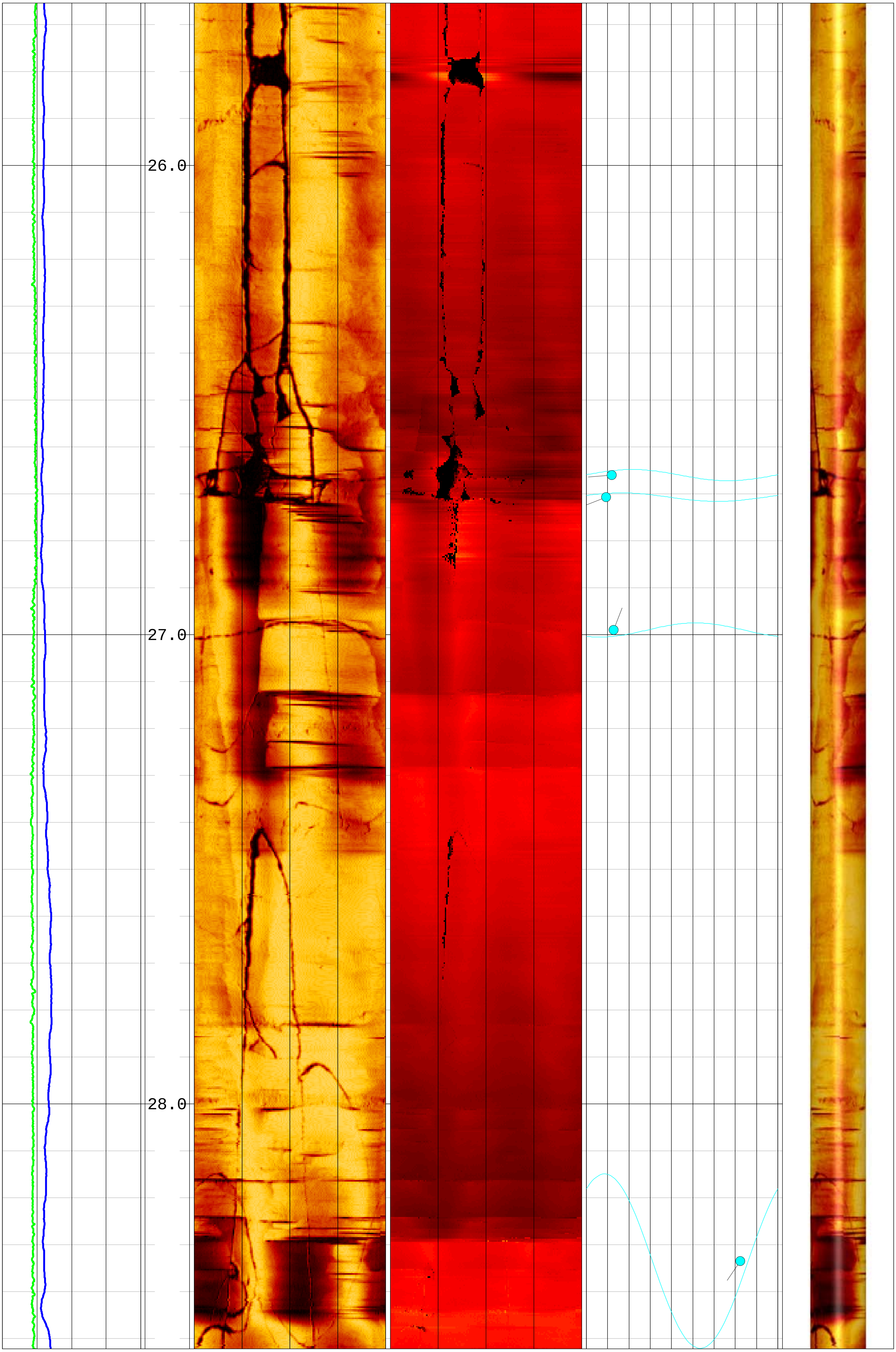
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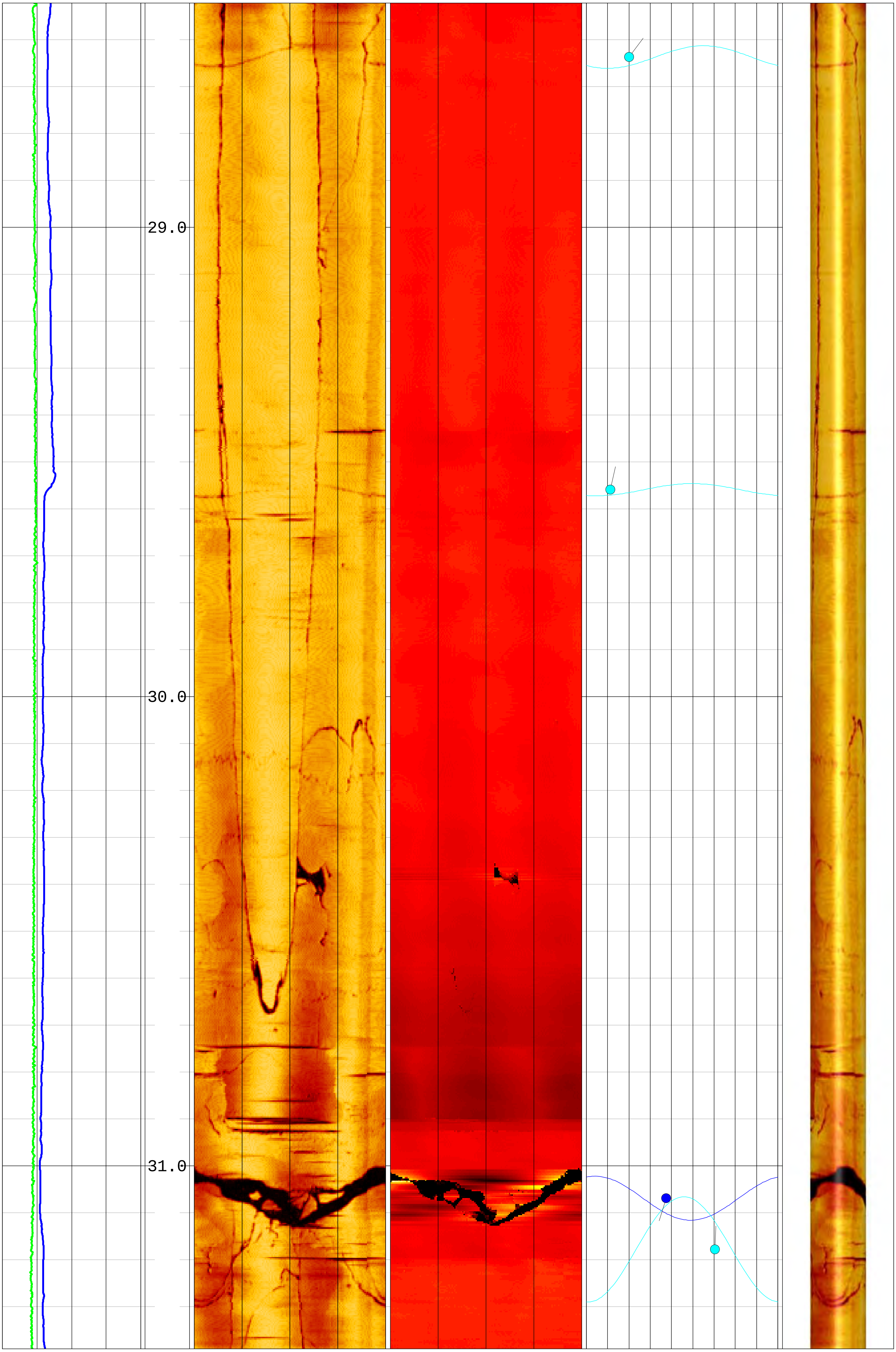
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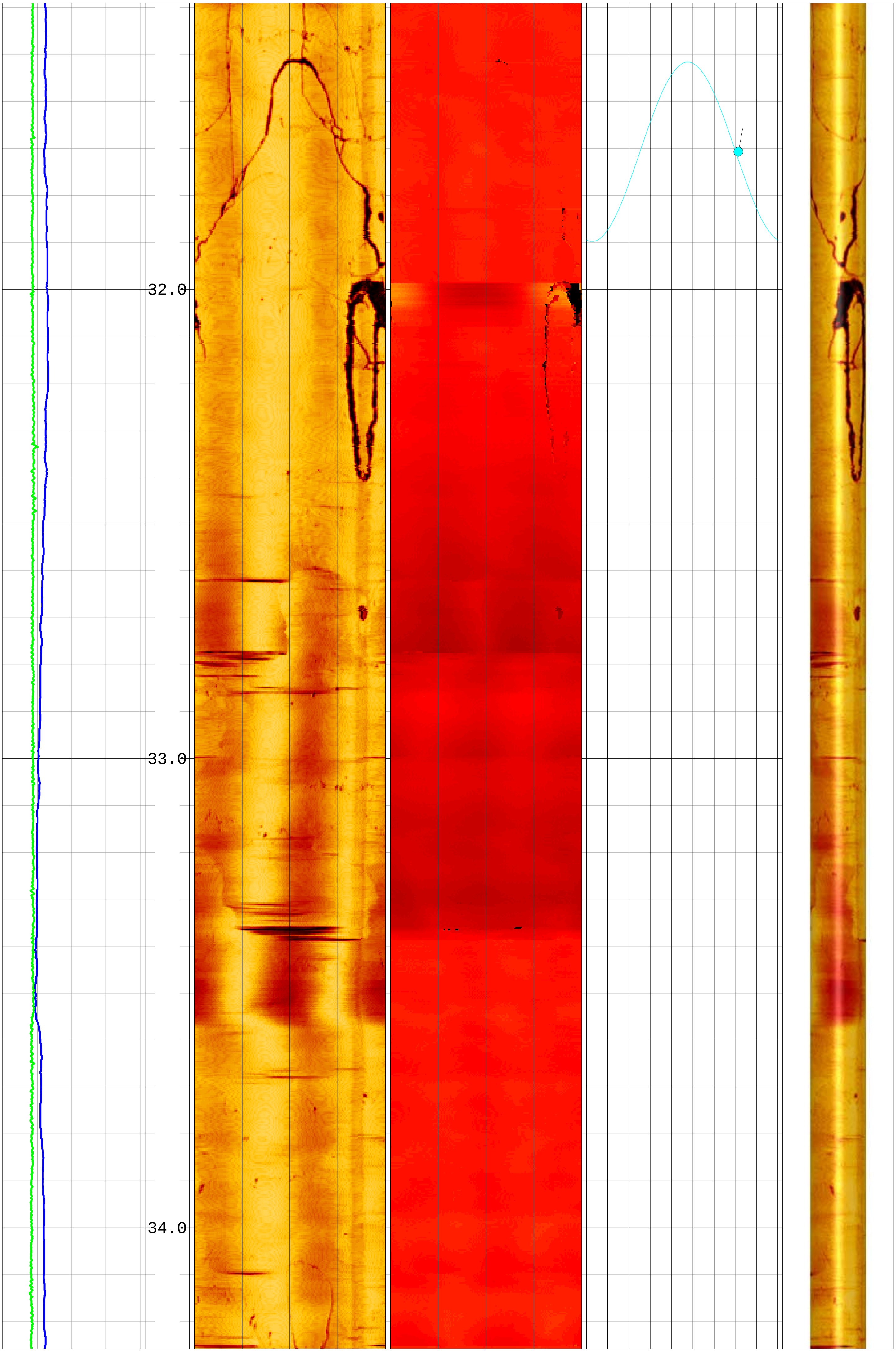
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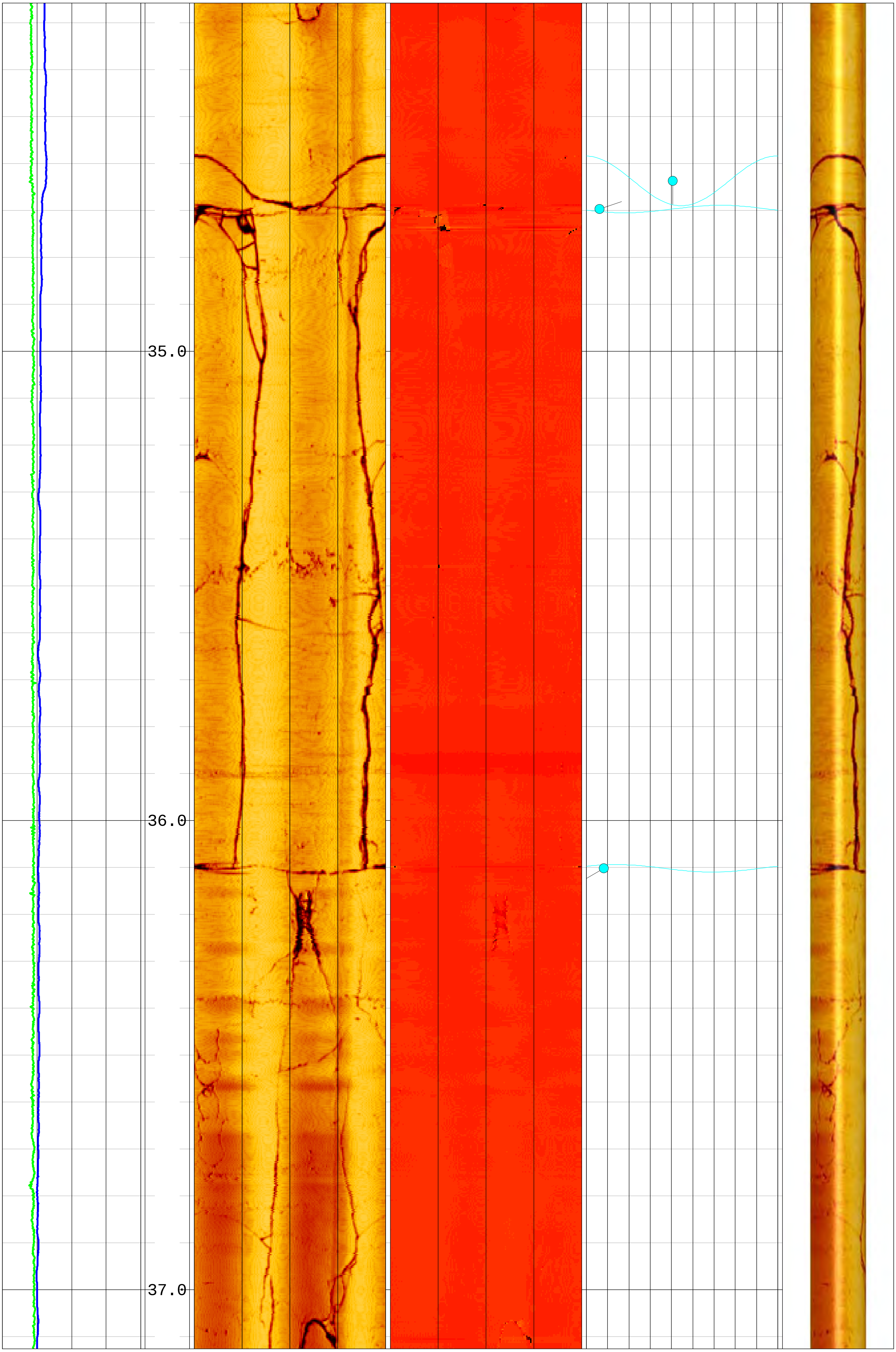
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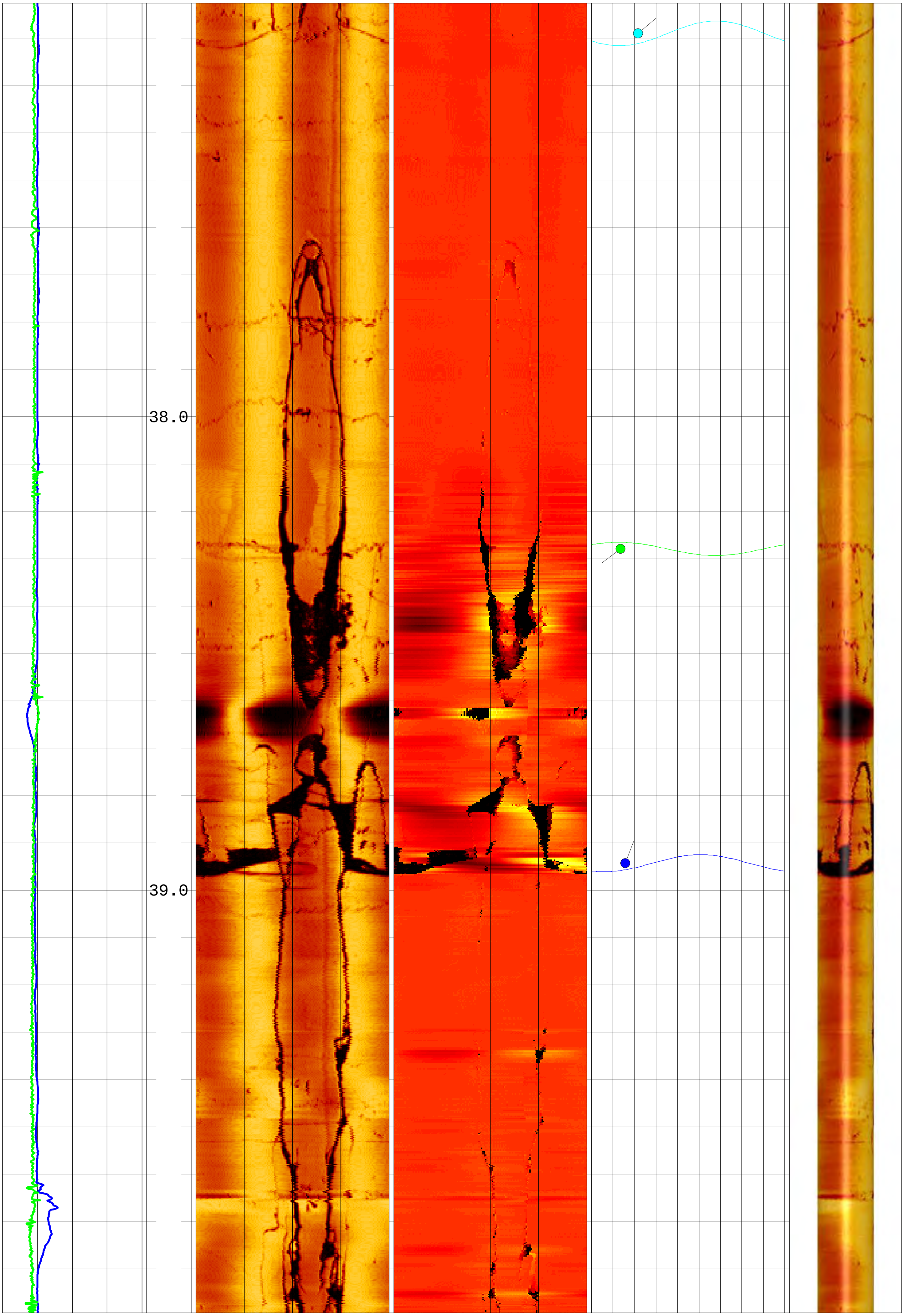

38.0
39.0

EUROPEAN GEOPHYSICAL SERVICES LTD

Client:	**Priority Drilling**	Log Type: ***Full Wave Sonic***
Borehole:	**BH5**	

Location: **Lackagh Quarry** Area: **Co. Galway** Grid Ref: Elevation:

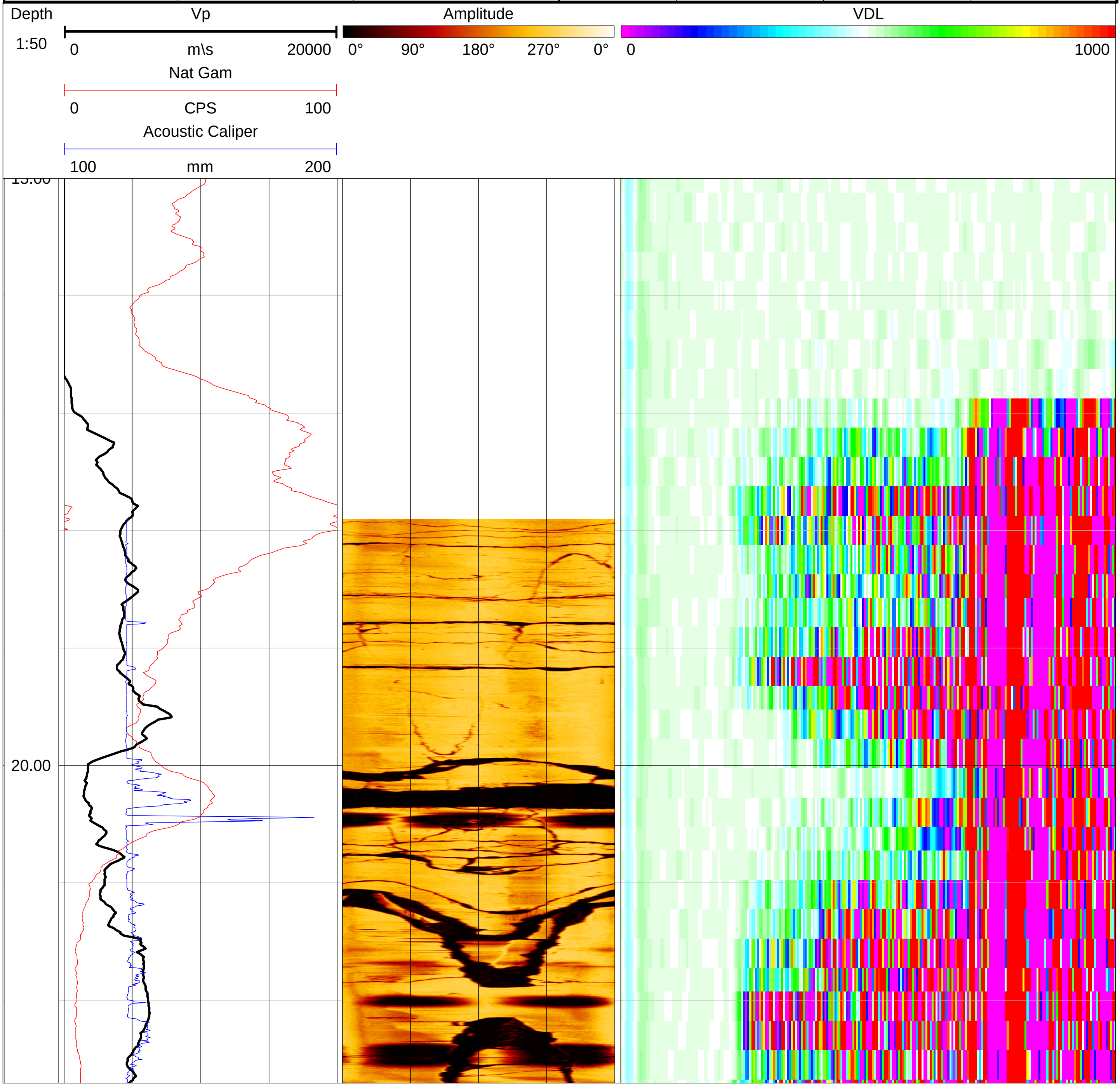
Drilled Depth: (m)	**40.3**	Date:	**8.12.15**
Logged Depth: (m)	**39.2**	Recorded By:	**Rhys Powell**
Logging Datum:	**Ground Level**	Remarks:	
Logged Interval: (m)	**16.9 - 39.2**		
Fluid Level: (m)	**16.9**	**Ref:**	

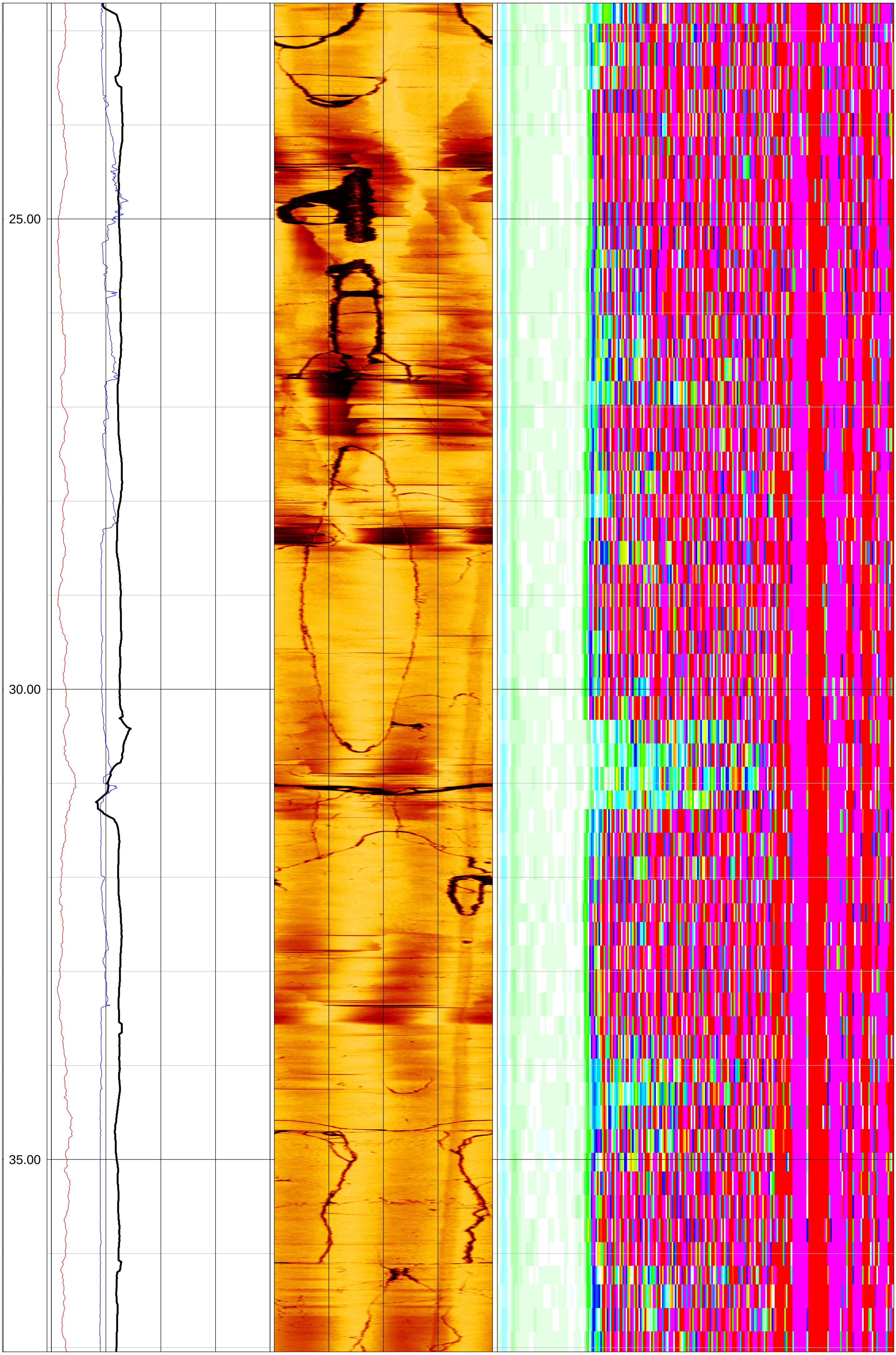
BOREHOLE RECORD

Bit: (mm)	From: (m)	To: (m)
122	**0.0**	**40.3**

CASING RECORD

Type	Size: (mm)	From: (m)	To: (m)
None			

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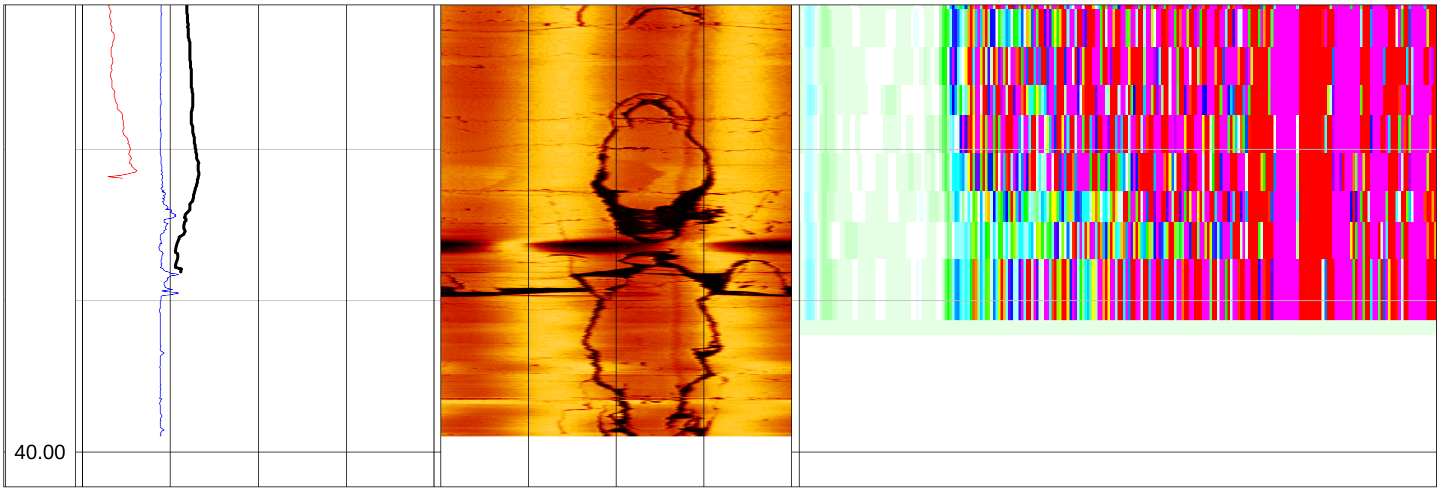
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APPENDIX VII

10% Fines

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 29 February 2016
Test Report Ref: STR 448031

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Ten Per Cent Fines Value (TFV) of aggregate sample 10mm and greater in accordance with **BS 812: Part 111: 1990.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**Bulk Sample**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**21/02/2016**
Sampling Location:	**Unknown**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Aggregate**
Target Specification	**N/A**

RESULTS:

Ten per cent fines value (DRY) = 150 kN

Comments

Has the “as received material” been altered by crushing in the laboratory: **Yes**

Report to nearest 10kN for forces of 100kN or more report to nearest 5kN for forces less than 100kN.

Certificate Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: -
Eric Goulden
Technical Manager

Aggregate Abrasion Value

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 29 February 2016
Test Report Ref: STR 448026

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Aggregate Abrasion Value (AAV) of aggregate sample, in accordance with **BS EN 1097-8 : 2009 Annex A**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**Bulk Sample**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**23/02/2016**
Sampling Location:	**Unknown**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Aggregate**
Target Specification:	**N/A**

RESULTS:

Aggregate Abrasion Value (Test 1) = 12.1 (three significant figures)
Aggregate Abrasion Value (Test 2) = 12.4 (three significant figures)

Mean Aggregate Abrasion Value = 12 (two significant figures)

Comments

None

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: -
Eric Goulden
Technical Manager

Aggregate Crushing Value

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 29 February 2016
Test Report Ref: STR 448024

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Aggregate Crushing Value (ACV) of aggregate sample, in accordance with **BS 812: Part 110: 1990.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**Bulk Sample**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**20/02/2016**
Sampling Location:	**Unknown**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Aggregate**
Target Specification:	**N/A**

RESULTS:

Aggregate Crushing Value (%) = **23 (nearest whole number)**

Comments

None

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: - EGoulden
Eric Goulden
Technical Manager

Aggregate Impact Value

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Contract: Lackagh Quarry

Date: 29 February 2016
Test Report Ref: STR 448025

Page 1 of 1

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Aggregate Impact Value (AIV) of aggregate sample – DRY, in accordance with **BS 812: Part 112: 1990.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**Bulk Sample**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**21/02/2016**
Sampling Location:	**Unknown**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Aggregate**
Target Specification:	**N/A**

RESULTS:

Aggregate Impact Value (DRY) (%) = 17 (nearest whole number)

Comments

If the AIV is greater than 30 then, the results should be treated with caution.
No departure from specified procedure.

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: -
Eric Goulden
Technical Manager

Deformability in Uniaxial Compression and Brazil Tests

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
REP. Of Ireland.
VAT No: 9D53971I

Date: 15th February 2016
Test Report Ref. STR: 443020

LABORATORY TEST REPORT

TEST REQUIREMENTS: Unconfined compressive strength, elastic moduli & indiect tensile strength by Brazil.

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**Various**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**8/12/2016**
Date of Start of Test.:	**15/12/2015**
Sampling Location:	**Various**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Aggregate Type and Nominal Size:	**Core**
Target Specification:	**N/A**

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

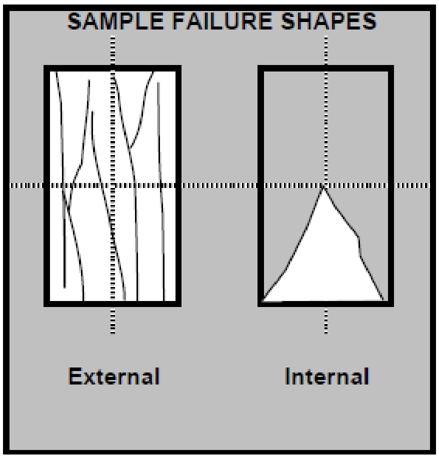
The work was carried out by our competent, sub contracted laboratory.

RESULTS

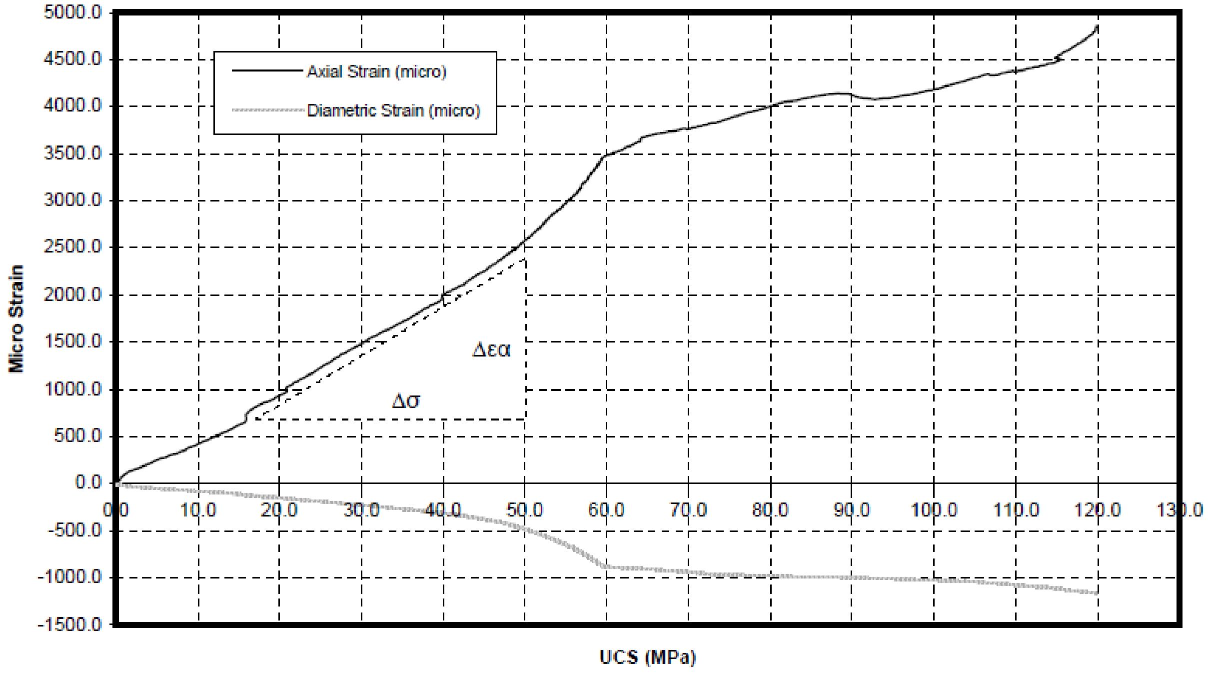
( ) E. R. Goulden Technical Manager Approved Signatories	( ) E. N. Jones Soils Laboratory Manager	(✓) N Dumbarton Assistant Laboratory Manager

BOREHOLE		**BH04**
CORE RUN		**48903**
DEPTH		**8.06-8.36**
SAMPLE DIAMETER	**mm**	**82.22**
SAMPLE HEIGHT	**mm**	**186.15**
WATER CONTENT	**%**	**0.0**
TEST CONDITION		**As Received**
RATE OF LOADING	**kN/s**	**0.7**
TEST DURATION	**mm.sec**	**14.21**
DATE OF TESTING		**24/01/2016**
LOAD FRAME USED		**2000kN**
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		**Perpendicular**
YOUNG'S MODULUS *E* (AVERAGE)	**GPa**	**18.60**
POISSON'S RATIO *v*		**0.20**
UNCONFINED COMPRESSIVE STRENGTH	**MPa**	**119.9**

SAMPLE FAILURE SHAPES

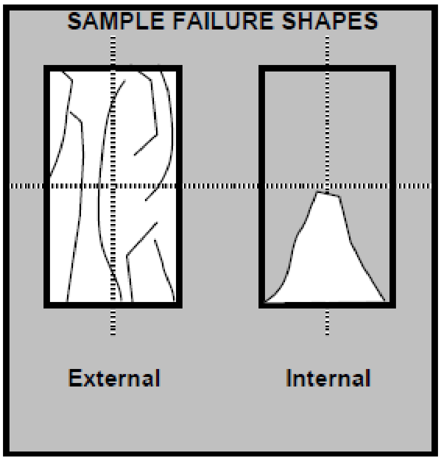


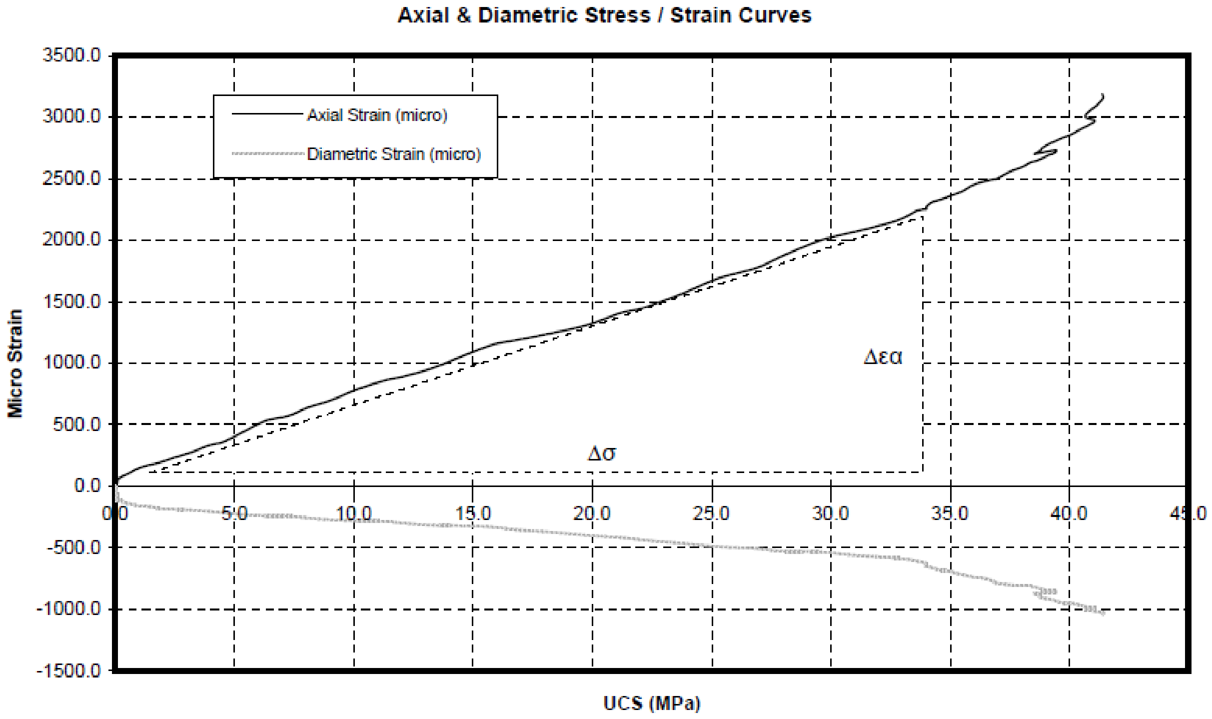
Axial & Diametric Stress / Strain Curves



Test Notes:
Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 16.6MPa and 50.1MPa

BOREHOLE		BH04
CORE RUN		48905
DEPTH		10.63-10.88
SAMPLE DIAMETER	mm	82.11
SAMPLE HEIGHT	mm	197.38
WATER CONTENT	%	0.1
TEST CONDITION		As Received
RATE OF LOADING	kN/s	0.6
TEST DURATION	mm.sec	6.4
DATE OF TESTING		25/01/2016
LOAD FRAME USED		2000kN
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Perpendicular
YOUNG'S MODULUS *E* (AVERAGE)	GPa	15.57
POISSON'S RATIO *v*		0.22
UNCONFINED COMPRESSIVE STRENGTH	MPa	41.6

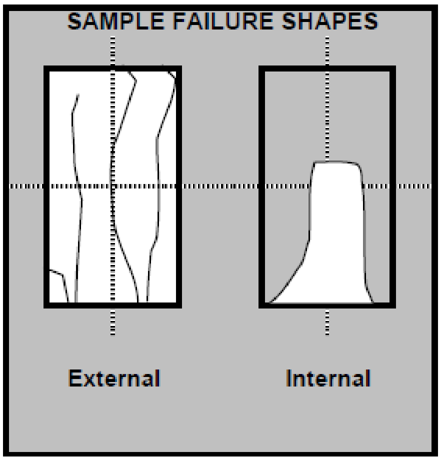


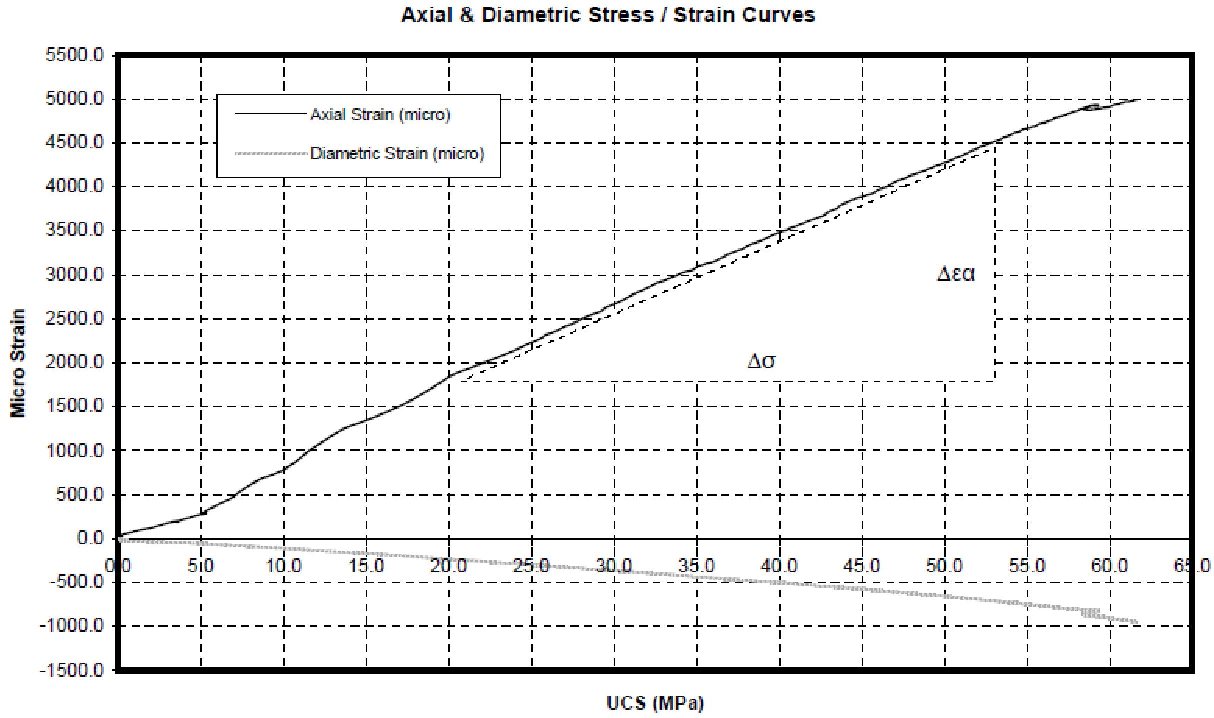


Test Notes:

Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 1MPa and 34MPa

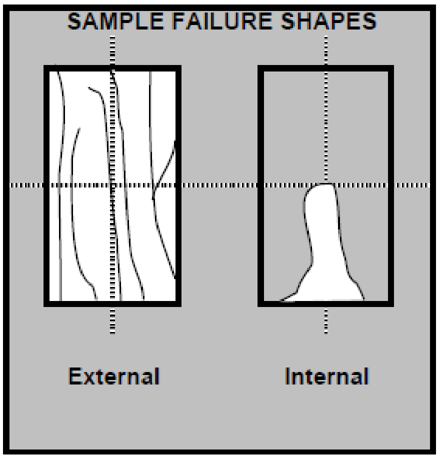
BOREHOLE		BH04
CORE RUN		48910
DEPTH		14.40-14.63
SAMPLE DIAMETER	mm	82.43
SAMPLE HEIGHT	mm	186.76
WATER CONTENT	%	0.2
TEST CONDITION		As Received
RATE OF LOADING	kN/s	0.8
TEST DURATION	mm.sec	6.52
DATE OF TESTING		25/01/2016
LOAD FRAME USED		2000kN
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Perpendicular
YOUNG'S MODULUS *E* (AVERAGE)	GPa	12.33
POISSON'S RATIO *v*		0.18
UNCONFINED COMPRESSIVE STRENGTH	MPa	62.0

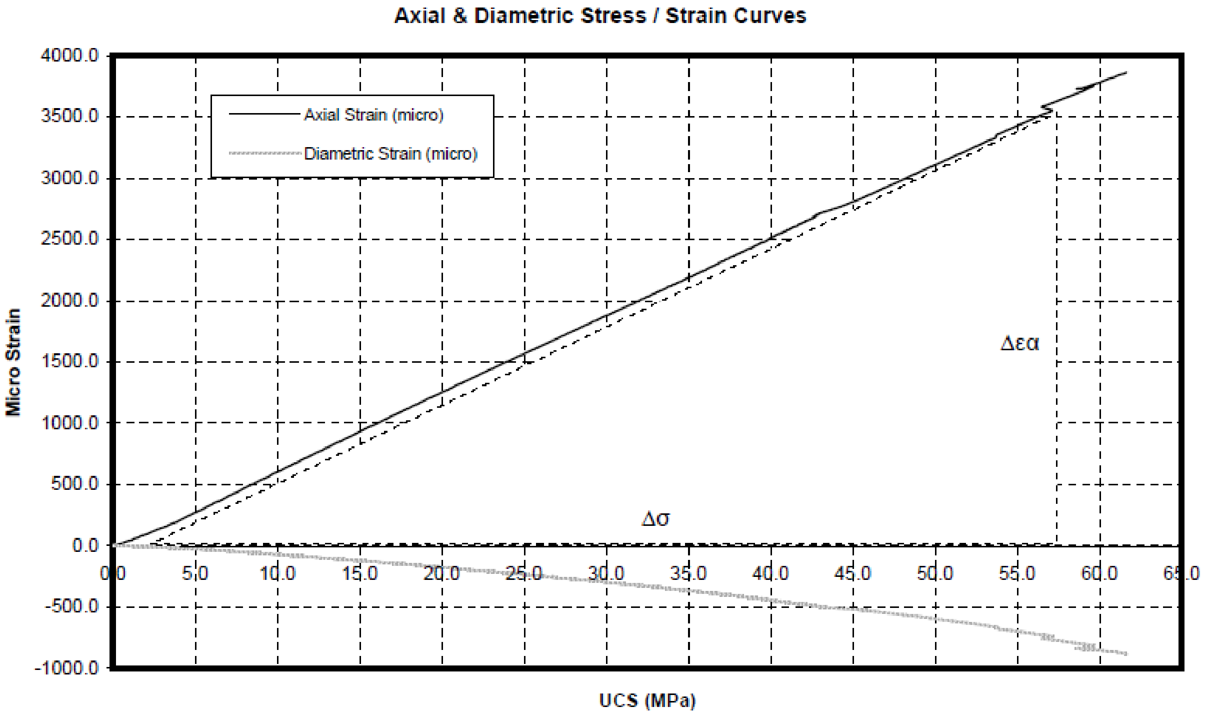




Test Notes:
Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 20.2MPa and 52.9MPa

BOREHOLE		BH04
CORE RUN		48935
DEPTH		25.19-25.41
SAMPLE DIAMETER	mm	81.94
SAMPLE HEIGHT	mm	186.81
WATER CONTENT	%	0.1
TEST CONDITION		As Received
RATE OF LOADING	kN/s	0.7
TEST DURATION	mm.sec	8.34
DATE OF TESTING		25/01/2016
LOAD FRAME USED		2000kN
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Perpendicular
YOUNG'S MODULUS *E* (AVERAGE)	GPa	15.68
POISSON'S RATIO *v*		0.20
UNCONFINED COMPRESSIVE STRENGTH	MPa	64.1

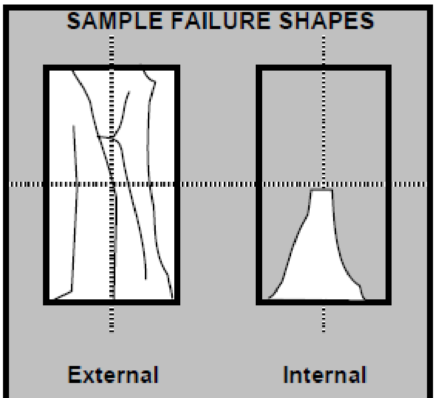




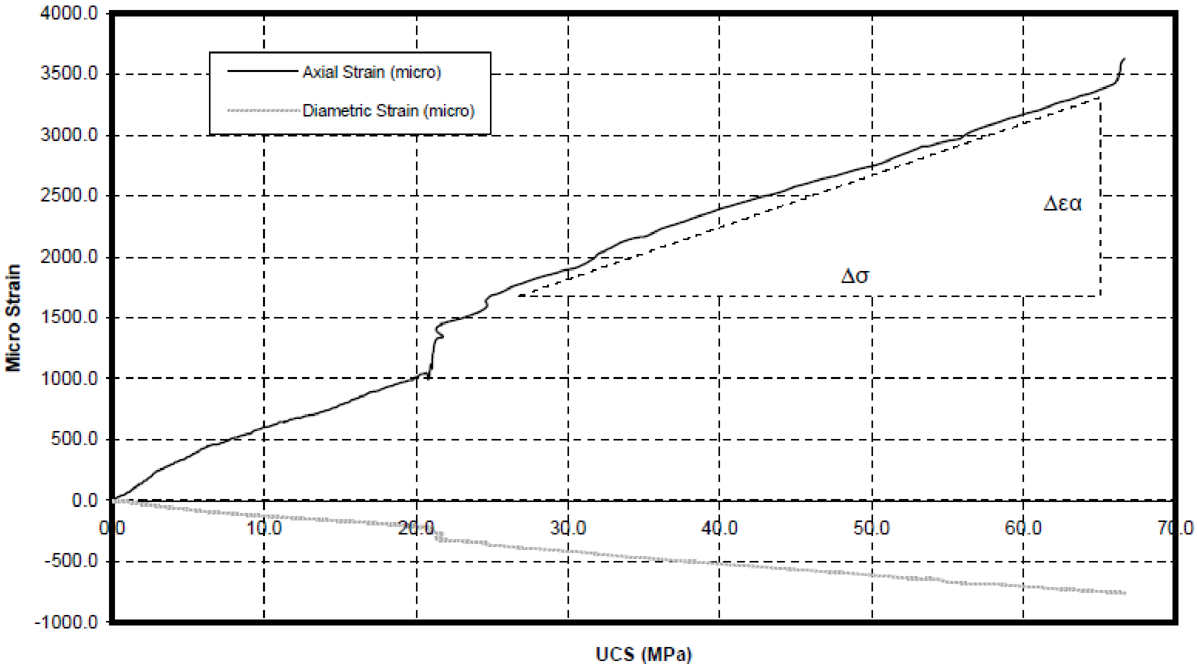
Test Notes:
Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 2MPa and 57.5MPa

BOREHOLE		BH04
CORE RUN		48966
DEPTH		33.20-33.48
SAMPLE DIAMETER	mm	82.14
SAMPLE HEIGHT	mm	184.83
WATER CONTENT	%	0.1
TEST CONDITION		As Received
RATE OF LOADING	kN/s	1.1
TEST DURATION	mm.sec	5.11
DATE OF TESTING		25/01/2016
LOAD FRAME USED		2000kN
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Perpendicular
YOUNG'S MODULUS *E* (AVERAGE)	GPa	23.77
POISSON'S RATIO *v*		0.23
UNCONFINED COMPRESSIVE STRENGTH	MPa	66.5

SAMPLE FAILURE SHAPES

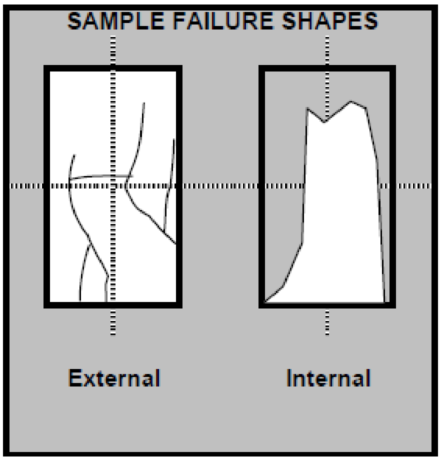


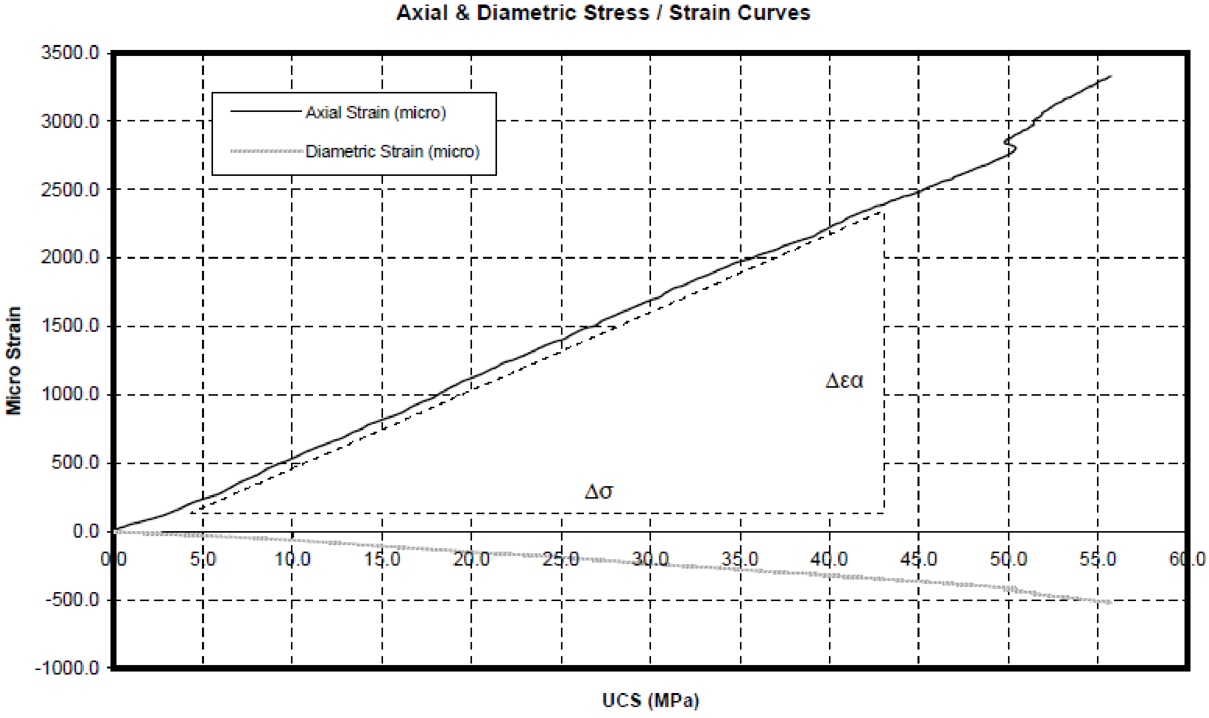
Axial & Diametric Stress / Strain Curves



Test Notes:
Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 25.9MPa and 65.1MPa

BOREHOLE		BH05
CORE RUN		48996
DEPTH		15.95-16.22
SAMPLE DIAMETER	mm	82.33
SAMPLE HEIGHT	mm	187.90
WATER CONTENT	%	0.2
TEST CONDITION		As Received
RATE OF LOADING	kN/s	0.5
TEST DURATION	mm.sec	9.58
DATE OF TESTING		21/01/2016
LOAD FRAME USED		2000kN
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Perpendicular
YOUNG'S MODULUS *E* (AVERAGE)	GPa	17.68
POISSON'S RATIO *v*		0.15
UNCONFINED COMPRESSIVE STRENGTH	MPa	57.0

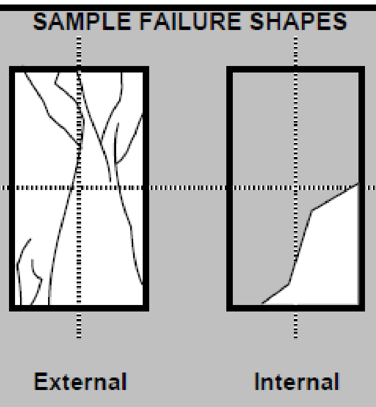




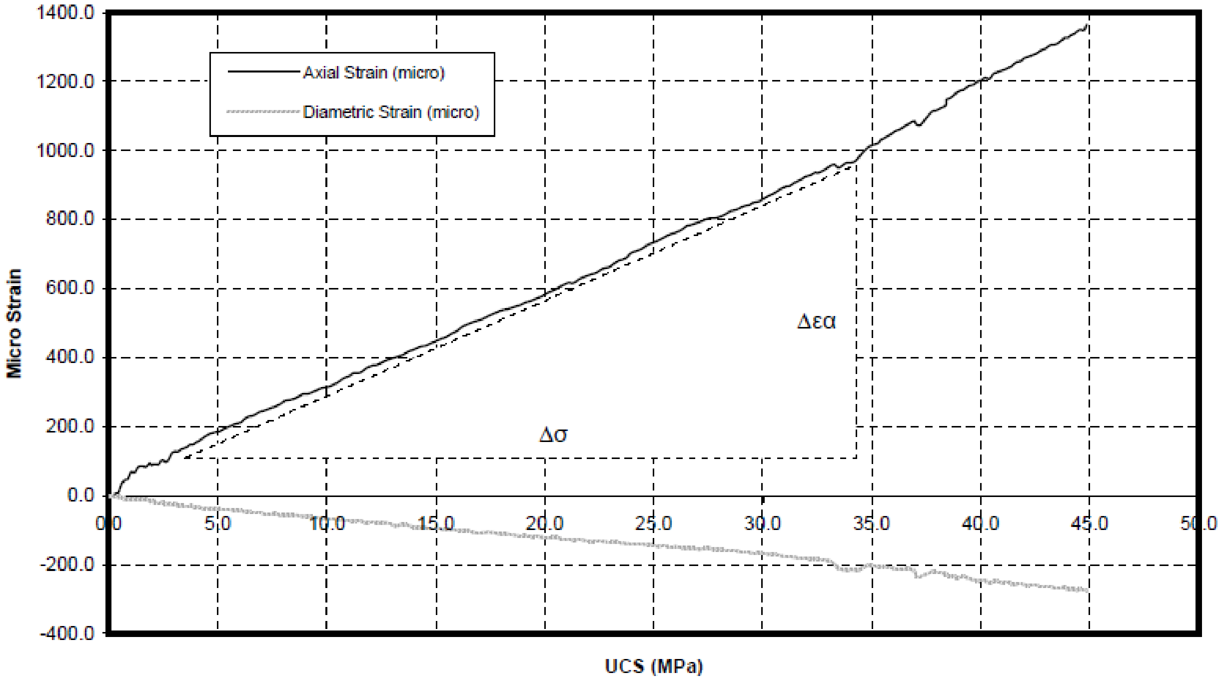
Test Notes:
Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 3.6MPa and 43MPa

BOREHOLE		BH05
CORE RUN		50706
DEPTH		24.05-24.30
SAMPLE DIAMETER	mm	81.06
SAMPLE HEIGHT	mm	187.95
WATER CONTENT	%	0.1
TEST CONDITION		As Received
RATE OF LOADING	kN/s	0.7
TEST DURATION	mm.sec	5.38
DATE OF TESTING		24/01/2016
LOAD FRAME USED		2000kN
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Perpendicular
YOUNG'S MODULUS *E* (AVERAGE)	GPa	36.97
POISSON'S RATIO *v*		0.20
UNCONFINED COMPRESSIVE STRENGTH	MPa	44.9

SAMPLE FAILURE SHAPES

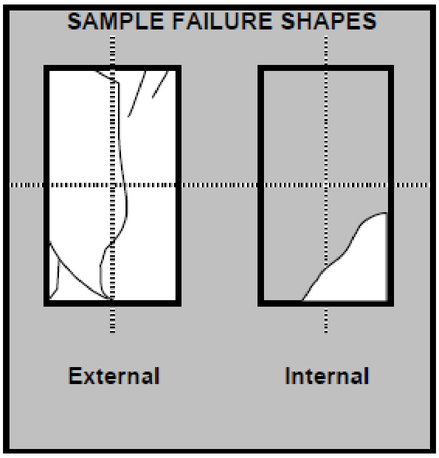


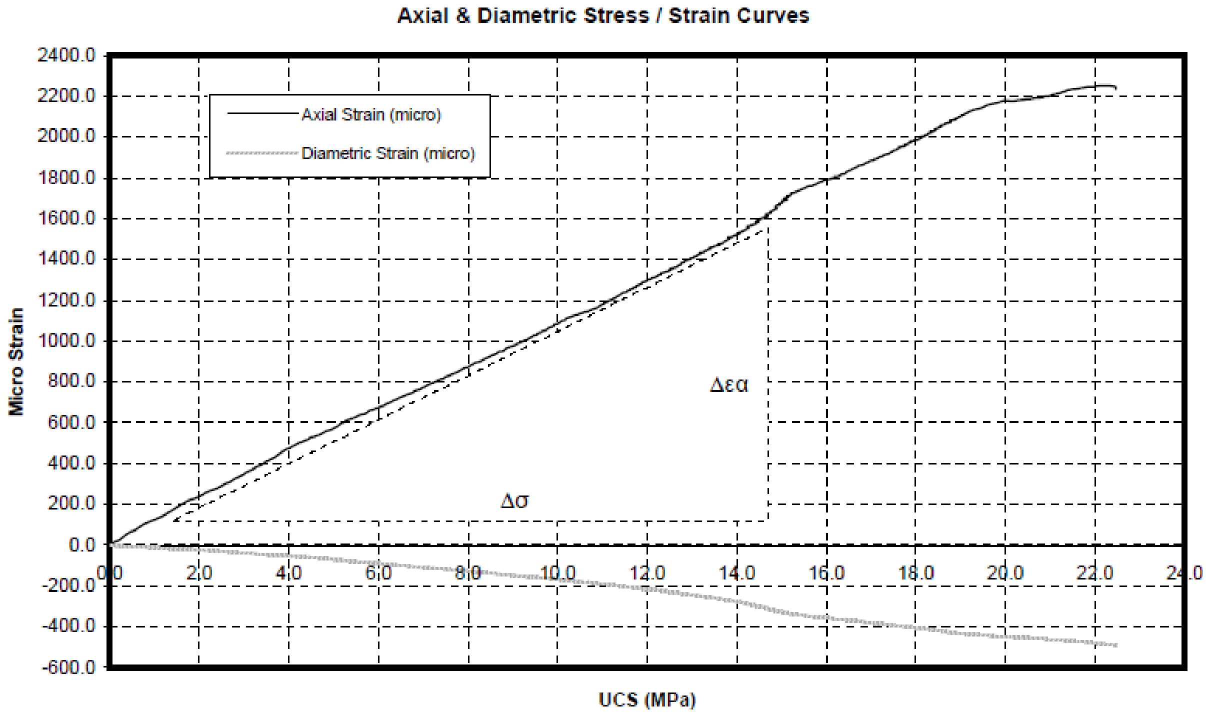
Axial & Diametric Stress / Strain Curves



Test Notes:
Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 3.1MPa and 34.3MPa

BOREHOLE		**BH05**
CORE RUN		**50708**
DEPTH		**25.20-25.40**
SAMPLE DIAMETER	**mm**	**82.08**
SAMPLE HEIGHT	**mm**	**190.12**
WATER CONTENT	**%**	**0.1**
TEST CONDITION		**As Received**
RATE OF LOADING	**kN/s**	**0.6**
TEST DURATION	**mm.sec**	**3.21**
DATE OF TESTING		**25/01/2016**
LOAD FRAME USED		**2000kN**
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		**Perpendicular**
YOUNG'S MODULUS *E* (AVERAGE)	**GPa**	**9.10**
POISSON'S RATIO *v*		**0.21**
UNCONFINED COMPRESSIVE STRENGTH	**MPa**	**22.6**

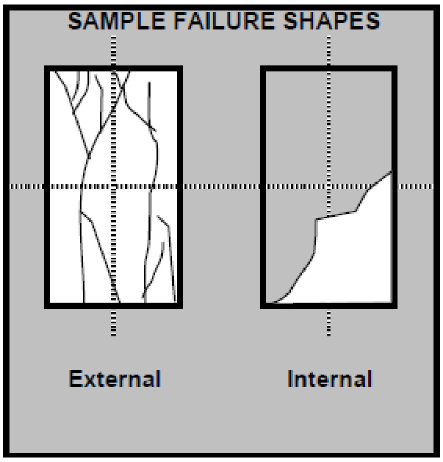




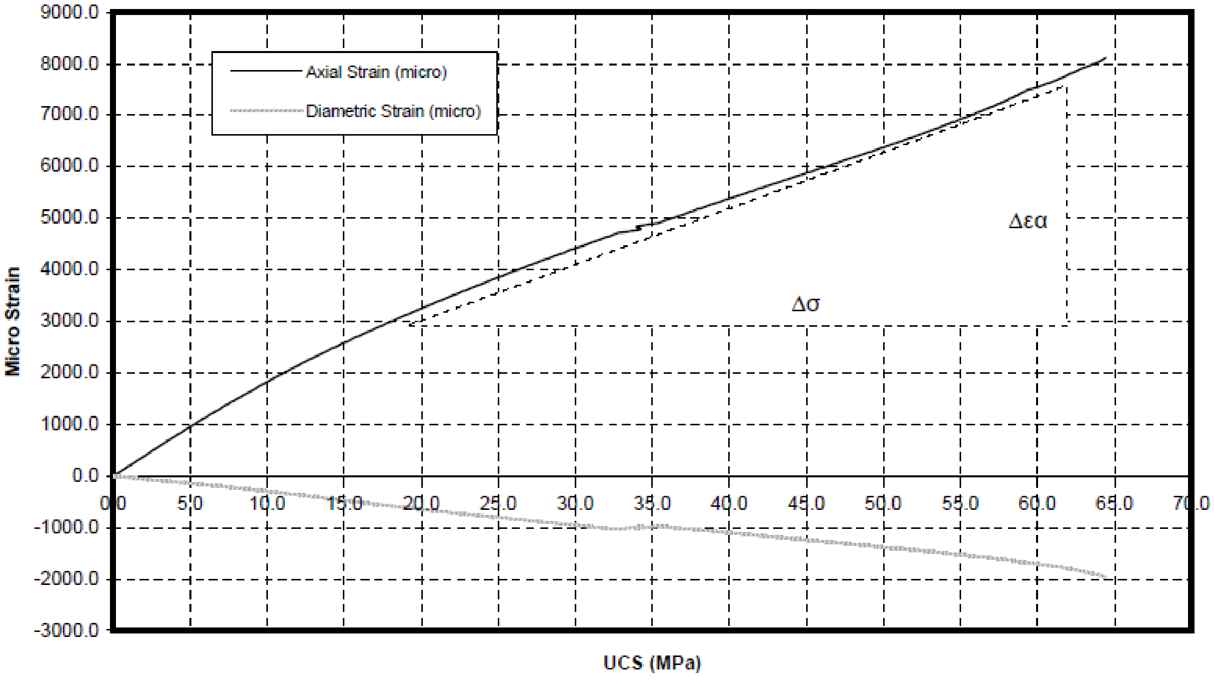
Test Notes:
Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 1.2MPa and 14.8MPa

BOREHOLE		BH05
CORE RUN		50710
DEPTH		26.12-26.35
SAMPLE DIAMETER	mm	79.70
SAMPLE HEIGHT	mm	181.09
WATER CONTENT	%	0.1
TEST CONDITION		As Received
RATE OF LOADING	kN/s	0.8
TEST DURATION	mm.sec	7.14
DATE OF TESTING		24/01/2016
LOAD FRAME USED		2000kN
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Perpendicular
YOUNG'S MODULUS *E* (AVERAGE)	GPa	9.18
POISSON'S RATIO *v*		0.24
UNCONFINED COMPRESSIVE STRENGTH	MPa	66.3

SAMPLE FAILURE SHAPES



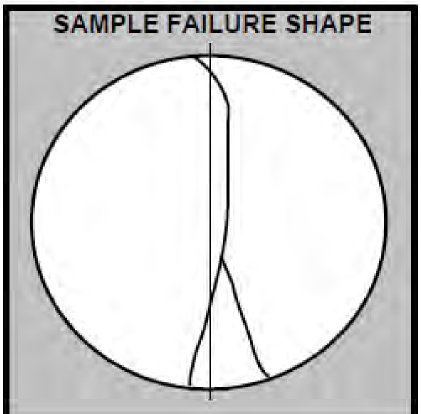
Axial & Diametric Stress / Strain Curves



Test Notes:
Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 18.8MPa and 62.4MPa

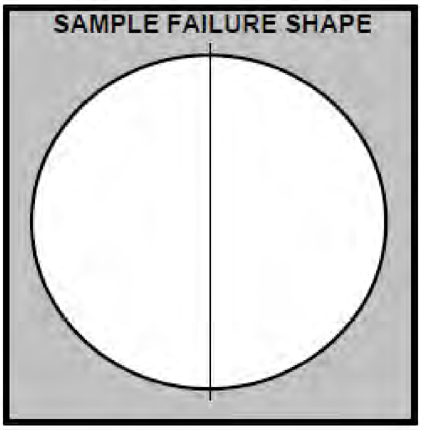
BOREHOLE		BH04
CORE RUN		48941
DEPTH		29.38-29.54
SAMPLE DIAMETER	mm	82.10
SAMPLE THICKNESS	mm	38.53
WATER CONTENT	%	0.1
DEGREE OF SATURATION	%	N/A
STRESS RATE	kN/s	1.90
TEST DURATION	secs	16
DATE OF TESTING		21-Jan-16
LOAD FRAME USED		Impact
ORIENTATION OF LOADING		Diam
TENSILE STRENGTH	MPa	5.97

SAMPLE FAILURE SHAPE



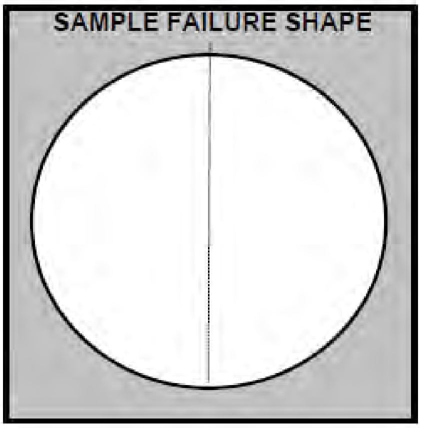
BOREHOLE		
CORE RUN		
DEPTH		
SAMPLE DIAMETER	mm	
SAMPLE THICKNESS	mm	
WATER CONTENT	%	
DEGREE OF SATURATION	%	
STRESS RATE	kN/s	
TEST DURATION	secs	
DATE OF TESTING		
LOAD FRAME USED		
ORIENTATION OF LOADING		
TENSILE STRENGTH	MPa	

SAMPLE FAILURE SHAPE

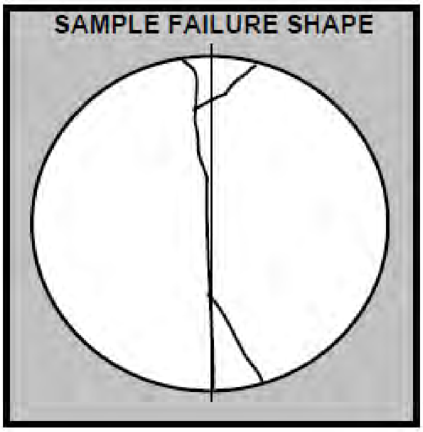


BOREHOLE		
CORE RUN		
DEPTH		
SAMPLE DIAMETER	mm	
SAMPLE THICKNESS	mm	
WATER CONTENT	%	
DEGREE OF SATURATION	%	
STRESS RATE	kN/s	
TEST DURATION	secs	
DATE OF TESTING		
LOAD FRAME USED		
ORIENTATION OF LOADING		
TENSILE STRENGTH	MPa	

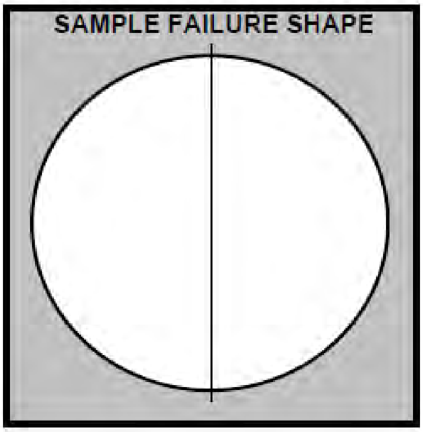
SAMPLE FAILURE SHAPE



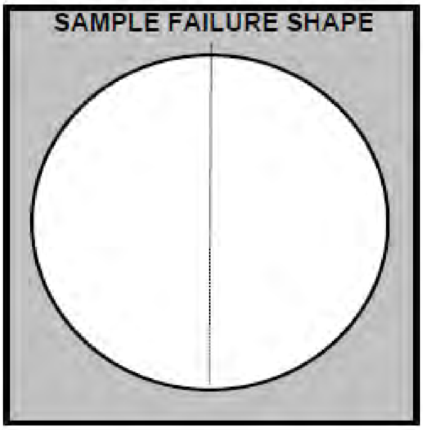
BOREHOLE		BH05
CORE RUN		50701
DEPTH		19.70-19.92
SAMPLE DIAMETER	mm	82.24
SAMPLE THICKNESS	mm	41.12
WATER CONTENT	%	0.2
DEGREE OF SATURATION	%	N/A
STRESS RATE	kN/s	0.80
TEST DURATION	secs	22
DATE OF TESTING		21-Jan-16
LOAD FRAME USED		Impact
ORIENTATION OF LOADING		Diam
TENSILE STRENGTH	MPa	3.39



BOREHOLE		
CORE RUN		
DEPTH		
SAMPLE DIAMETER	mm	
SAMPLE THICKNESS	mm	
WATER CONTENT	%	
DEGREE OF SATURATION	%	
STRESS RATE	kN/s	
TEST DURATION	secs	
DATE OF TESTING		
LOAD FRAME USED		
ORIENTATION OF LOADING		
TENSILE STRENGTH	MPa	



BOREHOLE		
CORE RUN		
DEPTH		
SAMPLE DIAMETER	mm	
SAMPLE THICKNESS	mm	
WATER CONTENT	%	
DEGREE OF SATURATION	%	
STRESS RATE	kN/s	
TEST DURATION	secs	
DATE OF TESTING		
LOAD FRAME USED		
ORIENTATION OF LOADING		
TENSILE STRENGTH	MPa	



Priority Drilling Ltd.
Killimor
Ballinasloe
Co Galway
Ireland
8D23036i

Date: 29th March 2016
Test Report Ref. STR: 447866

LABORATORY TEST REPORT

TEST REQUIREMENTS: Unconfined compressive strength, elastic moduli & indirect tensile strength by Brazil.

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**Various**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test.:	**18/03/2016**
Sampling Location:	**Various**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Aggregate Type and Nominal Size:	**Rock Testing**
Target Specification:	**N/A**

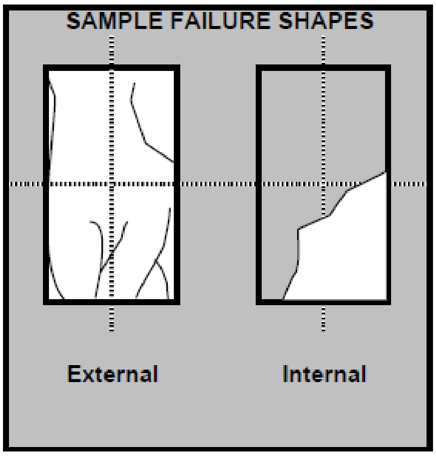
COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The work was carried out by our competent, sub contracted laboratory.

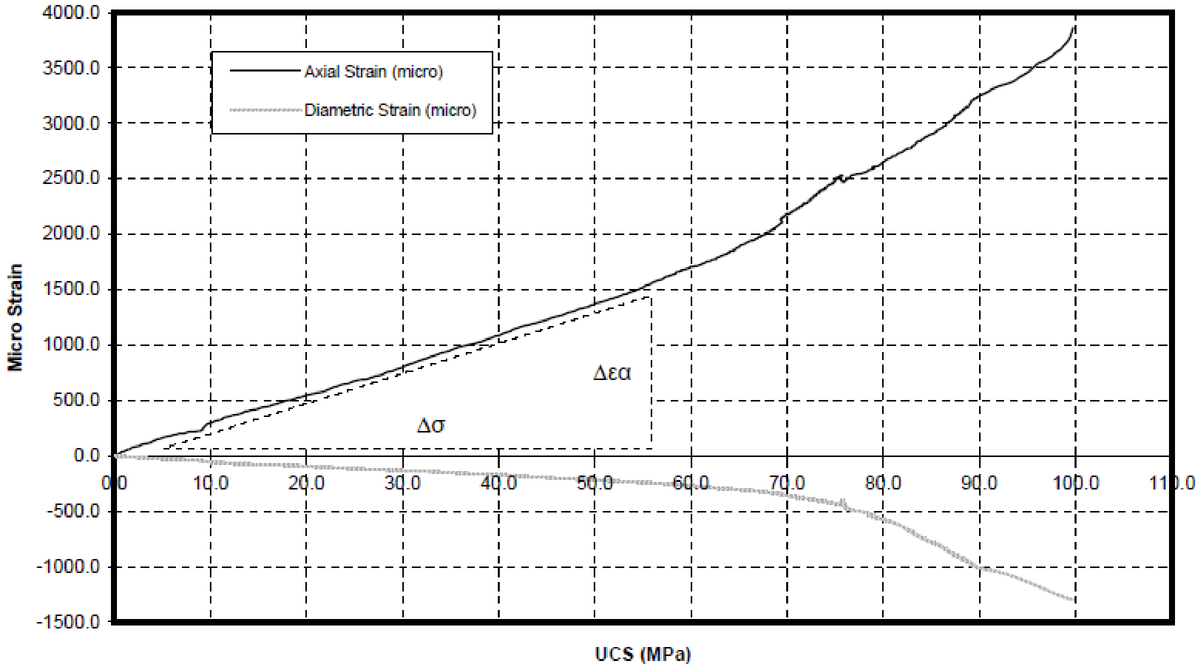
RESULTS

( ) E. R. Goulden Technical Manager Approved Signatories	( ) E. N. Jones Soils Laboratory Manager	(✓) N Dumbarton Assistant Laboratory Manager

BOREHOLE		BH01
CORE RUN		48867
DEPTH		11.57-11.94
SAMPLE DIAMETER	mm	61.08
SAMPLE HEIGHT	mm	137.42
WATER CONTENT	%	0.2
TEST CONDITION		As Received
RATE OF LOADING	kN/s	0.6
TEST DURATION	mm.sec	8.18
DATE OF TESTING		22/03/2016
LOAD FRAME USED		2000kN
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Perpendicular
YOUNG'S MODULUS *E* (AVERAGE)	GPa	36.46
POISSON'S RATIO *v*		0.15
UNCONFINED COMPRESSIVE STRENGTH	MPa	99.8

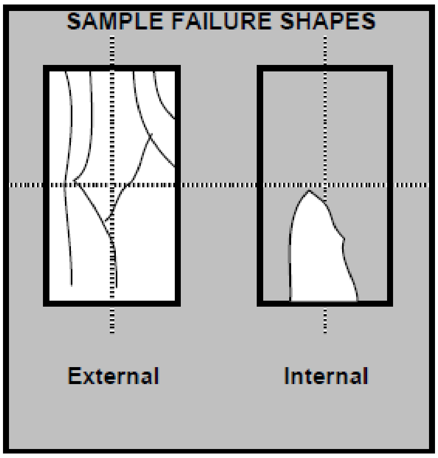


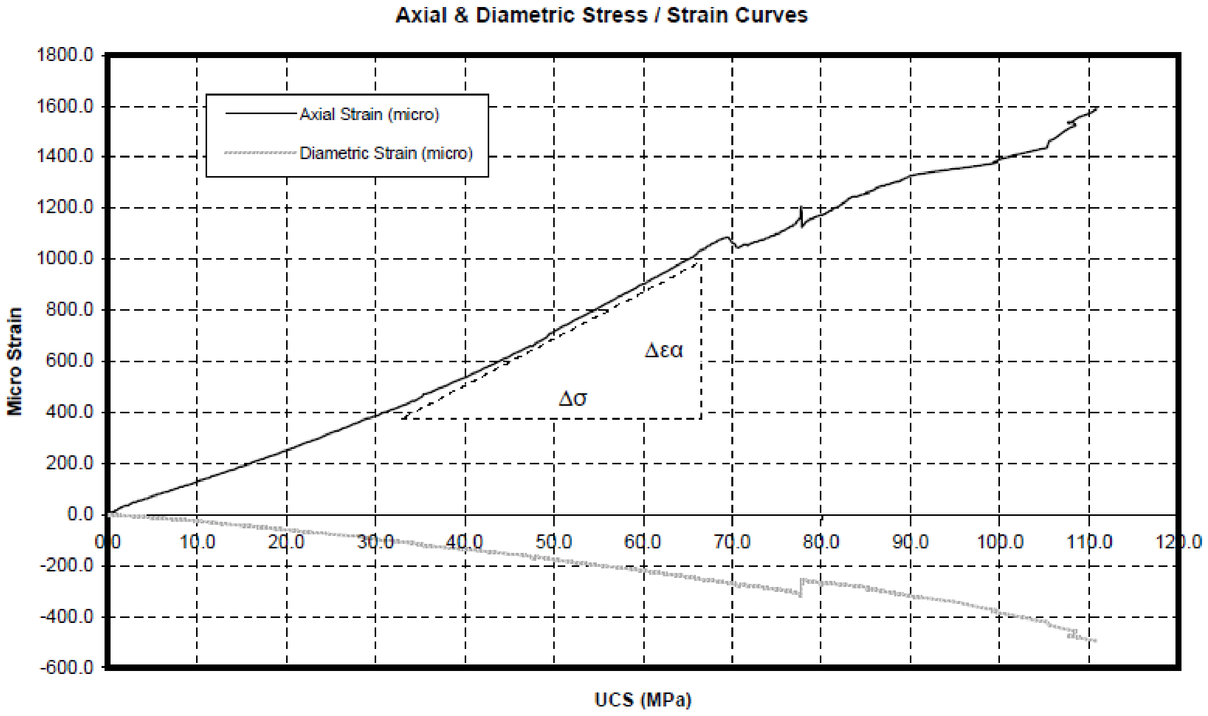
Axial & Diametric Stress / Strain Curves



Test Notes:
Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 4.4MPa and 56MPa

BOREHOLE		BH01
CORE RUN		48880
DEPTH		27.85-28.15
SAMPLE DIAMETER	mm	61.32
SAMPLE HEIGHT	mm	135.90
WATER CONTENT	%	0.1
TEST CONDITION		As Received
RATE OF LOADING	kN/s	0.7
TEST DURATION	mm.sec	8.18
DATE OF TESTING		22/03/2016
LOAD FRAME USED		2000kN
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Perpendicular
YOUNG'S MODULUS *E* (AVERAGE)	GPa	55.37
POISSON'S RATIO *v*		0.23
UNCONFINED COMPRESSIVE STRENGTH	MPa	112.4

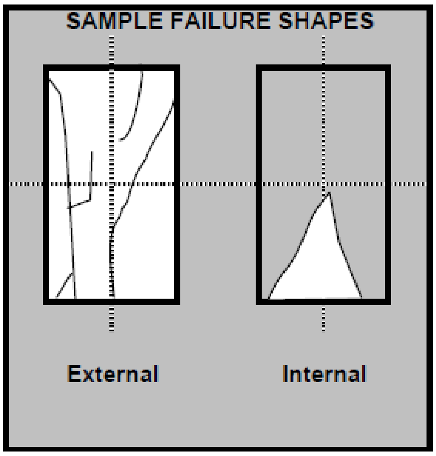




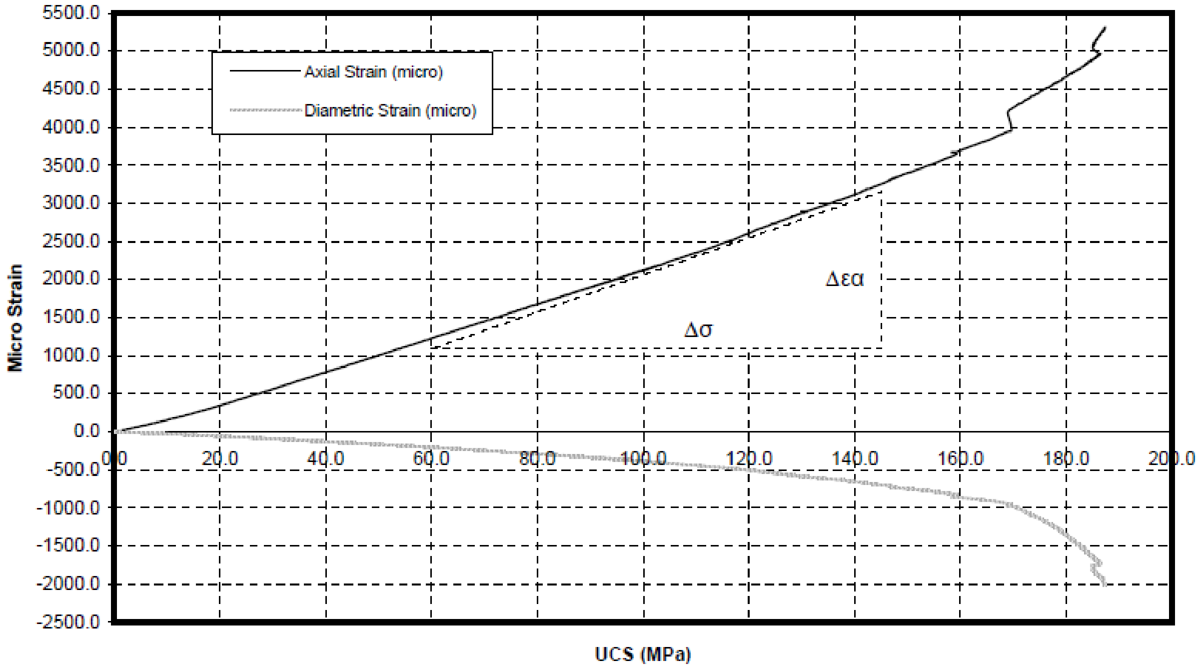
Test Notes:
Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 32MPa and 66.7MPa

BOREHOLE		**BH01**
CORE RUN		**48890**
DEPTH		**48.90-49.16**
SAMPLE DIAMETER	**mm**	**61.11**
SAMPLE HEIGHT	**mm**	**136.32**
WATER CONTENT	**%**	**0.1**
TEST CONDITION		**As Received**
RATE OF LOADING	**kN/s**	**0.7**
TEST DURATION	**mm.sec**	**12.58**
DATE OF TESTING		**22/03/2016**
LOAD FRAME USED		**2000kN**
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		**Perpendicular**
YOUNG'S MODULUS *E* (AVERAGE)	**GPa**	**42.01**
POISSON'S RATIO *v*		**0.24**
UNCONFINED COMPRESSIVE STRENGTH	**MPa**	**187.5**

SAMPLE FAILURE SHAPES

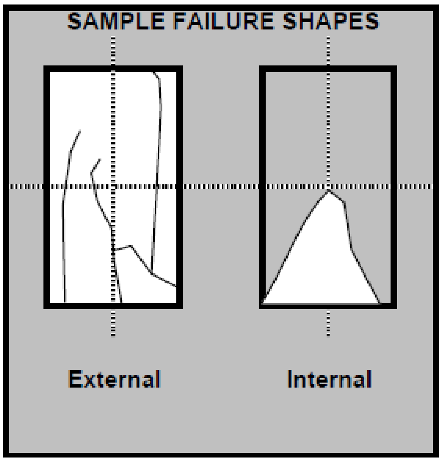


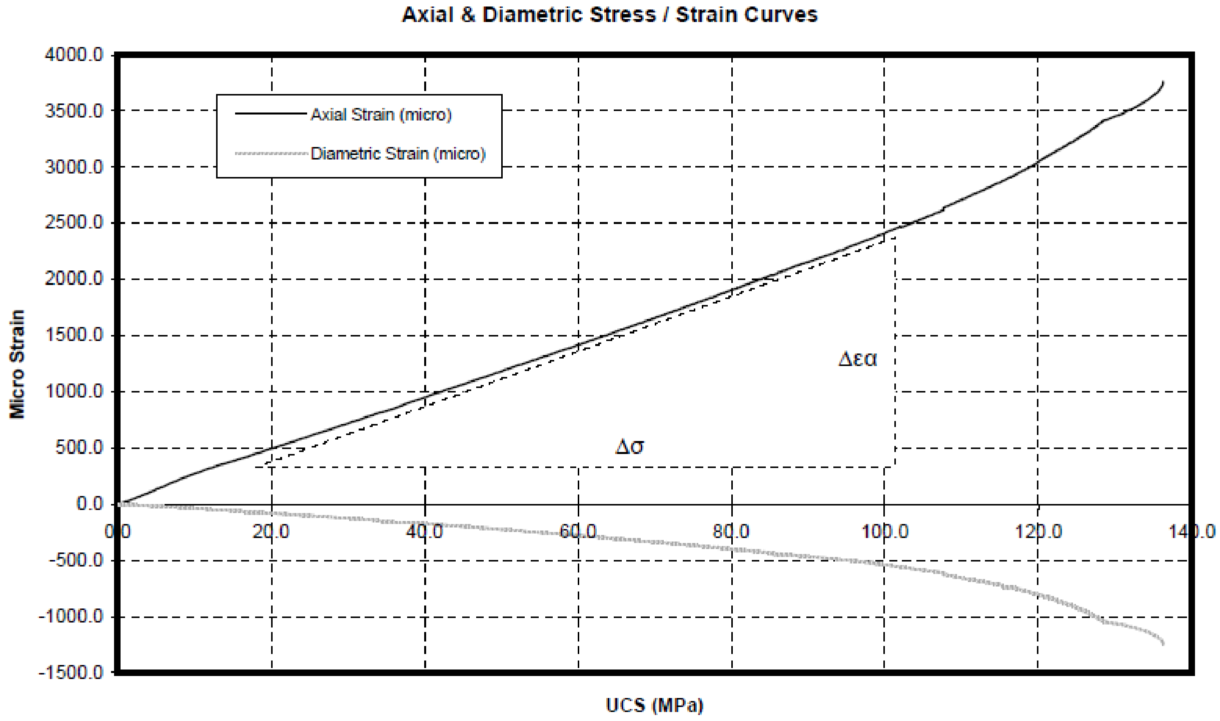
Axial & Diametric Stress / Strain Curves



Test Notes:
Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 58.6MPa and 145.9MPa

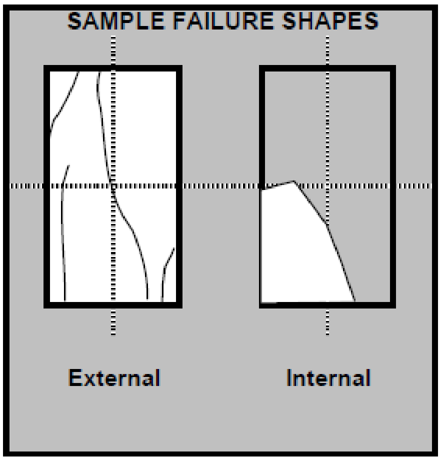
BOREHOLE		BH01
CORE RUN		50869
DEPTH		72.10-72.30
SAMPLE DIAMETER	mm	60.91
SAMPLE HEIGHT	mm	134.09
WATER CONTENT	%	0.1
TEST CONDITION		As Received
RATE OF LOADING	kN/s	0.6
TEST DURATION	mm.sec	10.36
DATE OF TESTING		22/03/2016
LOAD FRAME USED		2000kN
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Perpendicular
YOUNG'S MODULUS *E* (AVERAGE)	GPa	41.60
POISSON'S RATIO *v*		0.24
UNCONFINED COMPRESSIVE STRENGTH	MPa	136.3

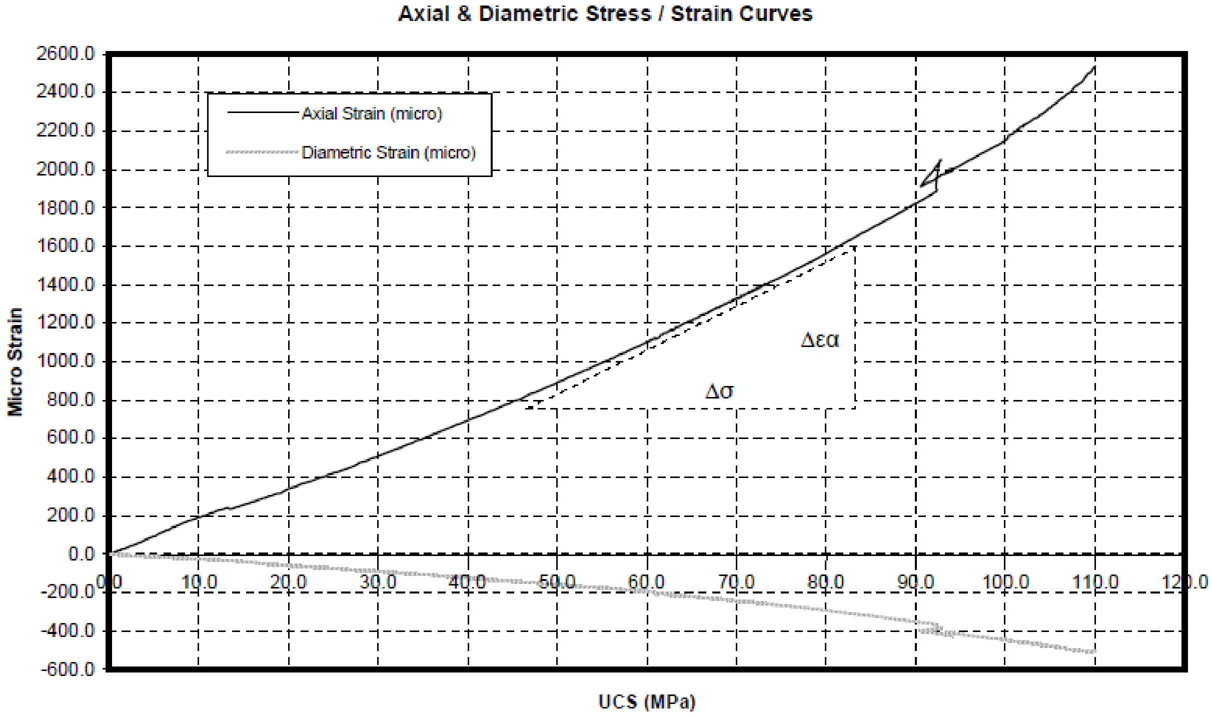




Test Notes:
Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 16.8MPa and 102.1MPa

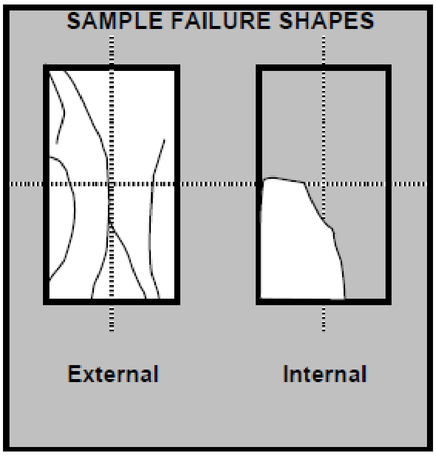
BOREHOLE		BH01
CORE RUN		50890
DEPTH		97.95-98.23
SAMPLE DIAMETER	mm	61.07
SAMPLE HEIGHT	mm	135.52
WATER CONTENT	%	0.1
TEST CONDITION		As Received
RATE OF LOADING	kN/s	0.7
TEST DURATION	mm.sec	7.5
DATE OF TESTING		22/03/2016
LOAD FRAME USED		2000kN
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Perpendicular
YOUNG'S MODULUS *E* (AVERAGE)	GPa	44.43
POISSON'S RATIO *v*		0.20
UNCONFINED COMPRESSIVE STRENGTH	MPa	110.0

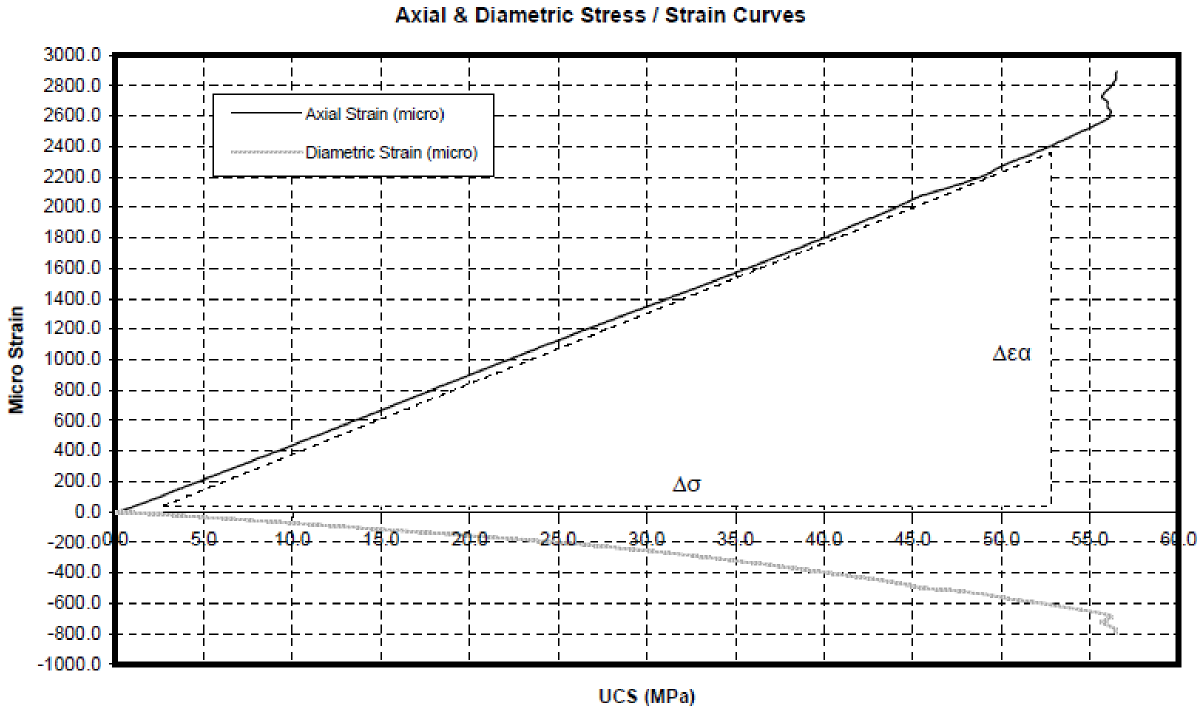




Test Notes:
Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 45.6MPa and 83.4MPa

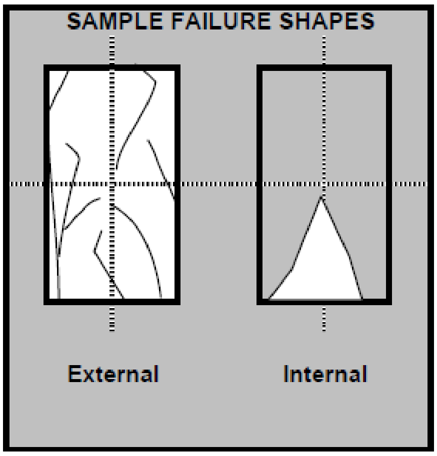
BOREHOLE		BH01
CORE RUN		50921
DEPTH		140.00-140.20
SAMPLE DIAMETER	mm	61.10
SAMPLE HEIGHT	mm	135.31
WATER CONTENT	%	0.1
TEST CONDITION		As Received
RATE OF LOADING	kN/s	0.7
TEST DURATION	mm.sec	4.05
DATE OF TESTING		22/03/2016
LOAD FRAME USED		2000kN
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Perpendicular
YOUNG'S MODULUS *E* (AVERAGE)	GPa	21.81
POISSON'S RATIO *v*		0.25
UNCONFINED COMPRESSIVE STRENGTH	MPa	58.7

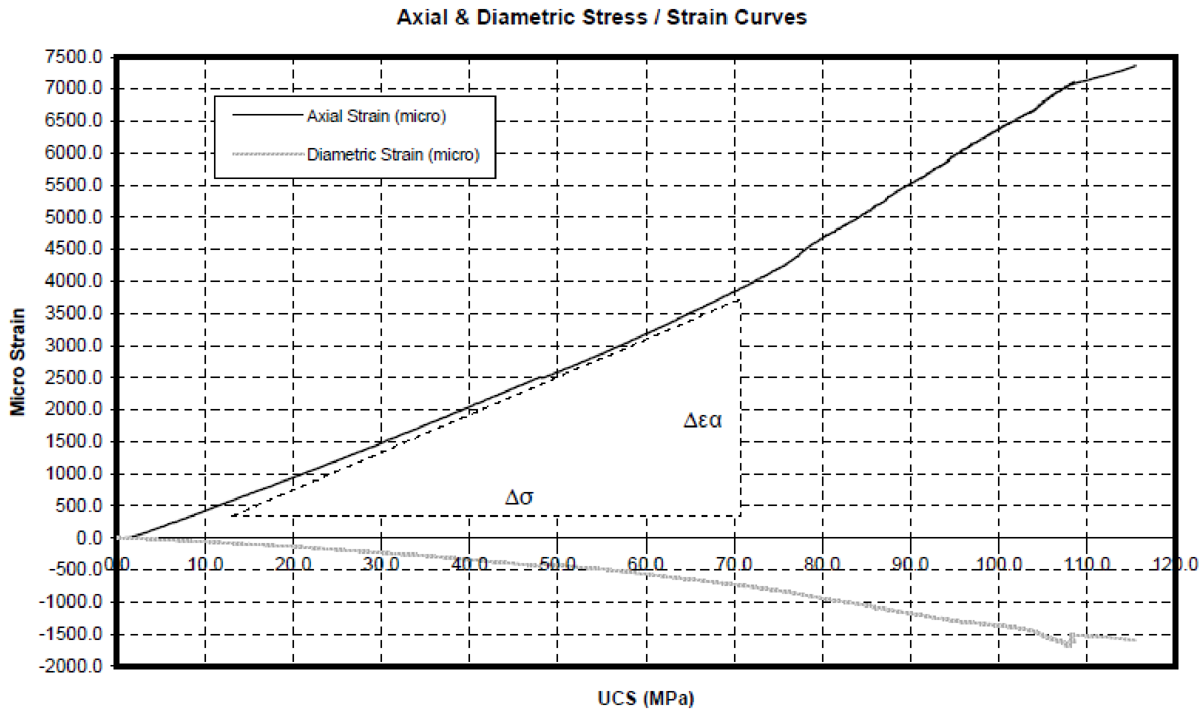




Test Notes:
Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 2.3MPa and 53MPa

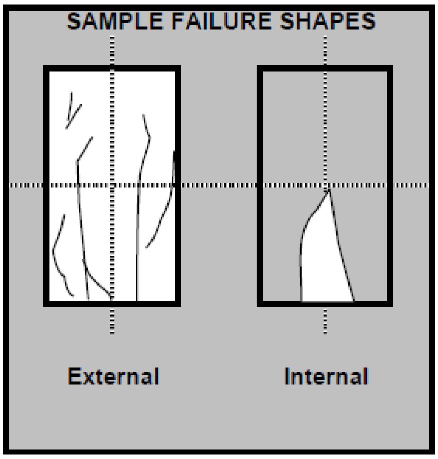
BOREHOLE		BH01
CORE RUN		50950
DEPTH		183.17-183.40
SAMPLE DIAMETER	mm	61.20
SAMPLE HEIGHT	mm	136.93
WATER CONTENT	%	0.1
TEST CONDITION		As Received
RATE OF LOADING	kN/s	0.9
TEST DURATION	mm.sec	6.55
DATE OF TESTING		22/03/2016
LOAD FRAME USED		2000kN
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Perpendicular
YOUNG'S MODULUS *E* (AVERAGE)	GPa	17.44
POISSON'S RATIO *v*		0.20
UNCONFINED COMPRESSIVE STRENGTH	MPa	118.6

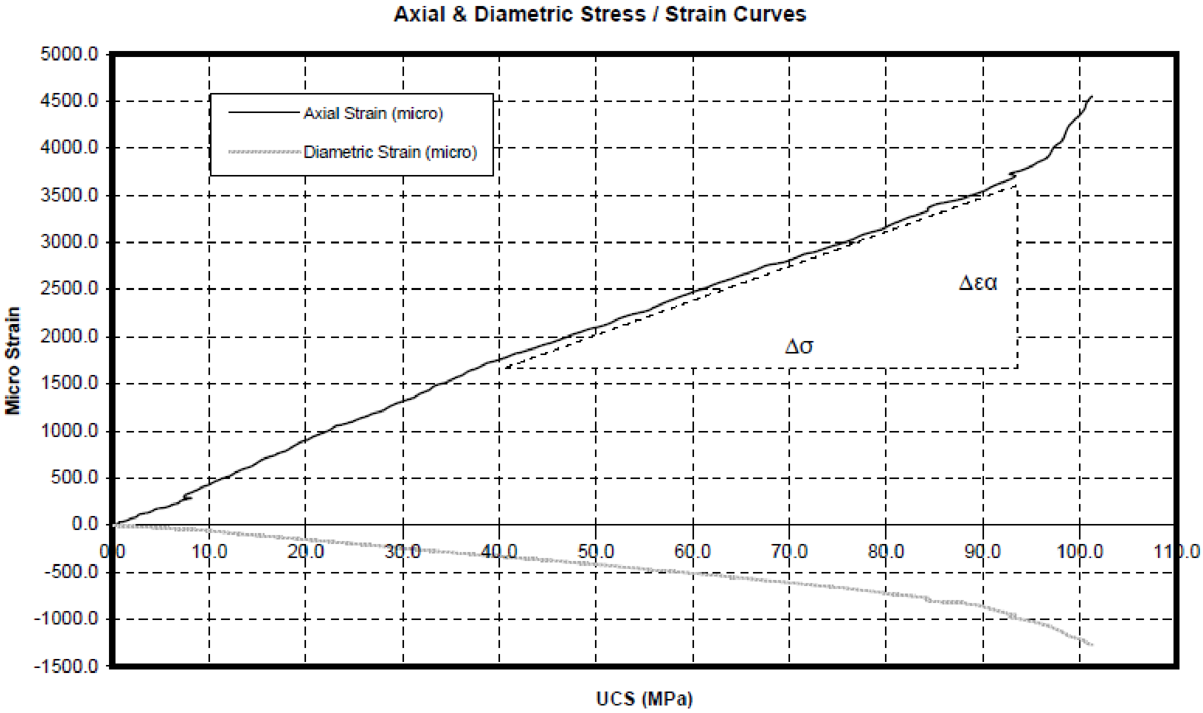




Test Notes:
Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 12.4MPa and 70.7MPa

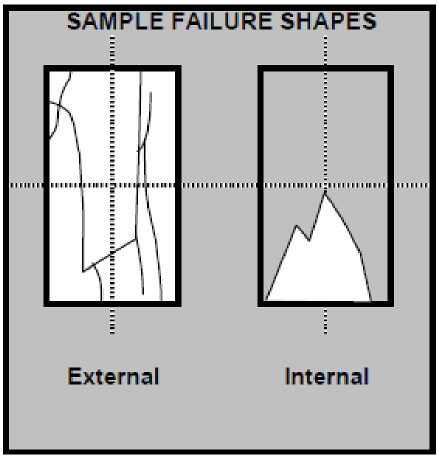
BOREHOLE		**BH01**
CORE RUN		**50973**
DEPTH		**212.33-212.58**
SAMPLE DIAMETER	**mm**	**61.08**
SAMPLE HEIGHT	**mm**	**136.48**
WATER CONTENT	**%**	**0.1**
TEST CONDITION		**As Received**
RATE OF LOADING	**kN/s**	**0.7**
TEST DURATION	**mm.sec**	**7.33**
DATE OF TESTING		**22/03/2016**
LOAD FRAME USED		**2000kN**
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		**Perpendicular**
YOUNG'S MODULUS *E* (AVERAGE)	**GPa**	**26.89**
POISSON'S RATIO *v*		**0.31**
UNCONFINED COMPRESSIVE STRENGTH	**MPa**	**104.7**

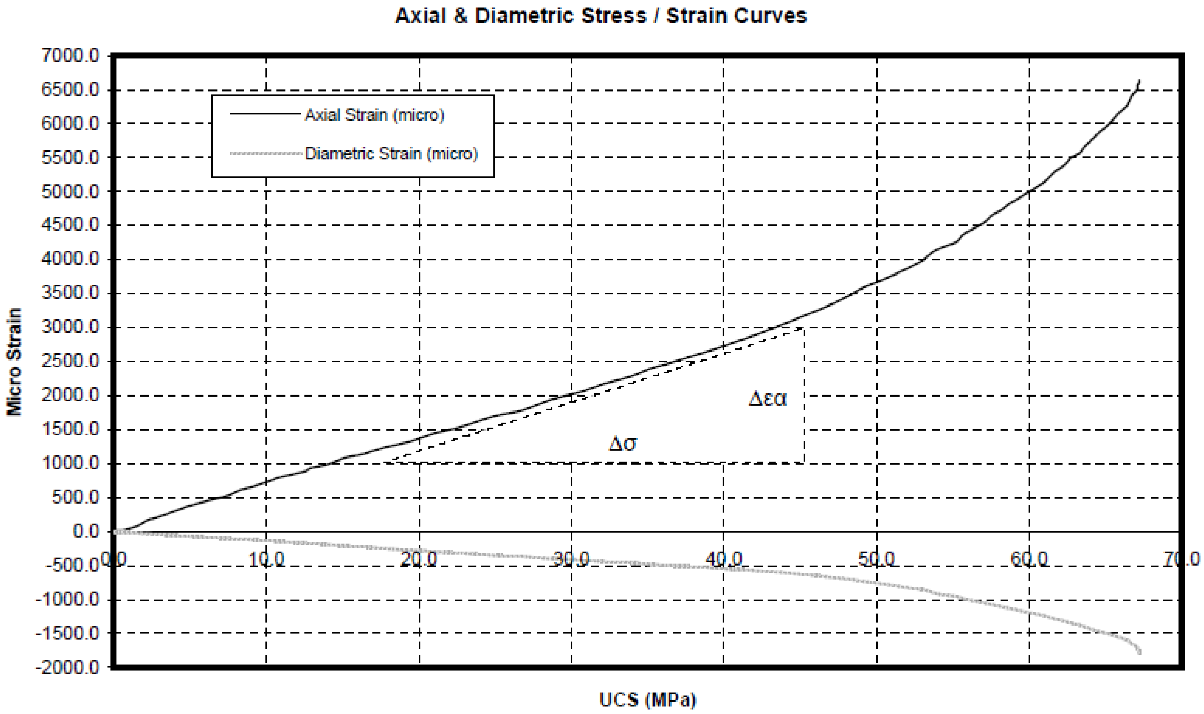




Test Notes:
Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 39.7MPa and 93.4MPa

BOREHOLE		BH01
CORE RUN		50988
DEPTH		232.46-232.60
SAMPLE DIAMETER	mm	60.90
SAMPLE HEIGHT	mm	125.20
WATER CONTENT	%	0.2
TEST CONDITION		As Received
RATE OF LOADING	kN/s	0.4
TEST DURATION	mm.sec	8.19
DATE OF TESTING		22/03/2016
LOAD FRAME USED		2000kN
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Perpendicular
YOUNG'S MODULUS *E* (AVERAGE)	GPa	14.17
POISSON'S RATIO *v*		0.19
UNCONFINED COMPRESSIVE STRENGTH	MPa	69.6

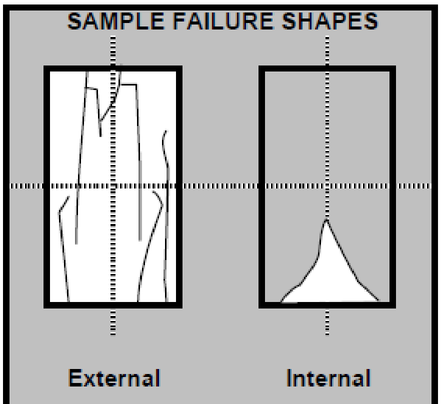




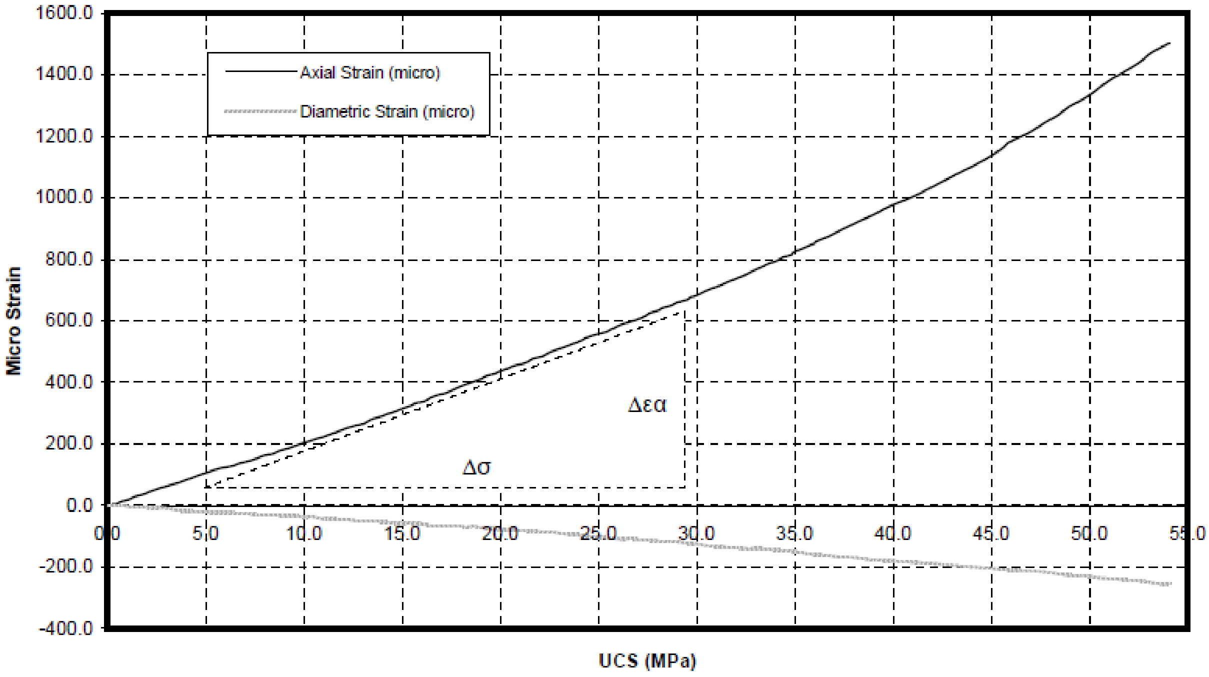
Test Notes:
Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 16.8MPa and 45.4MPa

BOREHOLE		BH01
CORE RUN		50996
DEPTH		250.30-250.56
SAMPLE DIAMETER	mm	60.88
SAMPLE HEIGHT	mm	126.80
WATER CONTENT	%	0.1
TEST CONDITION		As Received
RATE OF LOADING	kN/s	0.7
TEST DURATION	mm.sec	4.17
DATE OF TESTING		22/03/2016
LOAD FRAME USED		2000kN
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Perpendicular
YOUNG'S MODULUS *E* (AVERAGE)	GPa	43.34
POISSON'S RATIO *v*		0.18
UNCONFINED COMPRESSIVE STRENGTH	MPa	56.4

SAMPLE FAILURE SHAPES



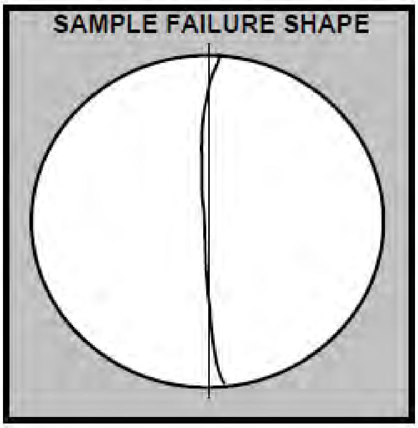
Axial & Diametric Stress / Strain Curves



Test Notes:
Method of Young's modulus determination - Average Modulus of Linear Portion of Axial Stress-Strain Curve
Method of Poisson's ratio determination - slope of axial curve / slope of lateral curve
Young's modulus and poisson's ratio calculated between stress levels of 5MPa and 29MPa

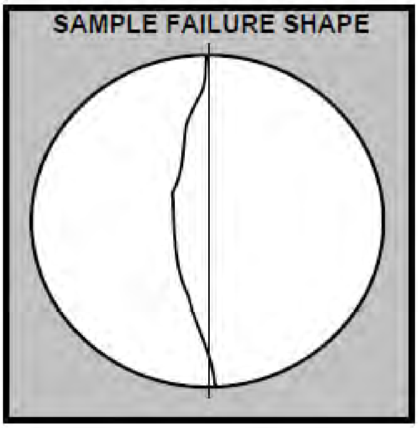
BOREHOLE		BH01
CORE RUN		50858
DEPTH		64.20-64.50
SAMPLE DIAMETER	mm	60.97
SAMPLE THICKNESS	mm	30.76
WATER CONTENT	%	0.3
DEGREE OF SATURATION	%	N/A
STRESS RATE	kN/s	1.10
TEST DURATION	secs	20
DATE OF TESTING		21-Mar-16
LOAD FRAME USED		2000kN
ORIENTATION OF LOADING		Diam
TENSILE STRENGTH	MPa	7.80

SAMPLE FAILURE SHAPE



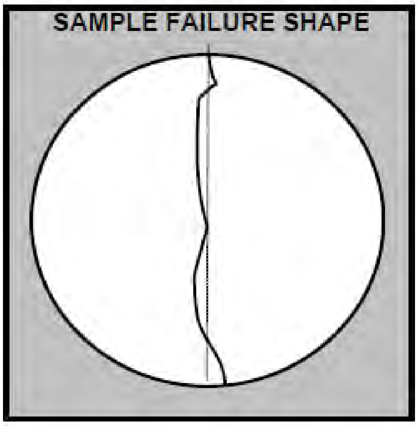
BOREHOLE		BH01
CORE RUN		50892
DEPTH		102.90-103.20
SAMPLE DIAMETER	mm	61.19
SAMPLE THICKNESS	mm	30.52
WATER CONTENT	%	0.1
DEGREE OF SATURATION	%	N/A
STRESS RATE	kN/s	1.50
TEST DURATION	secs	24
DATE OF TESTING		21-Mar-16
LOAD FRAME USED		2000kN
ORIENTATION OF LOADING		Diam
TENSILE STRENGTH	MPa	12.60

SAMPLE FAILURE SHAPE



BOREHOLE		BH01
CORE RUN		50948
DEPTH		180.24-180.50
SAMPLE DIAMETER	mm	61.51
SAMPLE THICKNESS	mm	30.46
WATER CONTENT	%	3.9
DEGREE OF SATURATION	%	N/A
STRESS RATE	kN/s	1.7
TEST DURATION	secs	26
DATE OF TESTING		21-Mar-16
LOAD FRAME USED		2000kN
ORIENTATION OF LOADING		Diam
TENSILE STRENGTH	MPa	14.60

SAMPLE FAILURE SHAPE



Frost Heave

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 16 March 2016
Test Report Ref: STR 448032

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Frost Heave of Unbound Aggregate in accordance with **BS 812: Part 124: 2009 - Annex B (Use of Comparator Specimens)**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**Bulk Samples**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**24/02/2016**
Sampling Location:	**Unknown**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Aggregate**
Target Specification	**SHW Series 800: clause 801.8**

RESULTS:

Were any unrepresentative lumps present? No

Frost Heave Test Result:

Maximum Heave Observed in 96 hours (mm)		
Comparator Specimen 1	11.5	(nearest 0.5mm)
Comparator Specimen 2	12.0	(nearest 0.5mm)
Comparator Specimen 3	12.0	(nearest 0.5mm)
Mean	**11.8**	(nearest 0.1mm)
Test Specimen 1	3.5	(nearest 0.5mm)
Test Specimen 2	2.0	(nearest 0.5mm)
Test Specimen 3	4.5	(nearest 0.5mm)
Mean Frost Heave	**3.3**	**(nearest 0.1mm)**

In accordance with SHW Series 800: clause 801.8 the sample is classified as being
Non Frost Susceptible (mean frost heave ≤ 15mm)

Test Report Ref: STR 448032 Page 2 of 2

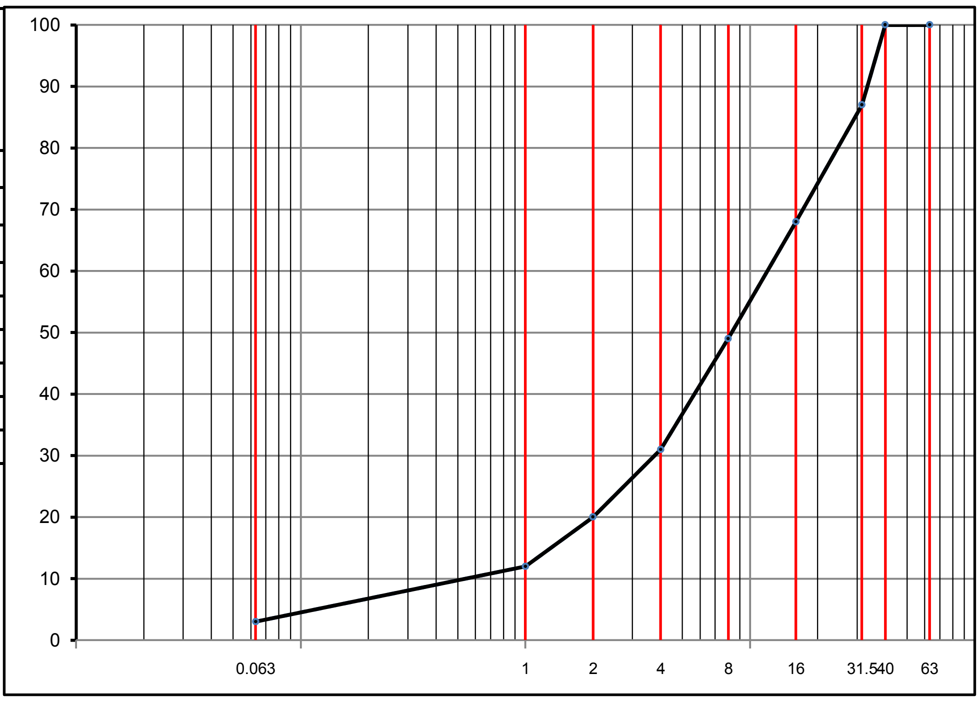
RESULTS CONTINUED:

Laboratory Dry Density & Water Content Test Result

Maximum Dry Density	**2.18 Mg/m3**
Optimum Water Content	**6.5 %**
Actual Dry Density	**2.18 Mg/m3**
Actual Water Content	**6.5 %**

Particle Size Distribution Test Result

BS Test Sieve Nominal Apperature	As Received Test Portion % Passing	Stable Test Portion % Passing
63.0 mm	100	100
40.0 mm	100	100
31.5 mm	87	87
16.0 mm	68	68
8.0 mm	49	49
4.0 mm	31	31
2.0 mm	20	20
1.0 mm	12	12
0.063 mm	3	3



Comments

None

Certificate
Prepared by:-

Mathew Sayer
Assistant Laboratory Manager

Approved by: -

Eric Goulden
Technical Manager

Los Angeles Coefficient

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 29 February 2016
Test Report Ref: STR 448029

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Fragmentation of Aggregate - Los Angeles Test Method in accordance with **BS EN 1097-2: 2010**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**Bulk Sample**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**21/02/2016**
Sampling Location:	**Unknown**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Aggregate**
Target Specification:	**N/A**

RESULTS:

Size fraction from which the test portion was obtained: 14mm to 12.5mm
12.5mm to 10.0mm

Los Angeles Coefficient (LA) = 28

Comments

None

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: - EGoulden
Eric Goulden
Technical Manager

Magnesium Sulphate Soundness

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 29 February 2016
Test Report Ref: STR 448030

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Magnesium Sulfate Value of aggregate sample within the size range 10mm to 14mm in accordance with **BS EN 1367-2 : 2009**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**Bulk Sample**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**26/02/2016**
Sampling Location:	**Unknown**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Aggregate**
Target Specification:	**N/A**

RESULTS:

Magnesium Sulfate Value Portion 1 (MS_1) =	**0.6**
Magnesium Sulfate Value Portion 2 (MS_2) =	**0.3**
Mean Magnesium Sulfate Value (MS) =	**1**

Comments

Proportion by mass of laboratory sample used for the test portion = 5% (nearest 5%)

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: -
Eric Goulden
Technical Manager

Moisture Content

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 24 February 2016
Test Report Ref: STR 447817

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 48861**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:6.70 Depth Base:6.80**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = 1.2

Comments

None

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: -
Eric Goulden
Technical Manager

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 24 February 2016
Test Report Ref: STR 447830

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 48868**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:13.26 Depth Base:13.35**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.6**

Comments

None

Certificate
Prepared by:-
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Approved by: - EGoulden
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Date: 24 February 2016
Test Report Ref: STR 447843

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 48881**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:32.65 Depth Base:32.72**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.4**

Comments

None

Certificate
Prepared by:-
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Date: 24 February 2016
Test Report Ref: STR 447861

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 48897**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:57.30 Depth Base:57.40**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.1**

Comments

None

Certificate
Prepared by:-
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Date: 24 February 2016
Test Report Ref: STR 447862

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received: **No**
Laboratory Ref. No: **S56595**
Client Ref. No: **BH01 - 48898**
Date and Time of Sampling: **Unknown**
Date of Receipt at Lab: **18/01/2016**
Date of Start of Test: **17/02/2016**
Sampling Location: **Depth Top:61.65 Depth Base:61.75**
Name of Source: **Lackagh Quarry**
Method of Sampling: **Unknown**
Sampled By: **Client**
Material Description: **Rock Core**
Target Specification: **N/A**

RESULTS:

Water Content (%) = **1.2**

Comments

None

Certificate
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Date: 24 February 2016
Test Report Ref: STR 447873

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50865**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:67.07 Depth Base:67.20**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.1**

Comments
None

Certificate
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Date: 24 February 2016
Test Report Ref: STR 447876

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50868**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:70.10 Depth Base:70.20**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = 1.3

Comments

None

Certificate
Prepared by:-
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Eric Goulden
Technical Manager

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Date: 24 February 2016
Test Report Ref: STR 447878

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50870**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:73.03 Depth Base:73.10**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.6**

Comments

None

Certificate
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Date: 24 February 2016
Test Report Ref: STR 447879

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received: **No**
Laboratory Ref. No: **S56595**
Client Ref. No: **BH01 - 50871**
Date and Time of Sampling: **Unknown**
Date of Receipt at Lab: **18/01/2016**
Date of Start of Test: **17/02/2016**
Sampling Location: **Depth Top:76.00 Depth Base:76.09**
Name of Source: **Lackagh Quarry**
Method of Sampling: **Unknown**
Sampled By: **Client**
Material Description: **Rock Core**
Target Specification: **N/A**

RESULTS:

Water Content (%) = **1.2**

Comments

None

Certificate
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Date: 24 February 2016
Test Report Ref: STR 447883

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50875**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:80.04 Depth Base:80.12**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.2**

Comments

None

Certificate
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Date: 24 February 2016
Test Report Ref: STR 447884

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50876**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:81.70 Depth Base:81.78**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = 1.6

Comments

None

Certificate
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Date: 24 February 2016
Test Report Ref: STR 447885

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50877**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:87.50 Depth Base:87.57**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) =	**1.8**

Comments

None

Certificate
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Date: 24 February 2016
Test Report Ref: STR 447886

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received: **No**
Laboratory Ref. No: **S56595**
Client Ref. No: **BH01 - 50878**
Date and Time of Sampling: **Unknown**
Date of Receipt at Lab: **18/01/2016**
Date of Start of Test: **17/02/2016**
Sampling Location: **Depth Top:39.70 Depth Base:39.80**
Name of Source: **Lackagh Quarry**
Method of Sampling: **Unknown**
Sampled By: **Client**
Material Description: **Rock Core**
Target Specification: **N/A**

RESULTS:

Water Content (%) = **1.3**

Comments

None

Certificate
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Date: 24 February 2016
Test Report Ref: STR 447890

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50882**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:91.63 Depth Base:91.71**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.8**

Comments

None

Certificate
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Date: 24 February 2016
Test Report Ref: STR 447894

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received: **No**
Laboratory Ref. No: **S56595**
Client Ref. No: **BH01 - 50886**
Date and Time of Sampling: **Unknown**
Date of Receipt at Lab: **18/01/2016**
Date of Start of Test: **17/02/2016**
Sampling Location: **Depth Top:93.00 Depth Base:93.10**
Name of Source: **Lackagh Quarry**
Method of Sampling: **Unknown**
Sampled By: **Client**
Material Description: **Rock Core**
Target Specification: **N/A**

RESULTS:

Water Content (%) = **1.5**

Comments

None

Certificate
Prepared by:-
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Date: 24 February 2016
Test Report Ref: STR 447897

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50889**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:94.96 Depth Base:95.05**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.3**

Comments

None

Certificate
Prepared by:-
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Date: 24 February 2016
Test Report Ref: STR 447899

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50891**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:101.36 Depth Base:101.45**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = 1.6

Comments

None

Certificate
Prepared by:-
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Date: 24 February 2016
Test Report Ref: STR 447904

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50896**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:108.62 Depth Base:108.70**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.2**

Comments

None

Certificate
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Date: 24 February 2016
Test Report Ref: STR 447908

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50900**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:113.12 Depth Base:113.19**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = 1.5

Comments

None

Certificate
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Date: 24 February 2016
Test Report Ref: STR 447912

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50904**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:118.82 Depth Base:118.88**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.9**

Comments

None

Certificate
Prepared by:-
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Date: 24 February 2016
Test Report Ref: STR 447908

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50900**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:113.12 Depth Base:113.19**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.5**

Comments

None

Certificate
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Date: 24 February 2016
Test Report Ref: STR 447912

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50904**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:118.82 Depth Base:118.88**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.9**

Comments

None

Certificate
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Date: 24 February 2016
Test Report Ref: STR 447913

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50905**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:123.44 Depth Base:123.55**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **2.2**

Comments

None

Certificate
Prepared by:-
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Approved by: - EGoulden
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Technical Manager

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Date: 24 February 2016
Test Report Ref: STR 447914

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50906**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:125.90 Depth Base:126.00**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) =	**1.3**

Comments

None

Certificate
Prepared by:-
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Approved by: - EJ Goulden
Eric Goulden
Technical Manager

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Date: 24 February 2016
Test Report Ref: STR 447915

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50907**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:126.80 Depth Base:126.90**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) =	**2.5**

Comments

None

Certificate
Prepared by:-
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Approved by: -
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Test Report Ref: STR 447919

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50911**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:131.12 Depth Base:131.17**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **2.6**

Comments
None

Certificate
Prepared by:-
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Approved by: -
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Date: 24 February 2016
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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50912**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:131.60 Depth Base:131.70**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.2**

Comments
None

Certificate
Prepared by:-
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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received: **No**
Laboratory Ref. No: **S56595**
Client Ref. No: **BH01 - 50913**
Date and Time of Sampling: **Unknown**
Date of Receipt at Lab: **18/01/2016**
Date of Start of Test: **17/02/2016**
Sampling Location: **Depth Top:132.65 Depth Base:132.62**
Name of Source: **Lackagh Quarry**
Method of Sampling: **Unknown**
Sampled By: **Client**
Material Description: **Rock Core**
Target Specification: **N/A**

RESULTS:

Water Content (%) = **1.8**

Comments

None

Certificate
Prepared by:-
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Date: 24 February 2016
Test Report Ref: STR 447925

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50917**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:134.35 Depth Base:134.44**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.1**

Comments

None

Certificate
Prepared by:-
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Date: 24 February 2016
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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50922**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:142.81 Depth Base:142.91**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) =	**1.3**

Comments

None

Certificate Prepared by:-
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Date: 24 February 2016
Test Report Ref: STR 447940

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50931**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:154.60 Depth Base:154.68**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.4**

Comments
None

Certificate
Prepared by:-
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Approved by: -
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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50932**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:155.20 Depth Base:155.28**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) =	**1.7**

Comments

None

Certificate Prepared by:-
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Technical Manager

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50936**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:163.49 Depth Base:163.56**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = 2.5

Comments

None

Certificate Prepared by:-
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Test Report Ref: STR 447949

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LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50940**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:172.96 Depth Base:173.07**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.3**

Comments

None

Certificate
Prepared by:-
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Date: 24 February 2016
Test Report Ref: STR 447949

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50940**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:172.96 Depth Base:173.07**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.3**

Comments

None

Certificate
Prepared by:-
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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50947**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:176.00 Depth Base:176.10**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = 1.2

Comments

None

Certificate
Prepared by:-
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Approved by: - EGoulden
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Test Report Ref: STR 447964

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50954**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:196.19 Depth Base:186.25**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = 1.8

Comments

None

Certificate
Prepared by:-
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Date: 24 February 2016
Test Report Ref: STR 447975

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50965**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:209.65 Depth Base:209.72**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.7**

Comments

None

Certificate
Prepared by:-
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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received: **No**
Laboratory Ref. No: **S56595**
Client Ref. No: **BH01 - 50969**
Date and Time of Sampling: **Unknown**
Date of Receipt at Lab: **18/01/2016**
Date of Start of Test: **17/02/2016**
Sampling Location: **Depth Top:211.10 Depth Base:211.20**
Name of Source: **Lackagh Quarry**
Method of Sampling: **Unknown**
Sampled By: **Client**
Material Description: **Rock Core**
Target Specification: **N/A**

RESULTS:

Water Content (%) = **1.4**

Comments

None

Certificate
Prepared by:-
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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received: **No**
Laboratory Ref. No: **S56595**
Client Ref. No: **BH01 - 50975**
Date and Time of Sampling: **Unknown**
Date of Receipt at Lab: **18/01/2016**
Date of Start of Test: **17/02/2016**
Sampling Location: **Depth Top:218.20 Depth Base:218.28**
Name of Source: **Lackagh Quarry**
Method of Sampling: **Unknown**
Sampled By: **Client**
Material Description: **Rock Core**
Target Specification: **N/A**

RESULTS:

Water Content (%) = **1.5**

Comments

None

Certificate
Prepared by:-
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Test Report Ref: STR 447986

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50976**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:222.52 Depth Base:222.62**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.0**

Comments

None

Certificate
Prepared by:-
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Date: 24 February 2016
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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50984**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:230.13 Depth Base:230.20**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **2.0**

Comments

None

Certificate
Prepared by:-
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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50989**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:235.04 Depth Base:235.10**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.3**

Comments

None

Certificate
Prepared by:-
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Approved by: - EGoulden
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Date: 16 February 2016
Test Report Ref: STR 443012

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH04 - 48901**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**15/12/2015**
Sampling Location:	**Depth Top: 3.5 Depth Base: 3.55**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **0.2**

Comments

None

Certificate
Prepared by:-
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Date: 15 February 2016
Test Report Ref: STR 443013

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received: **No**
Laboratory Ref. No: **S56158**
Client Ref. No: **BH04 - 48902**
Date and Time of Sampling: **Unknown**
Date of Receipt at Lab: **08/12/2015**
Date of Start of Test: **15/12/2015**
Sampling Location: **Depth Top: 5.4 Depth Base: 5.48**
Name of Source: **Lackagh Quarry SI**
Method of Sampling: **Unknown**
Sampled By: **Client**
Material Description: **Core**
Target Specification: **N/A**

RESULTS:

Water Content (%) = **0.6**

Comments

None

Certificate
Prepared by:-
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Approved by: -
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Date: 15 February 2016
Test Report Ref: STR 443016

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LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received: **No**
Laboratory Ref. No: **S56158**
Client Ref. No: **BH04 - 48904**
Date and Time of Sampling: **Unknown**
Date of Receipt at Lab: **08/12/2015**
Date of Start of Test: **15/12/2015**
Sampling Location: **Depth Top: 9.3 Depth Base: 9.36**
Name of Source: **Lackagh Quarry SI**
Method of Sampling: **Unknown**
Sampled By: **Client**
Material Description: **Core**
Target Specification: **N/A**

RESULTS:

Water Content (%) = **0.3**

Comments

None

Certificate
Prepared by:-
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Approved by: - EGoulden
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Date: 15 February 2016
Test Report Ref: STR 443018

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LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH04 - 48906**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**15/12/2015**
Sampling Location:	**Depth Top: 11.77 Depth Base: 11.83**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **0.2**

Comments

None

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: - EGoulden
Eric Goulden
Technical Manager

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Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 21 December 2015
Test Report Ref: STR 443020

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Uniaxial Compressive Strength in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. :	**Various**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**08/12/2015**
Sampling Location:	**Various**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See attached

Certificate
Prepared by:-
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Approved by: -
Eric Goulden
Technical Manager

BH	**Core Diameter (mm)**	**Height/ Diameter Ratio**	**Uniaxial compressive strength (MPa)**	**Mode of Failure**	**EN ISO 14689-1 Term**	**Water content (%)**
BH04 48908	82	2.6:1	**76**	N	Strong	0.1
BH04 48912	82.3	1.9:1	**86**	N	Strong	0.3
BH04 48921	82.3	1.5:1	**55**	N	Strong	0.1
BH04 48927	82.1	1.6:1	**53**	N	Strong	0.2
BH04 48931	82.2	2.6:1	**111**	N	Very Strong	0.1
BH04 48933	82	2.1:1	**91**	N	Strong	0.2
BH04 48950	82	2.5:1	**76**	N	Strong	0.2
BH04 48957	82	2:1	**78**	N	Strong	0.3
BH04 48963	82.2	2.4:1	**92**	N	Strong	0.1
BH05 48982	82	1.8:1	**91**	N	Strong	0.2
BH05 48986	81.5	2.6:1	**86**	N	Strong	0.4
BH05 48991	81.4	2.5:1	**94**	N	Strong	0.1
BH05 48994	82	1.9:1	**72**	N	Strong	0.2
BH05 48998	82.2	2.6:1	**77**	N	Strong	0.2
BH05 50711	78.5	1.8:1	**79**	N	Strong	0.2
BH05 50729	79	2.5:1	**116**	N	Very Strong	0.3
BH05 50731	81.4	2.6:1	**51**	N	Strong	0.1
BH05 50733	81.6	2.1:1	**54**	N	Strong	0.2
BH05 50737	82	1.5:1	**131**	N	Very Strong	0.2

Comments

1) The uniaxial compressive strength was carried out in accordance with ISRM guidelines.

2) Stress Rate: 0.7Mpa/s.

3)

EN ISO 14689-1 : 2003 Rock Strength Terms	
Compressive Strength mpa	Term
<1.0	Extremely Weak
1 to 5	Very Weak
5 to 25	Weak
25 to 50	Meduim Strong
50 to 100	Strong
100 to 250	Very Strong
> 250	Extremely Strong

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VAT No: 9D53971I

Date: 15 February 2016
Test Report Ref: STR 443034

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH04 - 48922**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**15/12/2015**
Sampling Location:	**Depth Top: 20.8 Depth Base: 20.85**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **0.4**

Comments

None

Certificate
Prepared by:-
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VAT No: 9D53971I

Date: 15 February 2016
Test Report Ref: STR 443036

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH04 - 48924**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**15/12/2015**
Sampling Location:	**Depth Top: 21.8 Depth Base: 21.9**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **1.0**

Comments
None

Certificate Prepared by:-
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Date: 15 February 2016
Test Report Ref: STR 443050

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received: **No**
Laboratory Ref. No: **S56158**
Client Ref. No: **BH04 - 48938**
Date and Time of Sampling: **Unknown**
Date of Receipt at Lab: **08/12/2015**
Date of Start of Test: **15/12/2015**
Sampling Location: **Depth Top: 28.27 Depth Base: 38.4**
Name of Source: **Lackagh Quarry SI**
Method of Sampling: **Unknown**
Sampled By: **Client**
Material Description: **Core**
Target Specification: **N/A**

RESULTS:

Water Content (%) = **0.1**

Comments

None

Certificate
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Date: 15 February 2016
Test Report Ref: STR 443067

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Total Sulfur Content of an Aggregate Sample in accordance with **BS EN 1744-1 : 2009 : Clause 11**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH04 - 48954**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**21/12/2015**
Sampling Location:	**Depth Top: 31.66 Depth Base: 31.7**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

Total Sulfur Content as S (%) =	**<0.1**
*95% Confidence limit**	*<0.06% - <0.14%*

Comments / Departure from specified Procedure

*95% Confidence limit is the expanded uncertainty which is the combined uncertainty standard multiplied by a factor (k) of 2

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Date: 15 February 2016
Test Report Ref: STR 443069

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Oxidisable sulphides (OS) content of an Sample by calculation of **TRL Report 447 Test No. 2 and Test No. 4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. :	**BH04 - 48956**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**24/12/2015**
Sampling Location:	**Depth Top: 31.84 Depth Base: 31.93**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**<0.5 % SO_4 - If deposited within 500mm of Cementitious Materials** **<0.06 % SO_4 - If deposited within 500mm of Metallic Structural Elements**

RESULTS:

Oxidisable Sulphides (OS) (%) = **0.04 SO_4**

Comments

The work was carried out by our accredited, competent, sub contracted laboratory.

Certificate Prepared by:-
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Approved by: - EGoulden
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VAT No: 9D53971I

Date: 15 February 2016
Test Report Ref: STR 443072

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the pH Value of Soils in accordance with **BS 1377:Part 3:1990 - Clause 9, Electrometric Method.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH04 - 48959**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**22/12/2015**
Sampling Location:	**Depth Top: 32.26 Depth Base: 32.35**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

pH Value =	**9.3**
*95% Confidence limit**	*9.06% - 9.54%*

Comments

*95% Confidence limit is the expanded uncertainty which is the combined uncertainty standard multiplied by a factor (k) of 2

Certificate
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Date: 15 February 2016
Test Report Ref: STR 443081

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH04 - 48965**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**15/12/2015**
Sampling Location:	**Depth Top: 33.12 Depth Base: 33.16**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) =	**0.1**

Comments

None

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Date: 15 February 2016
Test Report Ref: STR 443085

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH04 - 48969**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**15/12/2015**
Sampling Location:	**Depth Top: 34.56 Depth Base: 34.59**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **0.3**

Comments

None

Certificate
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VAT No: 9D53971I

Date: 15 February 2016
Test Report Ref: STR 443086

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH04 - 48970**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**15/12/2015**
Sampling Location:	**Depth Top: 34.96 Depth Base: 35**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **0.2**

Comments

None

Certificate
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VAT No: 9D53971I

Date: 15 February 2016
Test Report Ref: STR 443087

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH05 - 48971**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**15/12/2015**
Sampling Location:	**Depth Top: 0.65 Depth Base: 0.73**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **0.3**

Comments
None

Certificate
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Date: 15 February 2016
Test Report Ref: STR 443088

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH05 - 48972**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**15/12/2015**
Sampling Location:	**Depth Top: 0.98 Depth Base: 1.04**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = 0.1

Comments

None

Certificate
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Date: 15 February 2016
Test Report Ref: STR 443089

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH05 - 48973**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**15/12/2015**
Sampling Location:	**Depth Top: 1.41 Depth Base: 1.5**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **0.1**

Comments

None

Certificate
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VAT No: 9D53971I

Date: 15 February 2016
Test Report Ref: STR 443096

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH05 - 48980**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**15/12/2015**
Sampling Location:	**Depth Top: 8.9 Depth Base: 8.96**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **0.1**

Comments

None

Certificate
Prepared by:-
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VAT No: 9D53971I

Date: 15 February 2016
Test Report Ref: STR 443104

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received: **No**
Laboratory Ref. No: **S56158**
Client Ref. No: **BH05 - 48988**
Date and Time of Sampling: **Unknown**
Date of Receipt at Lab: **08/12/2015**
Date of Start of Test: **15/12/2015**
Sampling Location: **Depth Top: 12.92 Depth Base: 13.07**
Name of Source: **Lackagh Quarry SI**
Method of Sampling: **Unknown**
Sampled By: **Client**
Material Description: **Core**
Target Specification: **N/A**

RESULTS:

Water Content (%) = **0.3**

Comments

None

Certificate
Prepared by:-
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VAT No: 9D53971I

Date: 15 February 2016
Test Report Ref: STR 443128

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Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH05 - 50712**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**15/12/2015**
Sampling Location:	**Depth Top: 28.75 Depth Base: 28.85**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **0.1**

Comments

None

Certificate
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Date: 15 February 2016
Test Report Ref: STR 443132

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Oxidisable sulphides (OS) content of an Sample by calculation of **TRL Report 447 Test No. 2 and Test No. 4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. :	**BH05 - 50716**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**24/12/2015**
Sampling Location:	**Depth Top: 29.18 Depth Base: 29.3**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**<0.5 % SO_4 - If deposited within 500mm of Cementitious Materials** **<0.06 % SO_4 - If deposited within 500mm of Metallic Structural Elements**

RESULTS:

Oxidisable Sulphides (OS) (%) = **<0.01 SO_4**

Comments

The work was carried out by our accredited, competent, sub contracted laboratory.

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VAT No: 9D53971I

Date: 15 February 2016
Test Report Ref: STR 443133

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the pH Value of Soils in accordance with **BS 1377:Part 3:1990 - Clause 9, Electrometric Method.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH05 - 50717**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**22/12/2015**
Sampling Location:	**Depth Top: 29.3 Depth Base: 29.4**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

pH Value =	**9.2**
*95% Confidence limit**	*8.96% - 9.44%*

Comments

*95% Confidence limit is the expanded uncertainty which is the combined uncertainty standard multiplied by a factor (k) of 2

Certificate
Prepared by:-
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VAT No: 9D53971I

Date: 15 February 2016
Test Report Ref: STR 443134

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received: **No**
Laboratory Ref. No: **S56158**
Client Ref. No: **BH05 - 50718**
Date and Time of Sampling: **Unknown**
Date of Receipt at Lab: **08/12/2015**
Date of Start of Test: **15/12/2015**
Sampling Location: **Depth Top: 30.3 Depth Base: 30.4**
Name of Source: **Lackagh Quarry SI**
Method of Sampling: **Unknown**
Sampled By: **Client**
Material Description: **Core**
Target Specification: **N/A**

RESULTS:

Water Content (%) = **0.4**

Comments

None

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Prepared by:-
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Date: 15 February 2016
Test Report Ref: STR 443137

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH05 - 50721**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**15/12/2015**
Sampling Location:	**Depth Top: 30.88 Depth Base: 30.92**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = 0.3

Comments

None

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162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 15 February 2016
Test Report Ref: STR 443142

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS To determine the Water Content of aggregates by – drying in a ventilated oven according to **BS EN 1097-5: 2008**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH05 - 50726**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**15/12/2015**
Sampling Location:	**Depth Top: 32.54 Depth Base: 32.6**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

Water Content (%) = **0.2**

Comments
None

Certificate Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: - EGoulden
Eric Goulden
Technical Manager

Oxidisable Sulphur

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INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 16 March 2016
Test Report Ref: STR 447856

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Oxidisable sulphides (OS) content of an Sample by calculation of **TRL Report 447 Test No. 2 and Test No. 4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. :	**BH01 - 48892**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:55.30 Depth Base:55.40**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**<0.5 % SO_4 - If deposited within 500mm of Cementitious Materials** **<0.06 % SO_4 - If deposited within 500mm of Metallic Structural Elements**

RESULTS:

Oxidisable Sulphides (OS) (%) = **<0.01 SO_4**

Comments

The work was carried out by our accredited, competent, sub contracted laboratory.

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: -
Eric Goulden
Technical Manager

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 16 March 2016
Test Report Ref: STR 447895

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Oxidisable sulphides (OS) content of an Sample by calculation of **TRL Report 447 Test No. 2 and Test No. 4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. :	**BH01 - 50887**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:94.90 Depth Base:94.96**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**<0.5 % SO_4 - If deposited within 500mm of Cementitious Materials** **<0.06 % SO_4 - If deposited within 500mm of Metallic Structural Elements**

RESULTS:

Oxidisable Sulphides (OS) (%) = <0.01 SO_4

Comments

The work was carried out by our accredited, competent, sub contracted laboratory.

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: - EGoulden
Eric Goulden
Technical Manager

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INDEPENDENT MATERIALS TESTING | DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 16 March 2016
Test Report Ref: STR 447938

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Oxidisable sulphides (OS) content of an Sample by calculation of **TRL Report 447 Test No. 2 and Test No. 4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. :	**BH01 - 50930**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:153.20 Depth Base:153.30**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**<0.5 % SO_4 - If deposited within 500mm of Cementitious Materials** **<0.06 % SO_4 - If deposited within 500mm of Metallic Structural Elements**

RESULTS:

Oxidisable Sulphides (OS) (%) = <0.01 SO_4

Comments

The work was carried out by our accredited, competent, sub contracted laboratory.

Certificate Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: - EGoulden
Eric Goulden
Technical Manager

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INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 16 March 2016
Test Report Ref: STR 447971

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Oxidisable sulphides (OS) content of an Sample by calculation of **TRL Report 447 Test No. 2 and Test No. 4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. :	**BH01 - 50961**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:201.47 Depth Base:201.55**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**<0.5 % SO_4 - If deposited within 500mm of Cementitious Materials** **<0.06 % SO_4 - If deposited within 500mm of Metallic Structural Elements**

RESULTS:

Oxidisable Sulphides (OS) (%) = <0.01 SO_4

Comments

The work was carried out by our accredited, competent, sub contracted laboratory.

Certificate Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: - EGoulden
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Technical Manager

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 16 March 2016
Test Report Ref: STR 448010

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Oxidisable sulphides (OS) content of an Sample by calculation of **TRL Report 447 Test No. 2 and Test No. 4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. :	**BH01 - 51000**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:253.30 Depth Base:253.38**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**<0.5 % SO_4 - If deposited within 500mm of Cementitious Materials** **<0.06 % SO_4 - If deposited within 500mm of Metallic Structural Elements**

RESULTS:

Oxidisable Sulphides (OS) (%) = <0.01 SO_4

Comments

The work was carried out by our accredited, competent, sub contracted laboratory.

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: - EGoulden
Eric Goulden
Technical Manager

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INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 15 February 2016
Test Report Ref: STR 443069

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Oxidisable sulphides (OS) content of an Sample by calculation of **TRL Report 447 Test No. 2 and Test No. 4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. :	**BH04 - 48956**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**24/12/2015**
Sampling Location:	**Depth Top: 31.84 Depth Base: 31.93**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**<0.5 % SO_4 - If deposited within 500mm of Cementitious Materials** **<0.06 % SO_4 - If deposited within 500mm of Metallic Structural Elements**

RESULTS:

Oxidisable Sulphides (OS) (%) = **0.04 SO_4**

Comments

The work was carried out by our accredited, competent, sub contracted laboratory.

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Assistant Laboratory Manager

Approved by: -
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Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 15 February 2016
Test Report Ref: STR 443132

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Oxidisable sulphides (OS) content of an Sample by calculation of **TRL Report 447 Test No. 2 and Test No. 4**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. :	**BH05 - 50716**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**24/12/2015**
Sampling Location:	**Depth Top: 29.18 Depth Base: 29.3**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**<0.5 % SO_4 - If deposited within 500mm of Cementitious Materials** **<0.06 % SO_4 - If deposited within 500mm of Metallic Structural Elements**

RESULTS:

Oxidisable Sulphides (OS) (%) = <0.01 SO_4

Comments

The work was carried out by our accredited, competent, sub contracted laboratory.

Certificate Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: - EGoulden
Eric Goulden
Technical Manager

pH Value

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 16 March 2016
Test Report Ref: STR 447857

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the pH Value of Soils in accordance with **BS 1377:Part 3:1990 - Clause 9, Electrometric Method.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 48893**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**09/02/2016**
Sampling Location:	**Depth Top:55.84 Depth Base:55.92**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

pH Value =	**9.1**
*95% Confidence limit**	*8.86% - 9.34%*

Comments

*95% Confidence limit is the expanded uncertainty which is the combined uncertainty standard multiplied by a factor (k) of 2

Certificate
Prepared by:-
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Assistant Laboratory Manager

Approved by: - EGoulden
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Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 16 March 2016
Test Report Ref: STR 447896

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the pH Value of Soils in accordance with **BS 1377:Part 3:1990 - Clause 9, Electrometric Method.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50888**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**09/02/2016**
Sampling Location:	**Depth Top:94.96 Depth Base:95.05**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

pH Value =	**9.2**
*95% Confidence limit**	*8.96% - 9.44%*

Comments

*95% Confidence limit is the expanded uncertainty which is the combined uncertainty standard multiplied by a factor (k) of 2

Certificate
Prepared by:-
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Assistant Laboratory Manager

Approved by: - EGoulden
Eric Goulden
Technical Manager

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INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 16 March 2016
Test Report Ref: STR 447928

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the pH Value of Soils in accordance with **BS 1377:Part 3:1990 - Clause 9, Electrometric Method.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50920**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**09/02/2016**
Sampling Location:	**Depth Top:138.60 Depth Base:138.72**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

pH Value =	**9.2**
*95% Confidence limit**	*8.96% - 9.44%*

Comments

*95% Confidence limit is the expanded uncertainty which is the combined uncertainty standard multiplied by a factor (k) of 2

Certificate
Prepared by:-
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Approved by: -
Eric Goulden
Technical Manager

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INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 16 March 2016
Test Report Ref: STR 447959

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the pH Value of Soils in accordance with **BS 1377:Part 3:1990 - Clause 9, Electrometric Method.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50949**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**09/02/2016**
Sampling Location:	**Depth Top:182.12 Depth Base:182.20**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

pH Value =	**9.3**
*95% Confidence limit**	*9.06% - 9.54%*

Comments

*95% Confidence limit is the expanded uncertainty which is the combined uncertainty standard multiplied by a factor (k) of 2

Certificate
Prepared by:-
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Approved by: -
Eric Goulden
Technical Manager

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INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 16 March 2016
Test Report Ref: STR 447984

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the pH Value of Soils in accordance with **BS 1377:Part 3:1990 - Clause 9, Electrometric Method.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50974**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**09/02/2016**
Sampling Location:	**Depth Top:213.80 Depth Base:213.90**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

pH Value =	**9.1**
*95% Confidence limit**	*8.86% - 9.34%*

Comments

*95% Confidence limit is the expanded uncertainty which is the combined uncertainty standard multiplied by a factor (k) of 2

Certificate
Prepared by:-
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Approved by: -
Eric Goulden
Technical Manager

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 15 February 2016
Test Report Ref: STR 443072

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the pH Value of Soils in accordance with **BS 1377:Part 3:1990 - Clause 9, Electrometric Method.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH04 - 48959**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**22/12/2015**
Sampling Location:	**Depth Top: 32.26 Depth Base: 32.35**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

pH Value =	**9.3**
*95% Confidence limit**	*9.06% - 9.54%*

Comments

*95% Confidence limit is the expanded uncertainty which is the combined uncertainty standard multiplied by a factor (k) of 2

Certificate Prepared by:-
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Approved by: - EGoulden
Eric Goulden
Technical Manager

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 15 February 2016
Test Report Ref: STR 443133

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the pH Value of Soils in accordance with **BS 1377:Part 3:1990 - Clause 9, Electrometric Method.**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH05 - 50717**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**22/12/2015**
Sampling Location:	**Depth Top: 29.3 Depth Base: 29.4**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

pH Value =	**9.2**
*95% Confidence limit**	*8.96% - 9.44%*

Comments

*95% Confidence limit is the expanded uncertainty which is the combined uncertainty standard multiplied by a factor (k) of 2

Certificate Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: - EGoulden
Eric Goulden
Technical Manager

Point Load Testing

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443019

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48907**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 12.62 Depth Base: 12.75**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443019 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48907

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	112	20.0	8960	11408	1.75	1.41	2.47	59.2
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**59.2**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443021

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48909**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 13.1 Depth Base: 13.25**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443021 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48909

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	130	20.0	10400	13242	1.51	1.46	2.20	52.7
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**52.7**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443023

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48911**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 14.63 Depth Base: 14.74**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443023 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48911

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	105	15.8	8400	10695	1.48	1.39	2.05	49.2
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**49.2**

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443025

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48913**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 14.97 Depth Base: 15.13**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 443025 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48913

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	125	22.1	10000	12732	1.74	1.44	2.50	60.1
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**60.1**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443027

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48915**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 17.74 Depth Base: 17.86**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443027 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48915

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample	Sample	Test		D	W	P	A	D*D	Is	F	Is (50)	Approx. Compressive
no	type	type		mm	mm	KN	=W*D					Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	135	23.5	10800	13751	1.71	1.47	2.51	60.2
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**60.2**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443029

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48917**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 18.12 Depth Base: 18.2**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443029 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48917

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	85	15.4	6800	8658	1.78	1.32	2.35	56.5
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**56.5**

INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443030

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48918**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 19.2 Depth Base: 19.32**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443030 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48918

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample	Sample	Test		D	W	P	A	D*D	Is	F	Is (50)	Approx. Compressive
no	type	type		mm	mm	KN	=W*D					Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	120	13.0	9600	12223	1.06	1.43	1.52	36.5
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**36.5**

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443032

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48920**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 20.12 Depth Base: 20.22**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443032 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48920

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	98	22.5	7840	9982	2.25	1.37	3.08	73.9
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**73.9**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443035

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48923**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 21.2 Depth Base: 21.3**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 443035 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48923

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	87	19.0	6960	8862	2.14	1.33	2.85	68.4
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**68.4**

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443037

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48925**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 22.2 Depth Base: 22.31**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443037 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48925

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	100	27.9	8000	10186	2.74	1.37	3.76	90.2
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**90.2**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443038

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48926**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 22.6 Depth Base: 22.78**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443038 - Page 2 of 2

Client Priority Construction Ltd
Sample Number S56158
Date Recived 8.12.15
Sample Ref BH04 48926

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	142	24.4	11360	14464	1.69	1.48	2.50	60.1
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**60.1**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443040

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48928**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 23.1 Depth Base: 23.2**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443040 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48928

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	100	20.0	8000	10186	1.96	1.37	2.69	64.6
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**64.6**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443042

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48930**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 23.7 Depth Base: 23.8**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 443042 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48930

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	95	23.1	7600	9677	2.39	1.36	3.24	77.7
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**77.7**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443044

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48932**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 24.17 Depth Base: 24.28**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443044 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48932

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	100	22.9	8000	10186	2.25	1.37	3.08	74.0
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**74.0**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443047

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48934**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 25.08 Depth Base: 25.19**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 443047 - Page 2 of 2

Client Priority Construction Ltd
Sample Number S56158
Date Recived 8.12.15
Sample Ref BH04 48934

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample	Sample	Test		D	W	P	A	D*D	Is	F	Is (50)	Approx. Compressive
no	type	type		mm	mm	KN	=W*D					Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	111	26.0	8880	11306	2.30	1.40	3.23	77.5
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**77.5**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443049

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48937**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 27.91 Depth Base: 28**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443049 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48937

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	86	24.6	6880	8760	2.81	1.33	3.72	89.4
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**89.4**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443051

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48939**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 28.4 Depth Base: 28.44**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 443051 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48939

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	104	21.8	8320	10593	2.06	1.38	2.85	68.3
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**68.3**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443051

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48939**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 28.4 Depth Base: 28.44**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443051 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48939

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	104	21.8	8320	10593	2.06	1.38	2.85	68.3
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**68.3**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443054

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48943**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 29.86 Depth Base: 29.94**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 443054 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48943

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Lump	b		80	40	14.0	3200	4074	3.44	1.12	3.84	92.0
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**92.0**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443062

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48949**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 30.93 Depth Base: 30.03**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443062 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48949

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	85	20.9	6800	8658	2.41	1.32	3.19	76.6
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**76.6**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443064

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48951**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 31.3 Depth Base: 31.4**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443064 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48951

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	112	22.9	8960	11408	2.01	1.41	2.82	67.8
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**67.8**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443068

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48955**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 31.76 Depth Base: 31.84**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443068 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48955

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	90	17.0	7200	9167	1.85	1.34	2.48	59.6
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**59.6**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443071

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48958**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 32.15 Depth Base: 32.26**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 443071 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48958

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Lump	b		59	125	16.1	7375	9390	1.71	1.35	2.31	55.4
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**55.4**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443075

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48962**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 32.5 Depth Base: 32.57**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 443075 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48962

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Lump	b		68	75	17.2	5100	6494	2.65	1.24	3.28	78.8
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**78.8**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443077

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48964**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 32.85 Depth Base: 32.96**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 443077 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48964

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Lump	b		65	90	15.9	5850	7448	2.13	1.28	2.73	65.5
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**65.5**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443083

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH04 - 48967**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 33.48 Depth Base: 33.6**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443083 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH04 48967

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	115	17.2	9200	11714	1.47	1.42	2.08	49.9
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**49.9**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443091

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 48975**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 2.8 Depth Base: 2.96**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443091 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 48975

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	170	13.0	13600	17316	0.75	1.55	1.16	27.8
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**27.8**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443093

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 48977**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 7.73 Depth Base: 7.84**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443093 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 48977

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	110	21.0	8800	11205	1.87	1.40	2.63	63.0
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**63.0**

Priority Construction Ltd
162 Clontarf Road
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Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443094

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 48978**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 8.1 Depth Base: 8.25**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443094 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 48978

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	160	19.5	12800	16297	1.20	1.52	1.82	43.8
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**43.8**

Priority Construction Ltd
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VAT No: 9D53971I

Date: 21^{st} December 2015
Test Report Ref:. STR: 443095

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 48979**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 8.54 Depth Base: 8.66**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443095 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 48979

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	120	22.1	9600	12223	1.81	1.43	2.58	62.0
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**62.0**

Priority Construction Ltd
162 Clontarf Road
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Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443097

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 48981**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 9.46 Depth Base: 9.57**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443097 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 48981

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	100	28.3	8000	10186	2.78	1.37	3.81	91.5
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**91.5**

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Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443099

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 48983**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 9.77 Depth Base: 9.92**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443099 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 48983

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	126	20.5	10080	12834	1.60	1.44	2.31	55.4
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**55.4**

Priority Construction Ltd
162 Clontarf Road
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Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443100

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 48984**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 10.2 Depth Base: 10.26**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 443100 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 48984

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Lump	b		80	48	17.7	3840	4889	3.62	1.16	4.21	101.0
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**101.0**

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Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443101

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 48985**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 11.3 Depth Base: 11.45**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443101 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 48985

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	146	17.9	11680	14871	1.20	1.49	1.80	43.1
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**43.1**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443103

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 48987**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 11.72 Depth Base: 11.83**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443103 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 48987

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	100	23.9	8000	10186	2.35	1.37	3.22	77.2
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**77.2**

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Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443105

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 48989**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 13.5 Depth Base: 13.6**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 443105 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 48989

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Lump	b		80	43	22.7	3440	4380	5.18	1.13	5.88	141.1
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**141.1**

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Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443106

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 48990**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 13.7 Depth Base: 13.81**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443106 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 48990

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	108	22.1	8640	11001	2.01	1.40	2.80	67.3
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**67.3**

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Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443108

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 48992**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 14.07 Depth Base: 14.15**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443108 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 48992

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Lump	b		80	70	19.8	5600	7130	2.78	1.27	3.52	84.4
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**84.4**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443109

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 48993**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 14.27 Depth Base: 14.4**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443109 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 48993

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	95	22.0	7600	9677	2.27	1.36	3.08	74.0
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**74.0**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443111

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 48995**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 15.43 Depth Base: 15.55**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443111 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 48995

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	80	21.3	6400	8149	2.61	1.30	3.41	81.8
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**81.8**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443113

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 48997**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 16.45 Depth Base: 16.55**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 443113 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 48997

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample	Sample	Test		D	W	P	A	D*D	Is	F	Is (50)	Approx. Compressive
no	type	type		mm	mm	KN	=W*D					Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	95	20.0	7600	9677	2.07	1.36	2.80	67.3
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**67.3**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443119

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 50703**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 22.07 Depth Base: 22.21**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443119 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 50703

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample	Sample	Test		D	W	P	A	D*D	Is	F	Is (50)	Approx. Compressive
no	type	type		mm	mm	KN	=W*D					Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	150	23.0	12000	15279	1.51	1.50	2.26	54.3
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**54.3**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443120

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 50704**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 22.9 Depth Base: 23**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443120 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 50704

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Lump	b		80	55	17.0	4400	5602	3.03	1.20	3.64	87.3
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**87.3**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443121

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 50705**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 23.94 Depth Base: 24.05**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443121 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 50705

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	100	20.8	8000	10186	2.04	1.37	2.80	67.2
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**67.2**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443123

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 50707**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 24.73 Depth Base: 24.85**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 443123 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 50707

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		75	90	18.0	6750	8594	2.09	1.32	2.77	66.4
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**66.4**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443125

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 50709**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 26 Depth Base: 26.12**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 443125 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 50709

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		75	103	23.0	7725	9836	2.34	1.36	3.18	76.4
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**76.4**

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443141

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 50725**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 32.44 Depth Base: 32.54**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443141 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 50725

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	80	20.0	6400	8149	2.45	1.30	3.20	76.8
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**76.8**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443143

Page 1 of 2

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 50727**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 32.83 Depth Base: 32.92**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 443143 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 50727

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Lump	b		80	72	16.0	5760	7334	2.18	1.27	2.78	66.7
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**66.7**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443154

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 50736**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 37.4 Depth Base: 37.5**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 443154 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 50736

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	95	24.0	7600	9677	2.48	1.36	3.36	80.7
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**80.7**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 21st December 2015
Test Report Ref:. STR: 443156

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 50738**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**8/12/2015**
Sampling Location:	**Depth Top: 37.82 Depth Base: 37.92**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 443156 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56158
Date Recived	8.12.15
Sample Ref	BH05 50738

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	100	23.9	8000	10186	2.35	1.37	3.22	77.2
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**77.2**

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447819

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 48862**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:10.36 Depth Base:10.46**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447819 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 48862

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	70	14.9	4200	5348	2.79	1.19	3.31	79.3
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**79.3**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447825

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 48864**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:10.69 Depth Base:10.76**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 447825 - Page 2 of 2

Client Priority Construction Ltd
Sample Number S56595
Date Recived 18.1.16
Sample Ref BH01 48864

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	60	13.0	3600	4584	2.84	1.15	3.25	78.0
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**78.0**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447831

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 48869**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:13.35 Depth Base:13.45**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447831 - Page 2 of 2

Client Priority Construction Ltd
Sample Number S56595
Date Recived 18.1.16
Sample Ref BH01 48869

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	85	18.1	5100	6494	2.79	1.24	3.46	82.9
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**82.9**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447833

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 48871**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:13.70 Depth Base:13.80**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447833 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 48871

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	90	16.4	5400	6875	2.39	1.26	3.00	71.9
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**71.9**

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447834

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 48872**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:16.30 Depth Base:16.40**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 447834 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 48872

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	95	16.1	5700	7257	2.22	1.27	2.82	67.7
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**67.7**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447836

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 48874**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:16.66 Depth Base:16.80**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447836- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 48874

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	115	21.1	6900	8785	2.40	1.33	3.19	76.5
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**76.5**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447839

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 48877**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:26.20 Depth Base:26.36**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447839 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 48877

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	165	17.2	9900	12605	1.36	1.44	1.96	47.1
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**47.1**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447841

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 48879**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:26.61 Depth Base:26.70**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447841 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 48879

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	85	13.2	5100	6494	2.03	1.24	2.52	60.5
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**60.5**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447844

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 48882**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:34.44 Depth Base:34.48**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 447844 - Page 2 of 2

Client Priority Construction Ltd
Sample Number S56595
Date Recived 18.1.16
Sample Ref BH01 48882

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		39	60	10.6	2340	2979	3.56	1.04	3.70	88.8
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**88.8**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447846

Order No:

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 48884**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:34.73 Depth Base: 34.83**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447846 - Page 2 of 2

Client Priority Construction Ltd
Sample Number S56595
Date Recived 18.1.16
Sample Ref BH01 48884

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	95	14.8	5700	7257	2.04	1.27	2.59	62.2
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**62.2**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447848

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 48886**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:44.45 Depth Base:44.54**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447848 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 48886

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	75	16.8	4500	5730	2.93	1.21	3.53	84.8
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**84.8**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447851

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 48888**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:44.79 Depth Base:44.90**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 447851- Page 2 of 2

Client Priority Construction Ltd
Sample Number S56595
Date Recived 18.1.16
Sample Ref BH01 48888

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	90	12.1	5400	6875	1.76	1.26	2.21	53.0
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**53.0**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447858

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 48894**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:56.50 Depth Base:56.60**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447858 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 48894

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	70	12.1	4200	5348	2.26	1.19	2.68	64.4
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**64.4**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447860

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 48896**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:56.85 Depth Base:56.93**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR :447860 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 48896

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	70	12.0	4200	5348	2.24	1.19	2.66	63.9
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**63.9**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447863

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 48899**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:62.76 Depth Base:62.86**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR :447863- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 48899

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	85	18.2	5100	6494	2.80	1.24	3.47	83.4
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**83.4**

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447865

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50857**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:63.05 Depth Base:63.16**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447865 - Page 2 of 2

Client Priority Construction Ltd
Sample Number S56595
Date Recived 18.1.16
Sample Ref BH01 50857

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample	Sample	Test		D	W	P	A	D*D	Is	F	Is (50)	Approx. Compressive
no	type	type		mm	mm	KN	=W*D					Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	125	14.6	7500	9549	1.53	1.35	2.07	49.6
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**49.6**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447870

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50862**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:66.00 Depth Base:66.10**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447870 - Page 2 of 2

Client Priority Construction Ltd
Sample Number S56595
Date Recived 18.1.16
Sample Ref BH01 50862

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	80	14.5	4800	6112	2.37	1.22	2.90	69.6
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**69.6**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447872

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50864**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:66.34 Depth Base:66.45**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447872- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50864

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	105	16.1	6300	8021	2.01	1.30	2.61	62.6
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**62.6**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447880

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50872**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:79.10 Depth Base:79.18**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR :447880 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50872

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	85	11.3	5100	6494	1.74	1.24	2.16	51.8
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**51.8**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447882

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50874**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:79.40 Depth Base:79.52**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447882 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50874

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	110	12.8	6600	8403	1.52	1.31	2.00	48.0
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**48.0**

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447891

Order No:

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50883**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:92.35 Depth Base:92.47**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447891- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50883

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	85	16.0	5100	6494	2.46	1.24	3.05	73.3
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**73.3**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447893

Order No:

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50885**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:92.70 Depth Base:92.79**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447893- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50885

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	80	14.8	4800	6112	2.42	1.22	2.96	71.1
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**71.1**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447901

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50893**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:108.15 Depth Base:108.22**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447901- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50893

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	70	11.5	4200	5348	2.15	1.19	2.55	61.2
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**61.2**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447903

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50895**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:108.51 Depth Base:108.62**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447903 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50895

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	75	13.9	4500	5730	2.43	1.21	2.92	70.2
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**70.2**

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447909

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50901**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:115.89 Depth Base:116.05**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447909- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50901

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	110	14.0	6600	8403	1.67	1.31	2.19	52.5
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**52.5**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447911

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50903**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:116.29 Depth Base:116.39**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR :447911- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50903

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	95	14.8	5700	7257	2.04	1.27	2.59	62.2
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**62.2**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447916

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50908**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:128.80 Depth Base:128.89**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447916- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50908

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	75	16.0	4500	5730	2.79	1.21	3.37	80.8
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**80.8**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447918

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50910**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:129.14 Depth Base:129.21**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447918 - Page 2 of 2

Client Priority Construction Ltd
Sample Number S56595
Date Recived 18.1.16
Sample Ref BH01 50910

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	60	14.0	3600	4584	3.05	1.15	3.50	84.0
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**84.0**

INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447922

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50914**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:133.21 Depth Base:133.32**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 447922 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50914

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	85	15.1	5100	6494	2.33	1.24	2.88	69.2
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**69.2**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447924

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50916**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:133.54 Depth Base:133.63**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR :447924 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50916

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	85	13.5	5100	6494	2.08	1.24	2.58	61.8
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**61.8**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447931

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50923**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:146.20 Depth BaseBase:146.30**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 447931 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50923

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample	Sample	Test		D	W	P	A	D*D	Is	F	Is (50)	Approx. Compressive
no	type	type		mm	mm	KN	=W*D					Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	85	12.0	5100	6494	1.85	1.24	2.29	55.0
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**55.0**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447933

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50925**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:146.52 Depth Base146.61**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447933 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50925

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	95	14.9	5700	7257	2.05	1.27	2.61	62.6
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**62.6**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447942

Page 1 of 2

Order No:

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50933**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:156.33 Depth Base:156.44**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447942- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50933

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	110	11.2	6600	8403	1.33	1.31	1.75	42.0
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**42.0**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447944

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50935**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:156.68 Depth Base:156.76**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447944- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50935

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	90	10.8	5400	6875	1.57	1.26	1.97	47.3
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**47.3**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447946

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50937**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:165.17 Depth Base:165.25**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447946 - Page 2 of 2

Client Priority Construction Ltd
Sample Number S56595
Date Recived 18.1.16
Sample Ref BH01 50937

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	75	15.4	4500	5730	2.69	1.21	3.24	77.7
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**77.7**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447948

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50939**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:166.00 Depth Base:166.10**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447948 - Page 2 of 2

Client Priority Construction Ltd
Sample Number S56595
Date Recived 18.1.16
Sample Ref BH01 50939

Key : -

D	Always distance between platen contact points		D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction		P	Load failure in KN
	ie core diameter for axial tests.		Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.		Is (50)	Point load strength index
A	W*D minimum x-sectional area		F	Size correction factor
	For axial or irregular block test 0.3W < D < W		#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests		//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	85	14.1	5100	6494	2.17	1.24	2.69	64.6
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**64.6**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447953

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50944**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:175.18 Depth Base:175.26**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447953 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50944

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	85	12.8	5100	6494	1.97	1.24	2.44	58.6
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**58.6**

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447956

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50946**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:175.50 Depth Base:175.59**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR :447956- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50944

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	85	12.8	5100	6494	1.97	1.24	2.44	58.6
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**58.6**

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447961

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50951**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:183.90 Depth Base:184.20**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 447961 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50951

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	110	13.0	6600	8403	1.55	1.31	2.03	48.8
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**48.8**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447963

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50953**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:184.25 Depth Base:184.34**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR :447963- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50953

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	90	16.0	5400	6875	2.33	1.26	2.92	70.1
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**70.1**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447967

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50957**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:194.60 Depth Base:194.67**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 447967 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50957

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	60	8.0	3600	4584	1.75	1.15	2.00	48.0
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**48.0**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447969

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50959**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:194.90 Depth Base:194.99**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 447969 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50959

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	80	12.0	4800	6112	1.96	1.22	2.40	57.6
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**57.6**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447972

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50962**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:204.62 Depth Base:204.70**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447972- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50962

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	80	17.4	4800	6112	2.85	1.22	3.48	83.6
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**83.6**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 11th April 2016
Test Report Ref:. STR: 447974

Order No:

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50964**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:204.95 Depth Base:205.02**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447974 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50964

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	85	13.2	5100	6494	2.03	1.24	2.52	60.5
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**60.5**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447980

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50970**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:211.77 Depth Base:211.85**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447980- Page 2 of 2

Client Priority Construction Ltd
Sample Number S56595
Date Recived 18.1.16
Sample Ref BH01 50970

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	75	11.2	4500	5730	1.95	1.21	2.36	56.5
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**56.5**

Point load test results
STR : 447982- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50972

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample	Sample	Test		D	W	P	A	D*D	Is	F	Is (50)	Approx. Compressive
no	type	type		mm	mm	KN	=W*D					Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	100	17.0	6000	7639	2.23	1.29	2.86	68.7
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**68.7**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447982

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50972**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:212.10 Depth Base:212.20**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447989

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50979**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:225.65 Depth Base:225.74**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447989- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50979

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	95	19.1	5700	7257	2.63	1.27	3.34	80.3
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**80.3**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447991

Page 1 of 2

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50981**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:225.95 Depth Base:226.03**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 447991 Page 2 of 2

Client Priority Construction Ltd
Sample Number S56595
Date Recived 18.1.16
Sample Ref BH01 50981

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	95	17.2	5700	7257	2.37	1.27	3.01	72.3
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**72.3**

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447995

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received: **No**
Laboratory Ref. No.: **S56595**
Client Ref. No.: **BH01 - 50985**
Date and Time of Sampling: **Unknown**
Date of Receipt at Lab.: **18/1/2016**
Date of Start of Test.: **18/1/2016**
Sampling Location: **Depth Top:231.65 Depth Base:231.78**
Name of Source: **Lackagh Quarry**
Method of Sampling: **Unknown**
Sampled By: **Client**
Material Description: **Rock Testing**
Target Specification: **N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 447994- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50985

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	120	15.1	7200	9167	1.65	1.34	2.21	53.0
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**53.0**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 447997

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50987**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:232.00 Depth Base:232.10**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 447997- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50987

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample	Sample	Test		D	W	P	A	D*D	Is	F	Is (50)	Approx. Compressive
no	type	type		mm	mm	KN	=W*D					Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	70	14.0	4200	5348	2.62	1.19	3.11	74.6
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**74.6**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 448003

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50993**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:242.82 Depth Base:242.92**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 448003- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50993

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	95	12.8	5700	7257	1.76	1.27	2.24	53.8
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**53.8**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 448005

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50995**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:243.14 Depth Base:243.23**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 448005 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50995

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	85	14.1	5100	6494	2.17	1.24	2.69	64.6
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**64.6**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 448007

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50997**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:251.81 Depth Base:251.95**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 448007 - Page 2 of 2

Client Priority Construction Ltd
Sample Number S56595
Date Recived 18.1.16
Sample Ref BH01 50997

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	110	14.0	6600	8403	1.67	1.31	2.19	52.5
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**52.5**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 448009

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 50999**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:252.22 Depth Base:252.32**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 448009- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 50999

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	90	14.0	5400	6875	2.04	1.26	2.56	61.4
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**61.4**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 448011

Page 1 of 2

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 51001**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:259.72 Depth Base:259.82**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 448011- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 51001

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	85	14.0	5100	6494	2.16	1.24	2.67	64.1
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**64.1**

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 448013

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 51003**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:260.06 Depth Base:260.18**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR :448013- Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 51003

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample	Sample	Test		D	W	P	A	D*D	Is	F	Is (50)	Approx. Compressive
no	type	type		mm	mm	KN	=W*D					Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	120	12.8	7200	9167	1.40	1.34	1.87	44.9
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**44.9**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 448015

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 51005**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:262.63 Depth Base:262.73**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results

STR : 448015 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S56595
Date Recived	18.1.16
Sample Ref	BH01 51005

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	95	16.1	5700	7257	2.22	1.27	2.82	67.7
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**67.7**

Priority Construction Ltd
Killmor
Ballinasloe
Co. Galway
Ireland

Date: 24th February 2016
Test Report Ref:. STR: 448016

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56595**
Client Ref. No.:	**BH01 - 51006**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**18/1/2016**
Date of Start of Test.:	**18/1/2016**
Sampling Location:	**Depth Top:264.80 Depth Base:164.93**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR :448016 - Page 2 of 2

Client Priority Construction Ltd
Sample Number S56595
Date Recived 18.1.16
Sample Ref BH01 51006

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	a		60	100	12.0	6000	7639	1.57	1.29	2.02	48.5
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**48.5**

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 15th February 2016
Test Report Ref:. STR: 451474

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Point Load Index of Rock in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No.:	**S56158**
Client Ref. No.:	**BH05 - 50740**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab.:	**08/12/2015**
Date of Start of Test.:	**15/12/2015**
Sampling Location:	**Depth Top: 37.92 Depth Base: 38.08**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See Attached

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The specimens were perpendicular to the axis of loading with respect to the existing planes of anisotropy.

Nick Dumbarton – Assistant Laboratory Manager

Point load test results
STR : 451474 - Page 2 of 2

Client	Priority Construction Ltd
Sample Number	S6158
Date Recived	8.12.15
Sample Ref	BH05 50740

Key : -

D	Always distance between platen contact points	D*D	= 4A/pi for axial (a) and irregular block (b) tests
W	Smallest width perpendicular to loading direction	P	Load failure in KN
	ie core diameter for axial tests.	Is	Uncorrected strength index
	W =(W1 + W2)/2 for irregular blocks.	Is (50)	Point load strength index
A	W*D minimum x-sectional area	F	Size correction factor
	For axial or irregular block test 0.3W < D < W	#	Test perpendicular to fabric
D*D	= D*D for diametral (d) tests	//	Test parallel to fabric

Sample no	Sample type	Test type		D mm	W mm	P KN	A =W*D	D*D	Is	F	Is (50)	Approx. Compressive Strength (MPa)
*	*	*	*	*	*	*						
Axial, Block or Lump Tests												
1	Core	d		80	140	21.0	11200	14260	1.47	1.48	2.18	52.3
2												
3												
4												
5												
6												
7												
8												
9												
10												
											Mean	**52.3**

Porosity / Density Testing

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 22nd March 2016
Test Report No: STR: 443026

Page 1 of 2

LABORATORY TEST REPORT

REQUIREMENTS: To determine the Porosity & Density using saturation and calliper in accordance with **ISRM Part 1: Test 2**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref.:	**Various**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**11/02/2016**
Sampling Location:	**Various**
Name of Supplier:	**Lackagh Quarry**
Name and Location of Quarry	**Unknown**
Sampled By:	**Client**
Method of Sampling:	**Rock Testing**

Nick Dumbarton – Laboratory Manager

Test Report No: STR 443026 Page 2 of 2

RESULTS:

Sample ref:	Porosity (%)	Dry Density of Rock (Kg/m^3)
BH4 - 48929	0.4	2.69
BH4 - 48936	0.5	2.65
BH5 - 48974	0.4	2.68
BH5 – 50702	0.4	2.69
BH5 – 50730	0.6	2.69

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 22nd March 2016
Test Report No: STR: 443115

LABORATORY TEST REPORT

REQUIREMENTS: To determine the Porosity & Density using saturation and buoyancy in accordance with **ISRM Part 1: Test 3**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref.:	**Various**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**11/02/2016**
Sampling Location:	**Various**
Name of Supplier:	**Lackagh Quarry**
Name and Location of Quarry	**Unknown**
Sampled By:	**Client**
Method of Sampling:	**Rock Testing**

Nick Dumbarton – Laboratory Manager

Test Report No: STR: 443115 Page 2 of 2

RESULTS:

Sample ref:	Porosity (%)	Dry Density of Rock (Kg/m^3)
BH4 - 48914	0.2	2.72
BH4 - 48968	0.4	2.69
BH5 - 48976	0.3	2.65
BH5 - 48999	0.3	2.69
BH5 - 50735	0.4	2.68

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date:17th March 2016
Test Report No: STR: 447826

LABORATORY TEST REPORT

REQUIREMENTS: To determine the Porosity & Density using saturation and buoyancy in accordance with **ISRM Part 1: Test 3**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref.:	**Various**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/1/2016**
Date of Start of Test:	**21/2/2016**
Sampling Location:	**Various**
Name of Supplier:	**Lackagh Quarry**
Name and Location of Quarry	**Unknown**
Sampled By:	**Client**
Method of Sampling:	**Rock Testing**

Nick Dumbarton – Laboratory Manager

Test Report No: STR: 447826 Page 1 of 2

RESULTS:

Sample ref:	Porosity (%)	Dry Density of Rock (Kg/m^3)
BH01 - 48865	0.5	2.63
BH01 - 48876	1.2	2.70
BH01 - 48889	0.5	2.68
BH01 - 50860	0.2	2.72
BH01 - 50867	0.2	2.63
BH01 - 50881	1.0	2.70
BH01 - 50898	0.7	2.59
BH01 - 50919	0.3	2.63
BH01 - 50928	0.7	2.67
BH01 - 50942	0.4	2.72
BH01 - 50960	0.5	2.71
BH01 - 50967	0.3	2.85
BH01 - 50978	0.3	2.63
BH01 - 50983	0.4	2.65
BH01 - 51009	0.5	2.64

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 17th March 2016
Test Report No: STR: 447828

LABORATORY TEST REPORT

REQUIREMENTS: To determine the Porosity & Density using saturation and calliper in accordance with **ISRM Part 1: Test 2**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref.:	**Various**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**21/02/2016**
Sampling Location:	**Various**
Name of Supplier:	**Lackagh Quarry**
Name and Location of Quarry	**Unknown**
Sampled By:	**Client**
Method of Sampling:	**Rock Testing**

Nick Dumbarton – Laboratory Manager

Test Report No: STR: 447828 Page 1 of 2

RESULTS:

Sample ref:	Porosity (%)	Dry Density of Rock (Kg/m^3)
BH01 - 48866	0.47	2.69
BH01 - 48875	0.58	2.65
BH01 - 48885	0.54	2.70
BH01 - 50861	0.64	2.69
BH01 - 50866	0.57	2.71
BH01 - 50880	0.49	2.71
BH01 - 50897	0.57	2.69
BH01 - 50918	0.76	2.81
BH01 - 50927	0.61	2.75
BH01 - 50941	0.49	2.68
BH01 - 50956	0.54	2.69
BH01 - 50966	0.65	2.69
BH01 - 50977	0.56	2.75
BH01 - 50982	0.64	2.70
BH01 - 51008	0.63	2.65

Polish Stone Value

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 01 March 2016
Test Report Ref: STR 448027

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Polished Stone Value (PSV) of aggregate sample in accordance with **BS EN 1097-8 : 2009**

SAMPLE DETAILS:

Certificate of sampling received:	**No**	Name of Source:	**Lackagh Quarry**
Laboratory Ref. No:	**S56595**	Method of Sampling:	**Unknown**
Client Ref. No:	**Bulk Sample**	Sampled By:	**Client**
Date and Time of Sampling:	**Unknown**		
Date of Receipt at Lab:	**18/01/2016**		
Date of Start of Test:	**23/02/2016**		
Sampling Location:	**Unknown**		
Material Description:	**Aggregate**		

RESULTS:

Recorded Polished Stone Value

Test Specimen	Test Run 1	(i)	35.3	Mean
		(ii)	35.7	Recorded
	Test Run 2	(iii)	35.0	Value (S)
		(iv)	37.0	= **35.8**
Control Stone	Test Run 1	(i)	47.7	Mean
		(ii)	47.3	Recorded
	Test Run 2	(iii)	47.0	Value (C)
		(iv)	46.7	= **47.2**

Corrected Polished Stone Value: S + 49* - C = **38**

Comments

*New Control Stone

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: -
Eric Goulden
Technical Manager

Slake Durability

celtest
INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 29 February 2016
Test Report Ref: STR 448028

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Slake Durability Index of an aggregate sample in accordance with **ISRM guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. :	**Bulk Sample**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**18/02/2016**
Sampling Location:	**Unknown**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Aggregate**
Target Specification:	**N/A**

RESULTS:

Slake Durability Index = **99.4 %**

Comments

None

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: - EGoulden
Eric Goulden
Technical Manager

Soil Testing

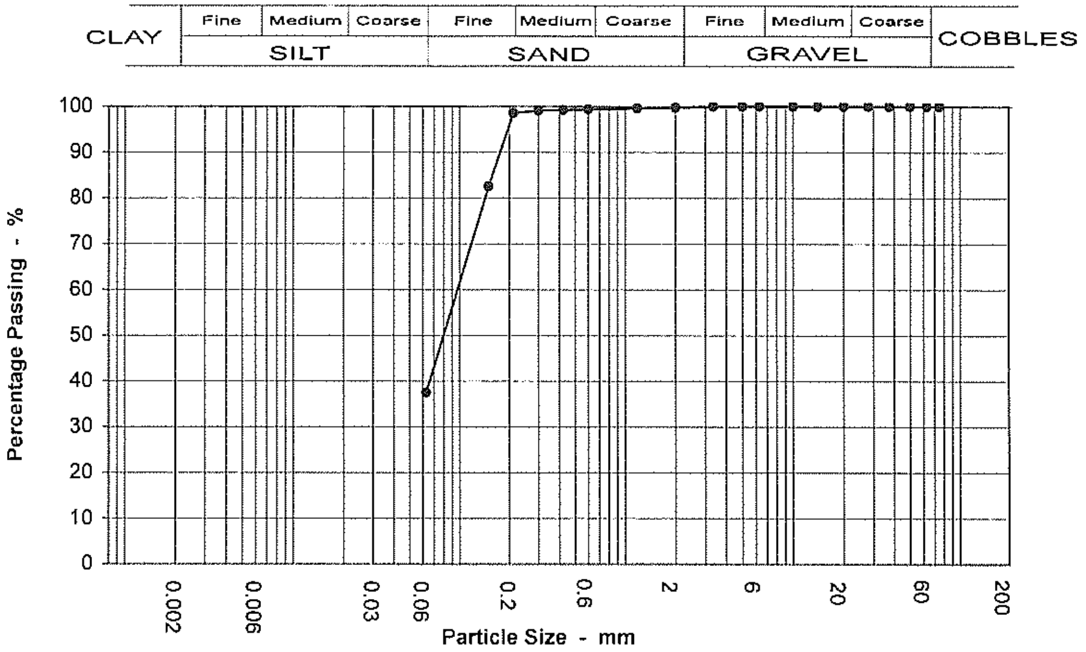
PRIORITY GEOTECHNICAL	Natural Moisture Content/Atterberg Limits Summary BS 1377 : Part 2 : 1990 : Clause 3	Job Ref
Location	Galway PDL	P16005

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	MC	LL	PL	PI	% Pass 425
BH03		13.65	B		26				
BH03		13.73	B			34	NP	NP	100
BH03		19.1	B			29	NP	NP	100
BH03		19.25	B		30				
BH03		19.9	B		30				
BH03		21.3	B		30				
BH03		27.45	B			28	NP	NP	100
BH03		31.2	B		25				
BH03		33.95	B		27				
BH03		38.6	B		36				
BH03		39.25	B			56	44	12	100
BH03		39.8	B		38				
BH03		40.65	B			27	20	7	100
BH03		42.3	B		31				
BH03		47.2	B		32				
BH03		48.2	B			54	43	11	100
BH03		49.3	B		37				
BH03		63.5	B		20				
BH03		64.3	B		29				
BH03		65.5	B		24				
BH03		66.95	B		38				
BH03		68.4	B		37				

PRIORITY GEOTECHNICAL	Natural Moisture Content/Atterberg Limits Summary BS 1377 : Part 2 : 1990 : Clause 3	Job Ref
Location	**Galway PDL**	**P16005**

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	MC	LL	PL	PI	% Pass 425
BH03		70.4	B		21				
BH03		70.75	B		21				
BH03		71.6	B		25				
BH06		16.6	B		22				
BH06		16.7	B			38	27	11	100
BH06		18.25	B		28				
BH06		18.65	B			49	38	11	100
BH06		21.45	B		26				
BH06		21.52	B			39	30	9	100

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P16005**
		Borehole / Pit No	BH03
Location	**Galway PDL**	Sample No	0
		Depth	14.90 m
Soil Description		Sample type	B



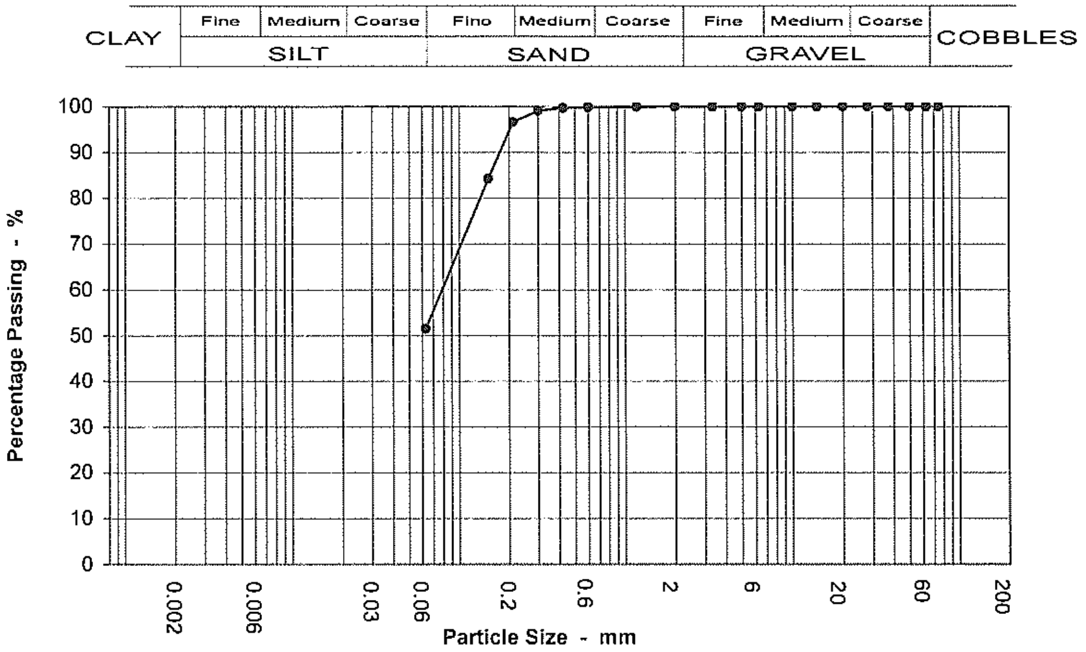
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	99		
0.425	99		
0.3	99		
0.212	99		
0.15	82		
0.063	38		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	0.3
Sand	62.2
Silt & Clay	37.5

Grading Analysis	
D100	3.350
D60	0.106
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	Job Ref	P16005
		Borehole / Pit No	BH03
Location	**Galway PDL**	Sample No	0
		Depth	19.00 m
Soil Description		Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100		
0.425	100		
0.3	99		
0.212	97		
0.15	84		
0.063	51		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	0.0
Sand	48.5
Silt & Clay	51.5

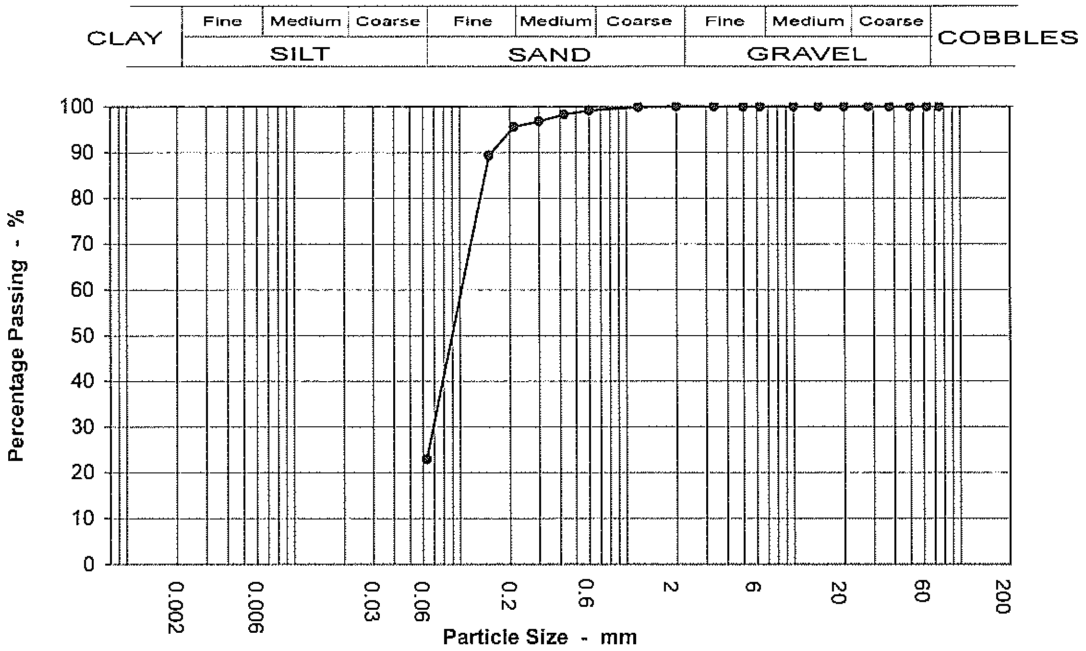
Grading Analysis	
D100	2.000
D60	0.086
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**P16005**
		Borehole / Pit No	BH03
Location	**Galway PDL**	Sample No	0
		Depth	25.50 m
Soil Description		Sample type	B



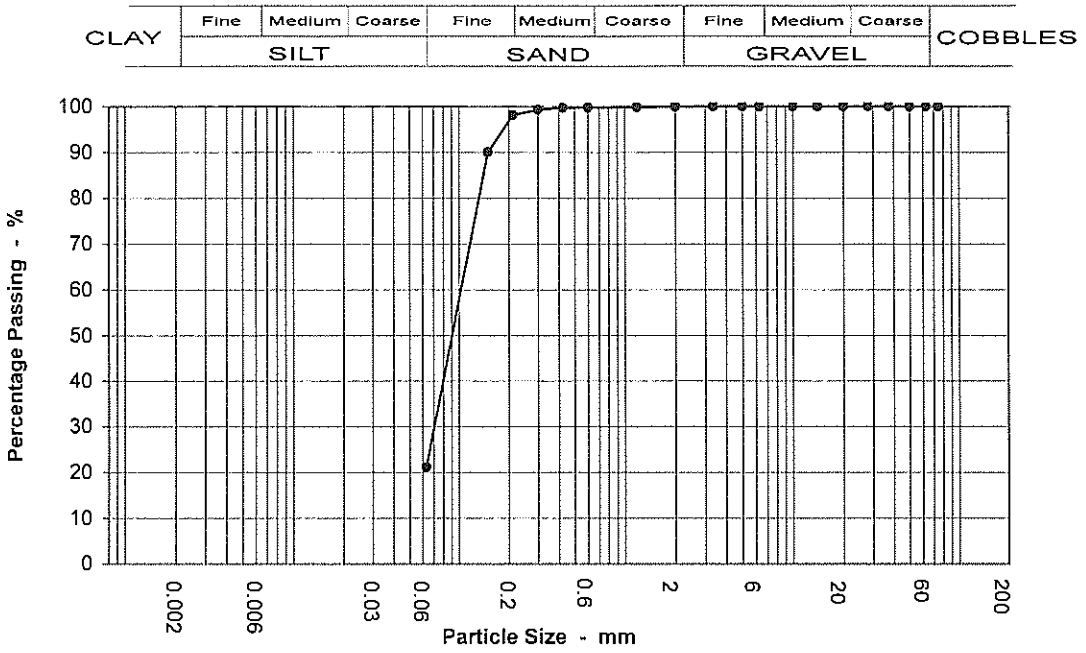
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	99		
0.425	98		
0.3	97		
0.212	95		
0.15	89		
0.063	23		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	0.0
Sand	77.1
Silt & Clay	22.9

Grading Analysis	
D100	2.000
D60	0.112
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P16005**
		Borehole / Pit No	BH03
Location	**Galway PDL**	Sample No	0
		Depth	25.80 m
Soil Description		Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100		
0.425	100		
0.3	99		
0.212	98		
0.15	90		
0.063	21		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	0.0
Sand	78.8
Silt & Clay	21.2

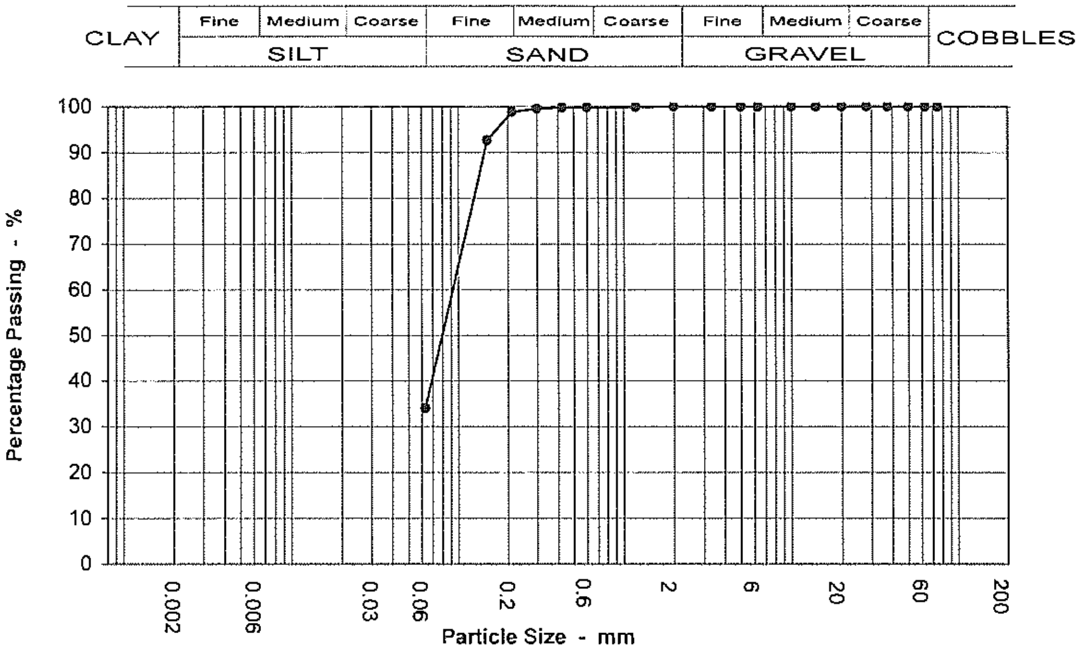
Grading Analysis	
D100	3.350
D60	0.112
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**P16005**
		Borehole / Pit No	BH03
Location	**Galway PDL**	Sample No	0
		Depth	26.50 m
Soil Description		Sample type	B



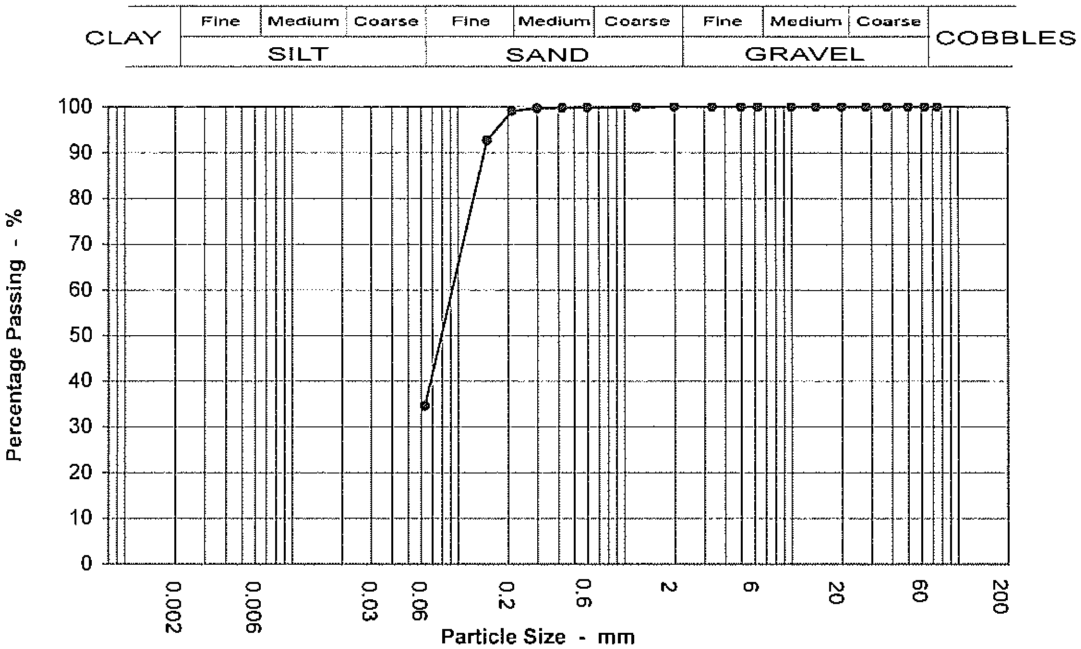
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100		
0.425	100		
0.3	99		
0.212	99		
0.15	93		
0.063	34		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	0.0
Sand	66.0
Silt & Clay	34.0

Grading Analysis	
D100	2.000
D60	0.102
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	Job Ref	**P16005**
		Borehole / Pit No	BH03
Location	**Galway PDL**	Sample No	0
		Depth	26.70 m
Soil Description		Sample type	B



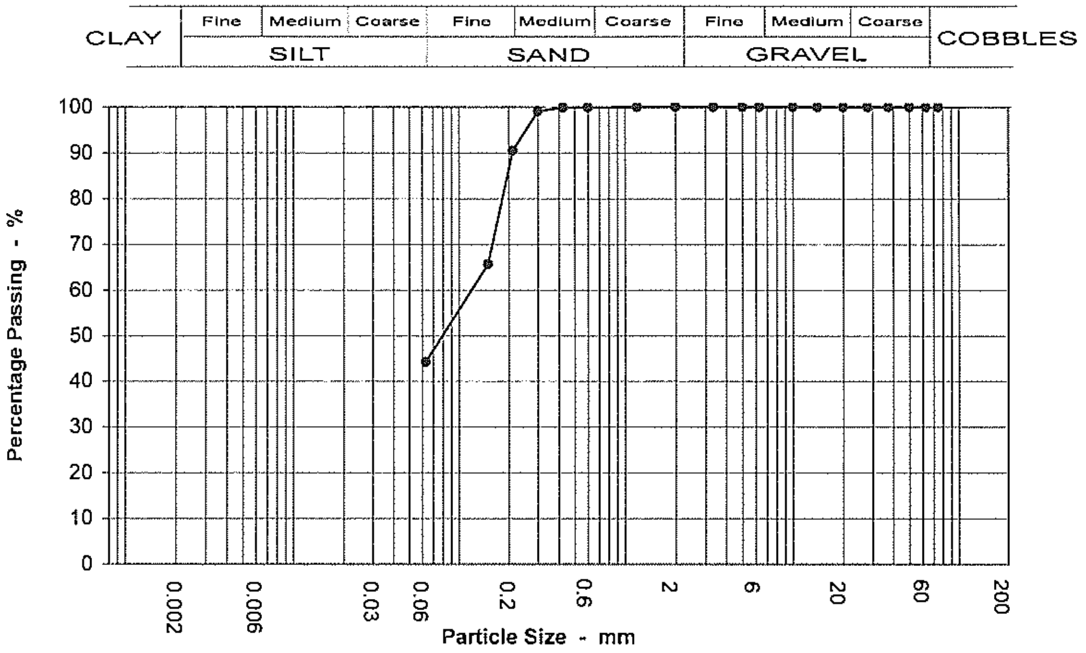
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100		
0.425	100		
0.3	100		
0.212	99		
0.15	93		
0.063	35		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	0.0
Sand	65.4
Silt & Clay	34.6

Grading Analysis	
D100	2.000
D60	0.101
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P16005**
		Borehole / Pit No	BH03
Location	**Galway PDL**	Sample No	0
		Depth	27.55 m
Soil Description		Sample type	B



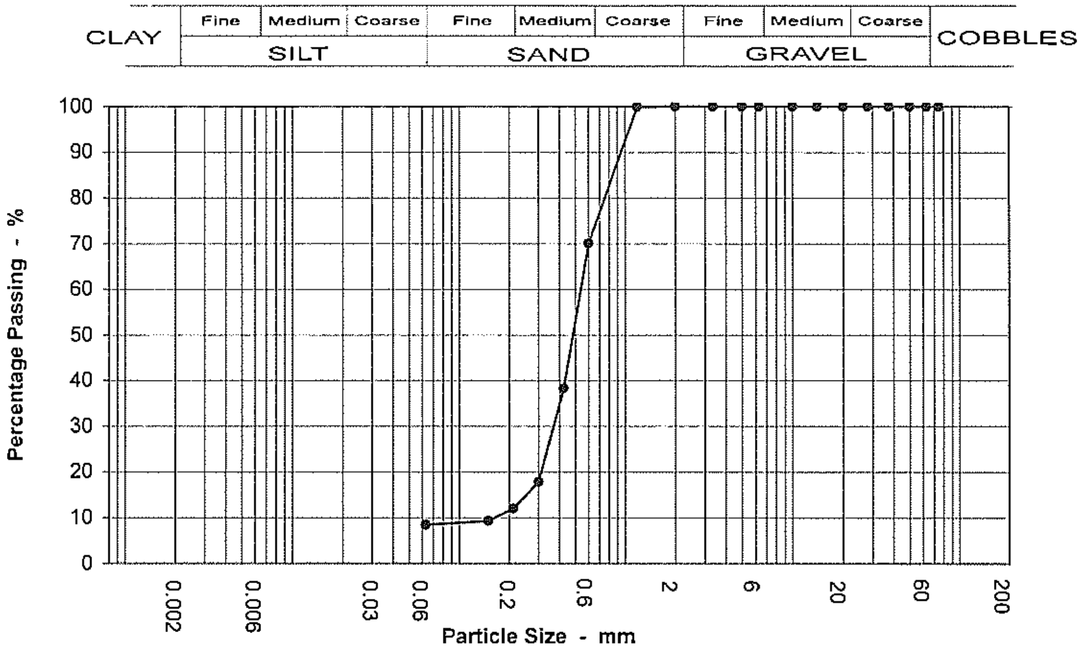
Sieving		**Sedimentation**	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100		
0.425	100		
0.3	99		
0.212	90		
0.15	66		
0.063	44		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	0.0
Sand	55.8
Silt & Clay	44.2

Grading Analysis	
D100	2.000
D60	0.127
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P16005
		Borehole / Pit No	BH03
Location	Galway PDL	Sample No	0
		Depth	30.25 m
Soil Description		Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	70		
0.425	38		
0.3	18		
0.212	12		
0.15	9		
0.063	8		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	0.0
Sand	91.5
Silt & Clay	8.4

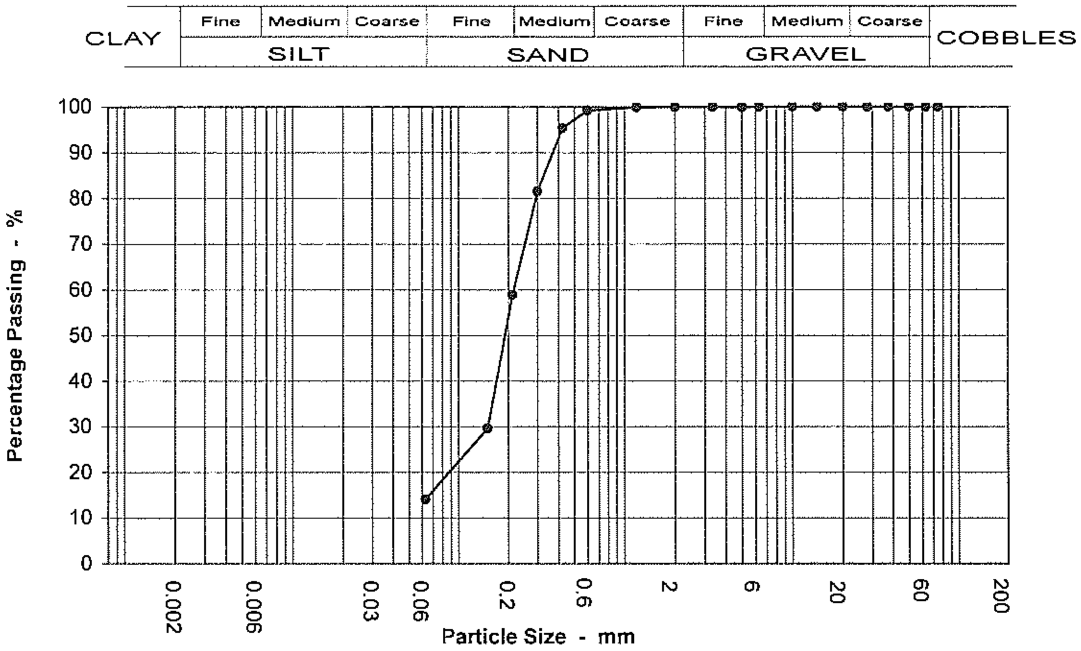
Grading Analysis	
D100	3.350
D60	0.545
D10	0.165
Uniformity Coefficient	3

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	P16005
		Borehole / Pit No	BH03
Location	Galway PDL	Sample No	0
		Depth	36.70 m
Soil Description		Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	99		
0.425	95		
0.3	81		
0.212	59		
0.15	30		
0.063	14		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	0.1
Sand	85.8
Silt & Clay	14.1

Grading Analysis	
D100	6.300
D60	0.217
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

Sulphate Content & pH Value

BS 1377 : Part 3 : 1990 : Clause 5.5 & 9.5

Location	**Galway PDL**	Job Ref **P16005**

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	% < 2.0 mm	pH Value	Sulphate Content as SO3			Sulphate Content as SO4		
							GW g/L	Total Sulphate %	Water Soluble g/L	GW g/L	Total Sulphate %	Water Soluble g/L
BH03		20.95	B			9.08						
BH03		27.20	B			8.93						
BH03		41.20	B			8.27						
BH03		47.00	B			7.77						
BH03		63.38	B			7.5						

PRIORITY GEOTECHNICAL	**Organic Matter Content** **BS 1377 : Part 3 : 1990 : Clause 3**	**Job Ref**
Location	**Galway PDL**	**P16005**

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	% Mass < 2 mm	Organic Matter Content %
BH03		38.95	B		100	8.85
BH03		39.45	B		100	5.63
BH03		42.35	B		100	7.04
BH03		46.20	B		100	15.12
BH03		47.45	B		99.97	6.64
BH03		49.00	B		100	6.49
BH03		63.15	B		98.97	10.22
BH03		63.90	B		100	5.99
BH03		64.90	B		99.3	7.68
BH06		17.13	B		99.51	3.15
BH06		18.95	B		99.5	3.17
BH06		21.75	B		99.93	12.51

UNDRAINED TRIAXIAL COMPRESSION

BS 1377 : Part 7 : 1990 Clause 8

		Job Ref	**P16005**
		Borehole / Pit No	BH03
Location	**Galway PDL**	Sample No	
Soils Description		Depth	4.15 m
		Date	

Sample Details **Specimen** 1

Sample Condition		Undisturbed
Height	mm	185.0
Diameter	mm	82.0
Moisture Content	%	7.9
Bulk Density	Mg/m³	2.34
Dry Density	Mg/m³	2.17

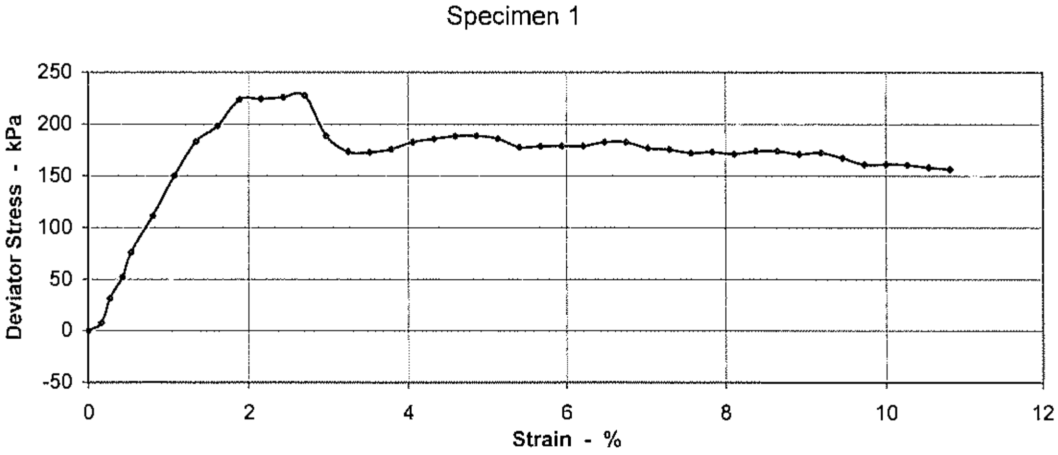
Test Details

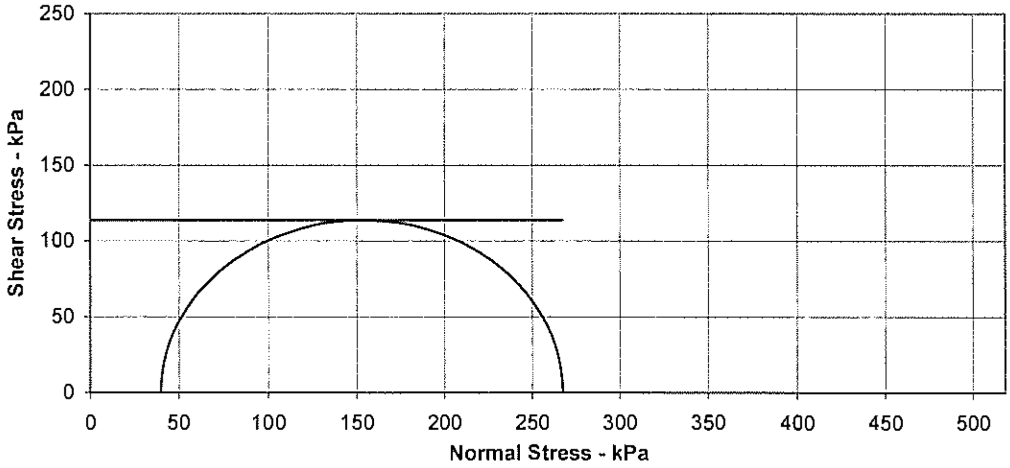
Membrane Thickness	mm	0.36
Membrane Correction	kPa	0.33
Rate of Axial Displacement	%/min	1.62
Cell Pressure	kPa	40
Strain at Failure	%	2.7
Maximum Deviator Stress	kPa	227
Shear Strength	kPa	114
Mode of Failure		Brittle

Position and orientation within the original sample

Shear Strength Parameters

C	114 kPa
Phi	0.0 °


Specimen 1



UNDRAINED TRIAXIAL COMPRESSION

BS 1377 : Part 7 : 1990 Clause 8

Location	**Galway PDL**	Job Ref	**P16005**
		Borehole / Pit No	BH03
		Sample No	
Soils Description		Depth	41.85 m
		Date	

Sample Details **Specimen 1**

Sample Condition		Undisturbed
Height	mm	208.0
Diameter	mm	83.0
Moisture Content	%	41
Bulk Density	Mg/m³	1.78
Dry Density	Mg/m³	1.26

Test Details

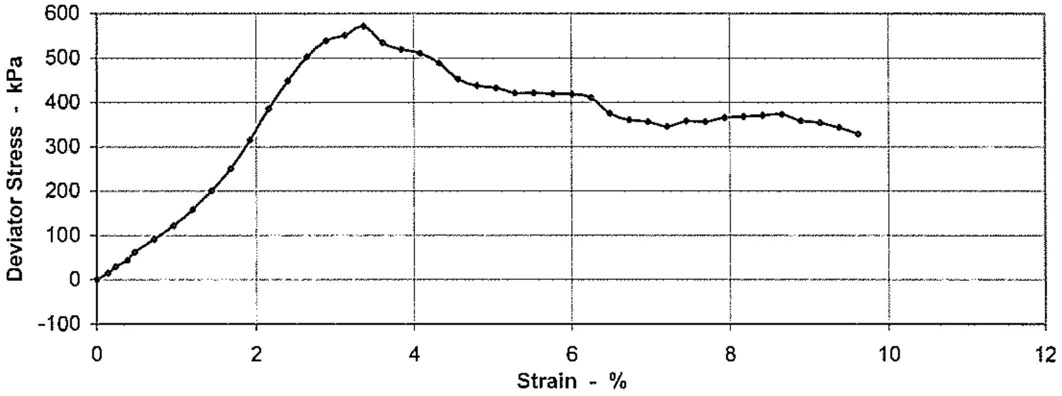
Membrane Thickness	mm	0.36
Membrane Correction	kPa	0.40
Rate of Axial Displacement	%/min	1.44
Cell Pressure	kPa	400
Strain at Failure	%	3.4
Maximum Deviator Stress	kPa	571
Shear Strength	kPa	286
Mode of Failure		Brittle

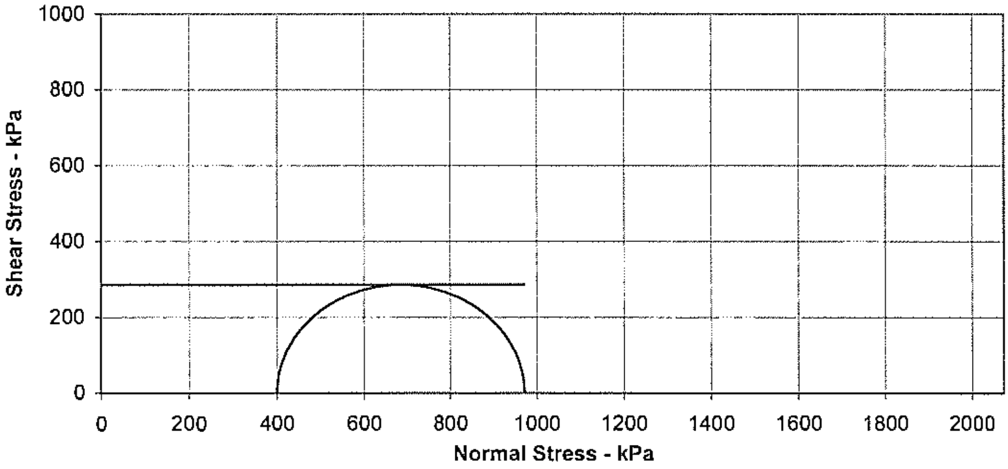
Position and orientation within the original sample

Shear Strength Parameters

C	286	kPa
Phi	0.0	°

Specimen 1





UNDRAINED TRIAXIAL COMPRESSION

BS 1377 : Part 7 : 1990 Clause 8

Location	Galway PDL	Job Ref	P16005
		Borehole / Pit No	BH03
		Sample No	
Soils Description		Depth	42.81 m
		Date	

Sample Details **Specimen** 1

Sample Condition		Undisturbed
Height	mm	205.0
Diameter	mm	83.0
Moisture Content	%	43
Bulk Density	Mg/m³	1.95
Dry Density	Mg/m³	1.36

Test Details

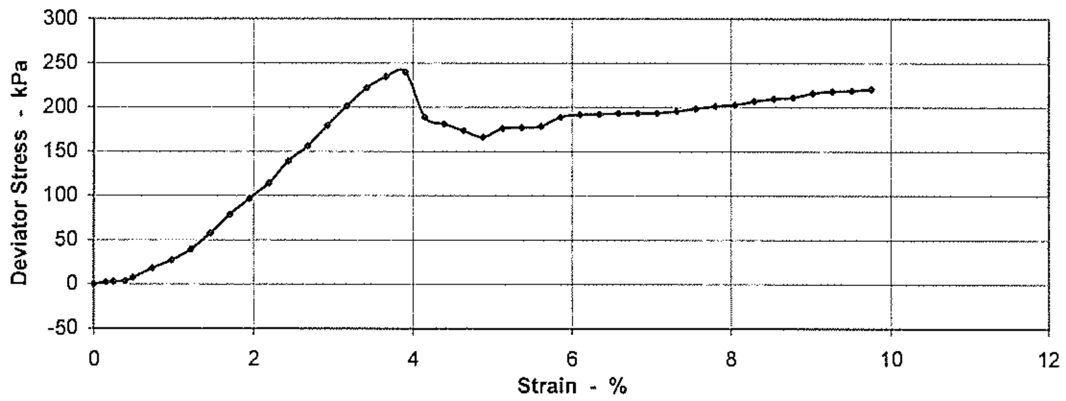
Membrane Thickness	mm	0.36
Membrane Correction	kPa	0.45
Rate of Axial Displacement	%/min	1.46
Cell Pressure	kPa	410
Strain at Failure	%	3.9
Maximum Deviator Stress	kPa	239
Shear Strength	kPa	120
Mode of Failure		Brittle

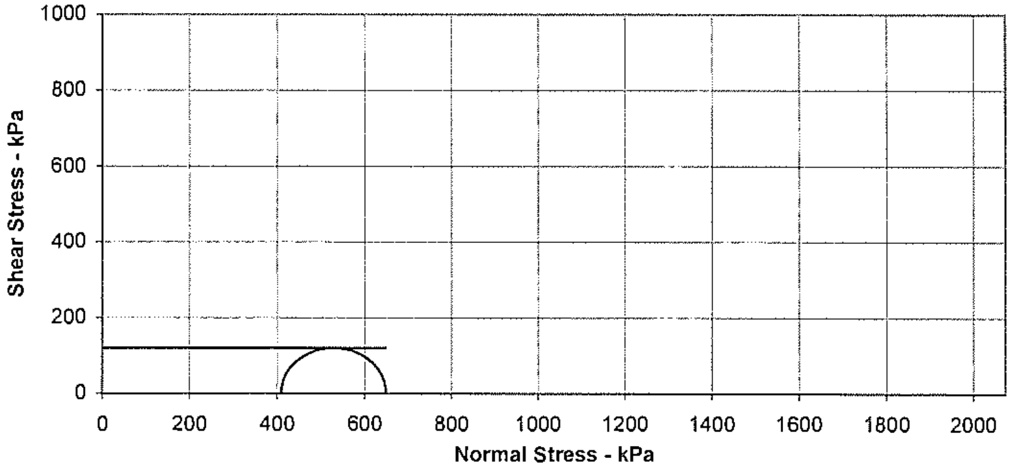
Position and orientation within the original sample

Shear Strength Parameters

C	120 kPa
Phi	0.0 °

Specimen 1





UNDRAINED TRIAXIAL COMPRESSION

BS 1377 : Part 7 : 1990 Clause 8

Location	**Galway PDL**	**Job Ref**	**P16005**
		Borehole / Pit No	BH03
		Sample No	
Soils Description		Depth	46.43 m
		Date	

Sample Details **Specimen** 1

Sample Condition		Undisturbed
Height	mm	201.0
Diameter	mm	80.0
Moisture Content	%	38
Bulk Density	Mg/m³	1.73
Dry Density	Mg/m³	1.26

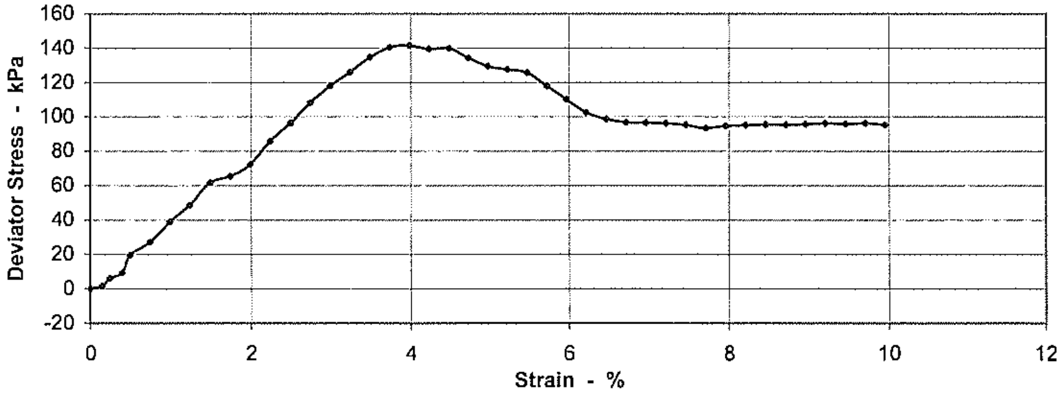
Test Details

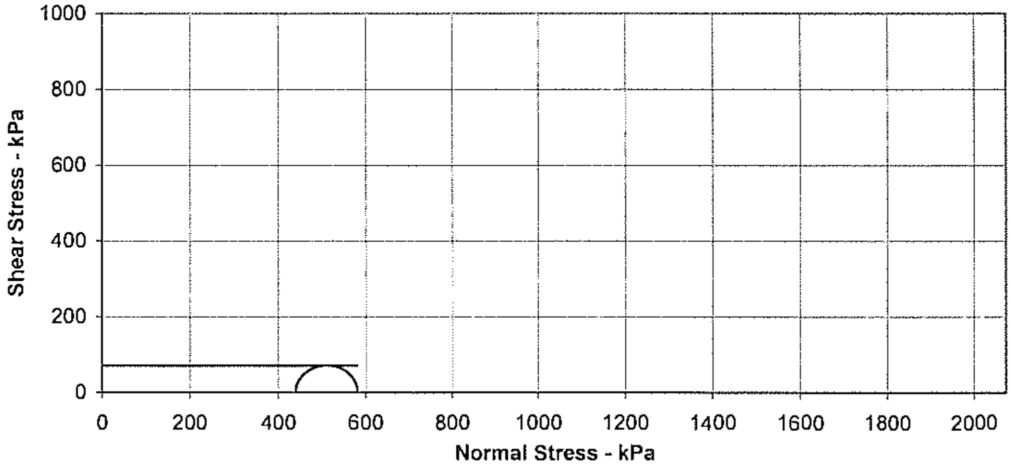
Membrane Thickness	mm	0.36
Membrane Correction	kPa	0.48
Rate of Axial Displacement	%/min	1.49
Cell Pressure	kPa	440
Strain at Failure	%	4.0
Maximum Deviator Stress	kPa	141
Shear Strength	kPa	71
Mode of Failure		Compound

Position and orientation within the original sample

Shear Strength Parameters		
C	71	kPa
Phi	0.0	°

Specimen 1





UNDRAINED TRIAXIAL COMPRESSION

BS 1377 : Part 7 : 1990 Clause 8

Location	Galway PDL	Job Ref	P16005
		Borehole / Pit No	BH03
		Sample No	
Soils Description		Depth	48.45 m
		Date	

Sample Details **Specimen** 1

Sample Condition		Undisturbed
Height	mm	210.0
Diameter	mm	83.0
Moisture Content	%	31
Bulk Density	Mg/m³	1.92
Dry Density	Mg/m³	1.47

Test Details

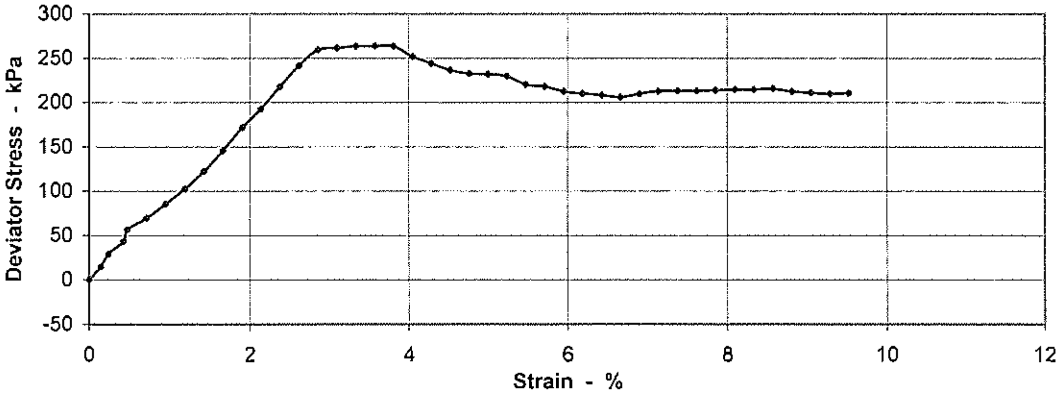
Membrane Thickness	mm	0.36
Membrane Correction	kPa	0.44
Rate of Axial Displacement	%/min	1.43
Cell Pressure	kPa	460
Strain at Failure	%	3.8
Maximum Deviator Stress	kPa	264
Shear Strength	kPa	132
Mode of Failure		Brittle

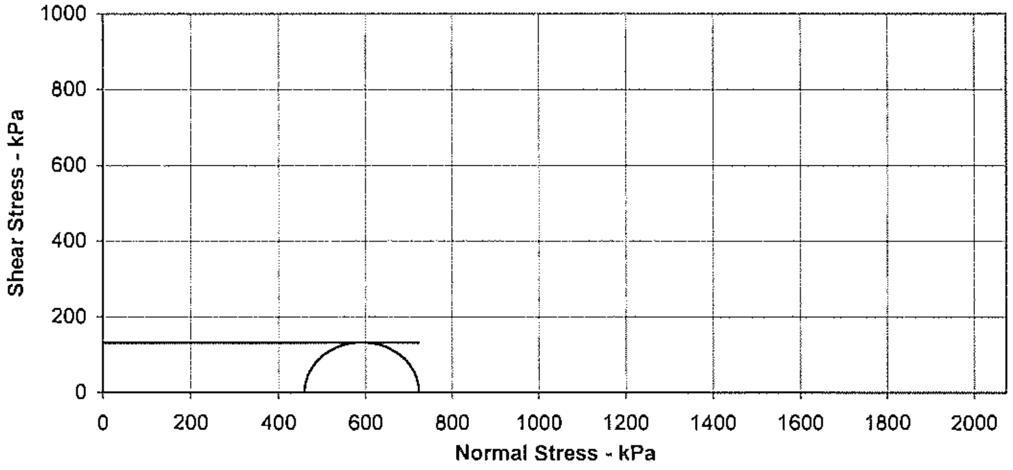
Position and orientation within the original sample

Shear Strength Parameters

C	132 kPa
Phi	0.0 °

Specimen 1





UNDRAINED TRIAXIAL COMPRESSION

BS 1377 : Part 7 : 1990 Clause 8

Location	**Galway PDL**	**Job Ref**	**P16005**
		Borehole / Pit No	BH06
		Sample No	
Soils Description		Depth	5.25 m
		Date	

Sample Details **Specimen 1**

Sample Condition		Undisturbed
Height	mm	196.0
Diameter	mm	82.0
Moisture Content	%	6.1
Bulk Density	Mg/m³	2.39
Dry Density	Mg/m³	2.26

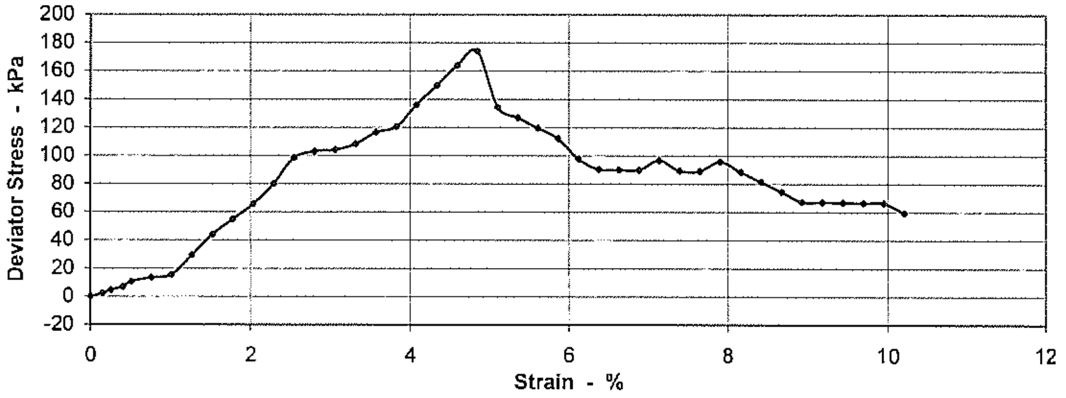
Test Details

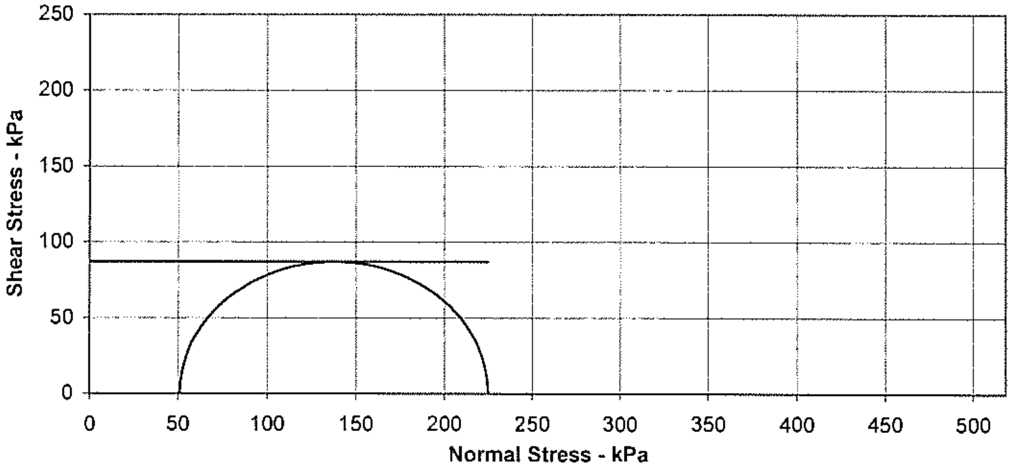
Membrane Thickness	mm	0.36
Membrane Correction	kPa	0.55
Rate of Axial Displacement	%/min	1.53
Cell Pressure	kPa	51
Strain at Failure	%	4.8
Maximum Deviator Stress	kPa	174
Shear Strength	kPa	87
Mode of Failure		Brittle

Position and orientation within the original sample

Shear Strength Parameters	
C	87 kPa
Phi	0.0 °

Specimen 1





UNDRAINED TRIAXIAL COMPRESSION

BS 1377 : Part 7 : 1990 Clause 8

		Job Ref	P16005
		Borehole / Pit No	BH06
Location	Galway PDL	Sample No	
Soils Description		Depth	18 m
		Date	

Sample Details **Specimen** 1

Sample Condition		Undisturbed
Height	mm	206.0
Diameter	mm	82.0
Moisture Content	%	30
Bulk Density	Mg/m³	2.09
Dry Density	Mg/m³	1.61

Test Details

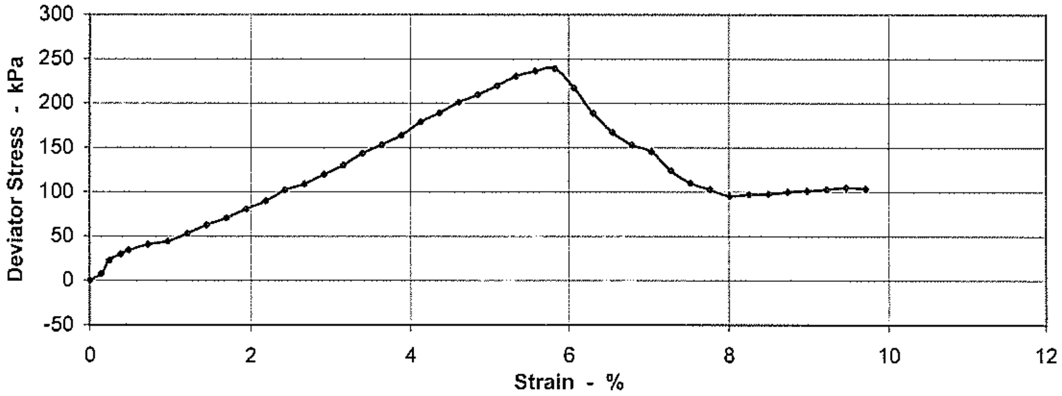
Membrane Thickness	mm	0.36
Membrane Correction	kPa	0.65
Rate of Axial Displacement	%/min	1.46
Cell Pressure	kPa	170
Strain at Failure	%	5.8
Maximum Deviator Stress	kPa	239
Shear Strength	kPa	119
Mode of Failure		Brittle

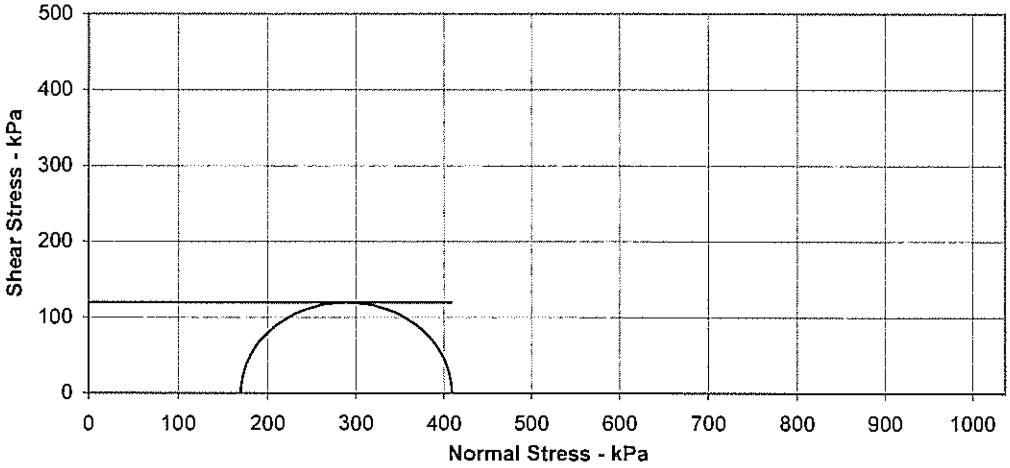
Position and orientation within the original sample

Shear Strength Parameters

C	119 kPa
Phi	0.0 °

Specimen 1





Laboratory Report

UKAS TESTING
2788

GSTL
GEO Site & Testing Services Ltd

Contract Number: 30522

Client's Reference: **P16005**
Report Date: **09-05-2016**

Client **Priority Geotechnical Limited**
Unit 12
Owenacurra Business Park
Midleton
Co. Cork.

Contract Title: **N6 Galway Bypass**
For the attention of: **Colette Kelly**

Date Received: **07-04-2016**
Date Commenced: **07-04-2016**
Date Completed: **09-05-2016**

Test Description	Qty
One-dimensional Consolidation 75mm or 50mm diameter specimens (5 days) 1377 : 1990 Part 5 : 3 - * UKAS	7
As 4.01 each additional day 1377 : 1990 Part 5 : 3	18
Disposal of Samples on Project	1

Notes: **Observations and Interpretations are outside the UKAS Accreditation**
*** - denotes test included in laboratory scope of accreditation**
 # - denotes test carried out by approved contractor
@ - denotes non accredited tests

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced in full, without the prior written approval of the laboratory.

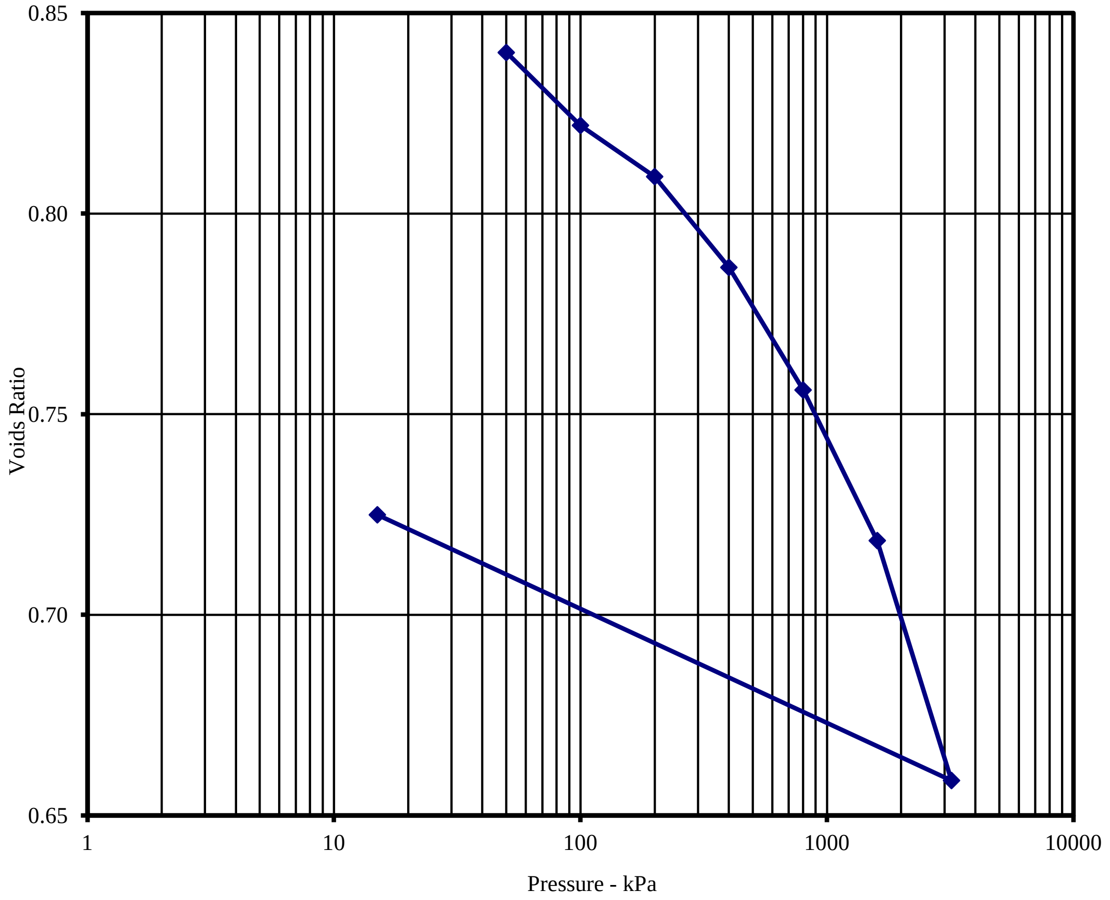
Approved Signatories:
Alex Wynn (Associate Director) - Benjamin Sharp (Contracts Manager) - Emma Sharp (Office Manager)
Paul Evans (Quality/Technical Manager) - Vaughan Edwards (Managing Director)

ONE DIMENSIONAL CONSOLIDATION

BS1377: Part 5: 1990

Client ref: **P16005**
Location: **N6 Galway Bypass**
Contract Number: **30522-070416**
Hole/Sample Number: **BH03**
Depth (m): **41.30 - 41.50**
Sample Type: **B**

Initial Conditions		Pressure Range			Mv	Cv	Method of time fitting used
Moisture Content (%):	33	kPa			m2/MN	m2/yr	Cv Calculated using t90
Bulk Density (Mg/m3):	1.89	0	-	50	0.20	23	Nominal Laboratory Temperature
Dry Density (Mg/m3):	1.43	50	-	100	0.20	15	20'C
Voids Ratio:	0.8590	100	-	200	0.070	24	Location of specimen with sample
Degree of saturation:	101.4	200	-	400	0.063	13	top
Height (mm):	19.96	400	-	800	0.043	7.4	Remarks:
Diameter (mm)	50.06	800	-	1600	0.027	9.8	
Particle Density (Mg/m3):	2.65	1600	-	3200	0.022	11	
Assumed		3200	-	15	0.013	20	



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Checked By

09/05/16
Date

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Approved By

09/05/16
Date

GSTL
GEO SITE & TESTING SERVICES LTD

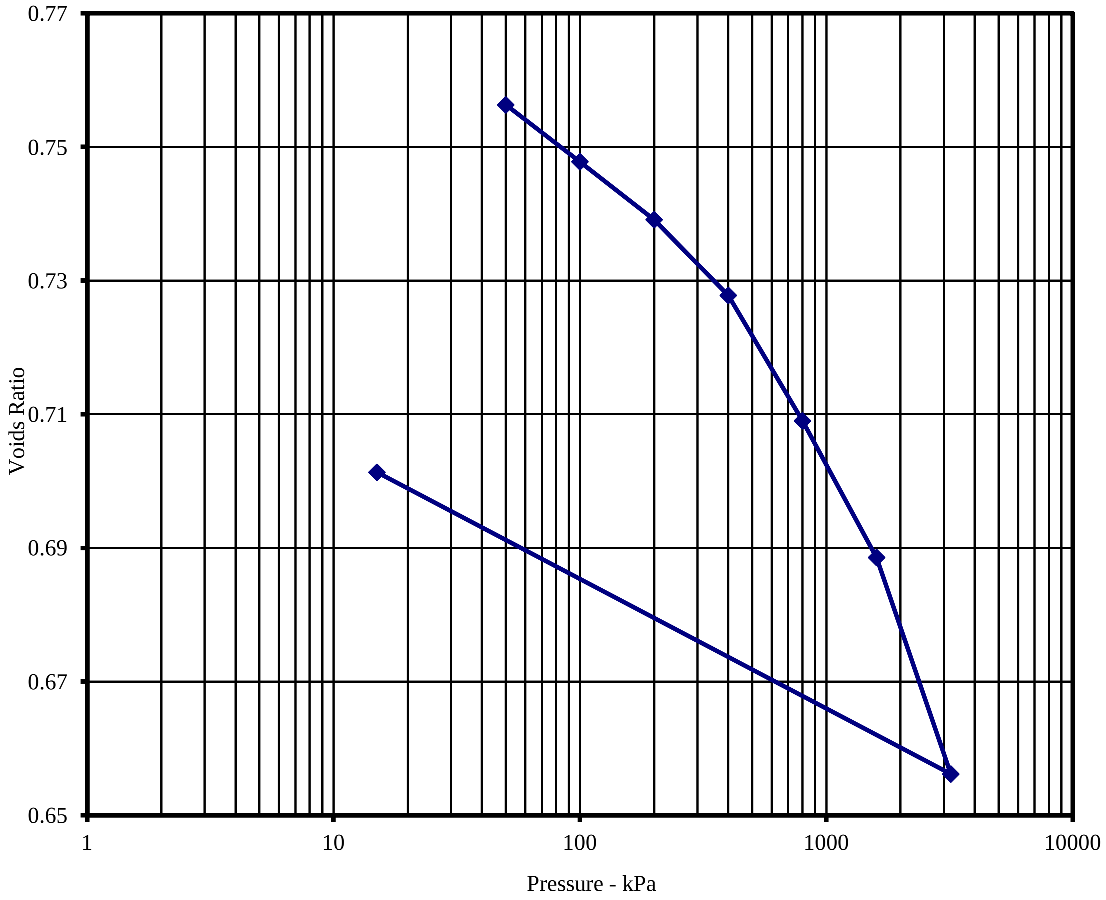
UKAS TESTING 2788

ONE DIMENSIONAL CONSOLIDATION

BS1377: Part 5: 1990

Client ref:	**P16005**
Location:	**N6 Galway Bypass**
Contract Number:	**30522-070416**
Hole/Sample Number:	**BH03**
Depth (m):	**42.97 - 43.00**
Sample Type:	**B**

Initial Conditions		Pressure Range kPa	Mv m2/MN	Cv m2/yr	Method of time fitting used Cv Calculated using t90
Moisture Content (%):	29				
Bulk Density (Mg/m3):	1.93	0 - 50	0.18	31	Nominal Laboratory Temperature 20'C
Dry Density (Mg/m3):	1.50	50 - 100	0.10	11	
Voids Ratio:	0.7721	100 - 200	0.050	36	Location of specimen with sample top
Degree of saturation:	99.6	200 - 400	0.033	11	
Height (mm):	20.02	400 - 800	0.027	12	Remarks:
Diameter (mm)	50.05	800 - 1600	0.015	25	
Particle Density (Mg/m3):	2.65	1600 - 3200	0.012	10	
Assumed		3200 - 15	0.0086	31	



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Checked By

09/05/16

Date

D P Evans

Approved By

09/05/16

Date

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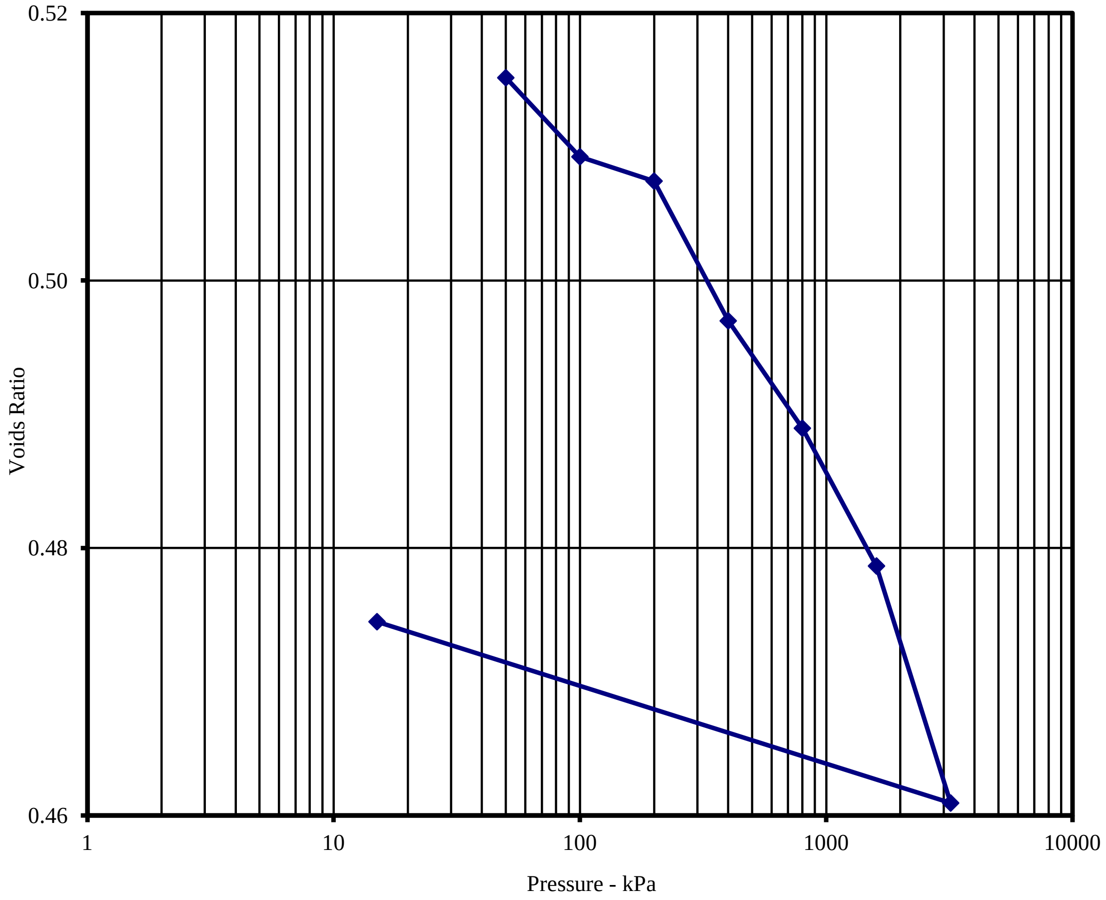
UKAS TESTING 2788

ONE DIMENSIONAL CONSOLIDATION

BS1377: Part 5: 1990

Client ref:	**P16005**
Location:	**N6 Galway Bypass**
Contract Number:	**30522-070416**
Hole/Sample Number:	**BH03**
Depth (m):	**44.05 - 44.20**
Sample Type:	**B**

Initial Conditions		Pressure Range			Mv	Cv	Method of time fitting used
Moisture Content (%):	21		kPa		m2/MN	m2/yr	Cv Calculated using t90
Bulk Density (Mg/m3):	2.11	0	-	50	0.025	19	Nominal Laboratory Temperature
Dry Density (Mg/m3):	1.75	50	-	100	0.078	0.53	20'C
Voids Ratio:	0.5171	100	-	200	0.012	19	Location of specimen with sample
Degree of saturation:	105.2	200	-	400	0.035	4.8	top
Height (mm):	20.03	400	-	800	0.013	6.2	Remarks:
Diameter (mm)	50	800	-	1600	0.0086	19	
Particle Density (Mg/m3):	2.65	1600	-	3200	0.0075	10	
Assumed		3200	-	15	0.0029	53	



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GEO SITE & TESTING SERVICES LTD

Checked By 09/05/16 **Date**

Approved By 09/05/16 **Date**

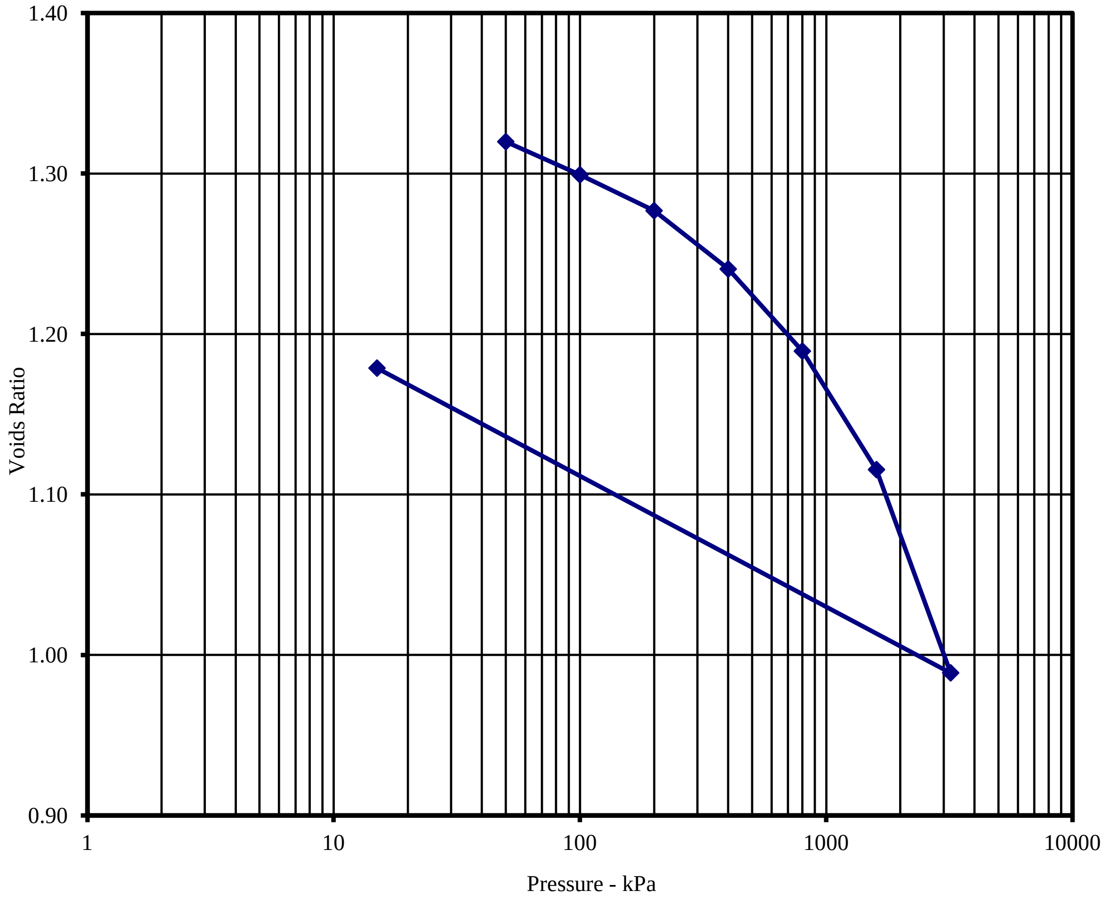
UKAS TESTING 2788

ONE DIMENSIONAL CONSOLIDATION

BS1377: Part 5: 1990

Client ref: P16005
Location: N6 Galway Bypass
Contract Number: 30522-070416
Hole/Sample Number: BH03
Depth (m): 47.85 - 48.02
Sample Type: B

Initial Conditions		Pressure Range			Mv	Cv	Method of time fitting used
Moisture Content (%):	40	kPa			m2/MN	m2/yr	Cv Calculated using t90
Bulk Density (Mg/m3):	1.59	0	-	50	0.13	18	Nominal Laboratory Temperature
Dry Density (Mg/m3):	1.14	50	-	100	0.18	5.6	20'C
Voids Ratio:	1.3346	100	-	200	0.097	18	Location of specimen with sample
Degree of saturation:	79.1	200	-	400	0.080	4.1	top
Height (mm):	20.04	400	-	800	0.057	0.63	Remarks:
Diameter (mm)	50.02	800	-	1600	0.042	15	
Particle Density (Mg/m3):	2.65	1600	-	3200	0.037	9.2	
Assumed		3200	-	15	0.030	2.8	



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Checked By 09/05/16 **Date**

Approved By 09/05/16 **Date**

UKAS
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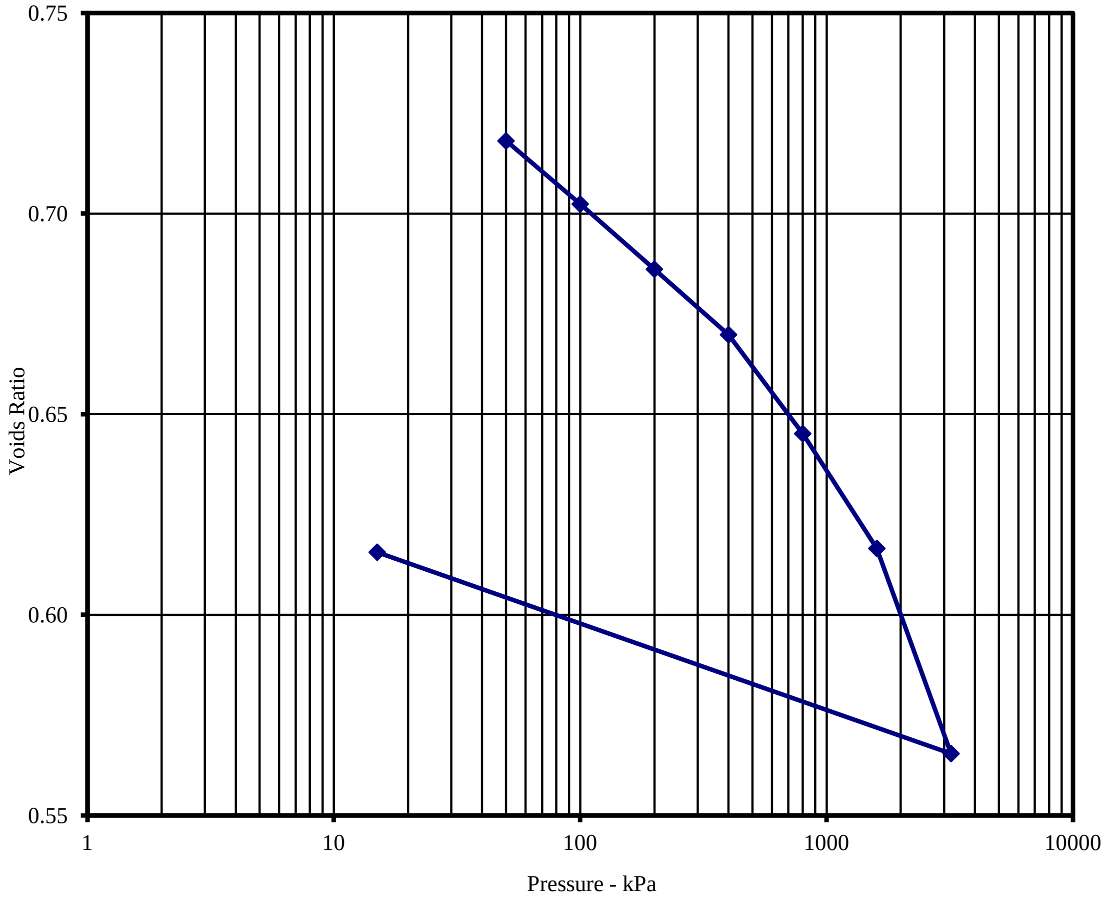
ONE DIMENSIONAL CONSOLIDATION

BS1377: Part 5: 1990

Client ref:	**P16005**
Location:	**N6 Galway Bypass**
Contract Number:	**30522-070416**
Hole/Sample Number:	**BH06**
Depth (m):	**16.20 - 16.50**
Sample Type:	**B**

Initial Conditions		Pressure Range kPa			Mv m2/MN	Cv m2/yr	Method of time fitting used
Moisture Content (%):	26						Cv Calculated using t90
Bulk Density (Mg/m3):	1.95	0	-	50	0.046	17	Nominal Laboratory Temperature
Dry Density (Mg/m3):	1.54	50	-	100	0.18	12	20'C
Voids Ratio:	0.7221	100	-	200	0.10	10	Location of specimen with sample
Degree of saturation:	96.9	200	-	400	0.048	16	top
Height (mm):	20.04	400	-	800	0.037	6.2	Remarks:
Diameter (mm)	50.02	800	-	1600	0.022	11	
Particle Density (Mg/m3):	2.65	1600	-	3200	0.020	14	
Assumed		3200	-	15	0.010	10	



Katam

Checked By

09/05/16

Date

D P Evans

Approved By

09/05/16

Date

GSTL
GEO SITE & TESTING SERVICES LTD

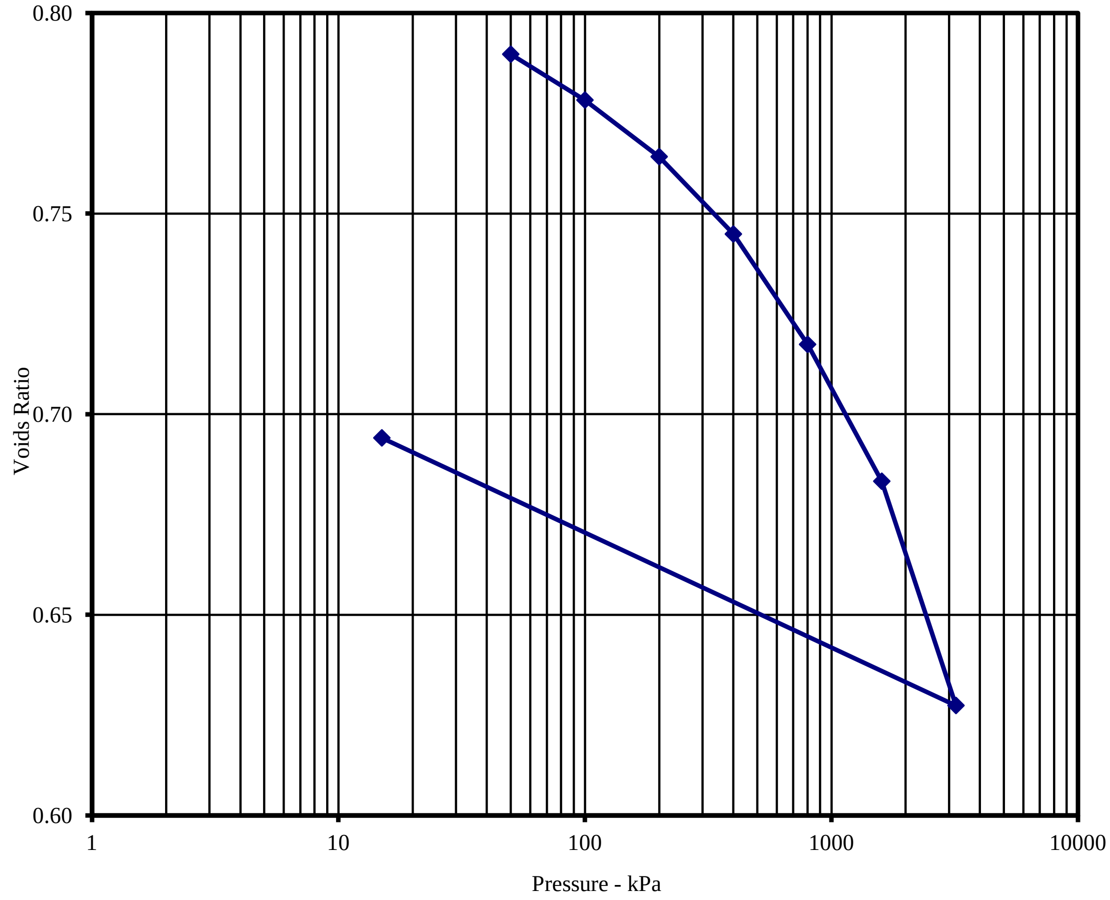
UKAS TESTING 2788

ONE DIMENSIONAL CONSOLIDATION

BS1377: Part 5: 1990

Client ref:	**P16005**
Location:	**N6 Galway Bypass**
Contract Number:	**30522-070416**
Hole/Sample Number:	**BH06**
Depth (m):	**19.70 - 19.95**
Sample Type:	**B**

Initial Conditions		Pressure Range kPa	Mv m2/MN	Cv m2/yr	Method of time fitting used
Moisture Content (%):	27				Cv Calculated using t90
Bulk Density (Mg/m3):	1.87	0 - 50	0.084	12	Nominal Laboratory Temperature
Dry Density (Mg/m3):	1.47	50 - 100	0.13	12	20'C
Voids Ratio:	0.7973	100 - 200	0.079	27	Location of specimen with sample
Degree of saturation:	90.1	200 - 400	0.055	11	top
Height (mm):	20.13	400 - 800	0.039	4.3	Remarks:
Diameter (mm)	50.01	800 - 1600	0.025	16	
Particle Density (Mg/m3):	2.65	1600 - 3200	0.021	15	
Assumed		3200 - 15	0.013	16	



Katam

09/05/16

Checked By **Date**

D P Evans

09/05/16

Approved By **Date**

GSTL GEO SITE & TESTING SERVICES LTD

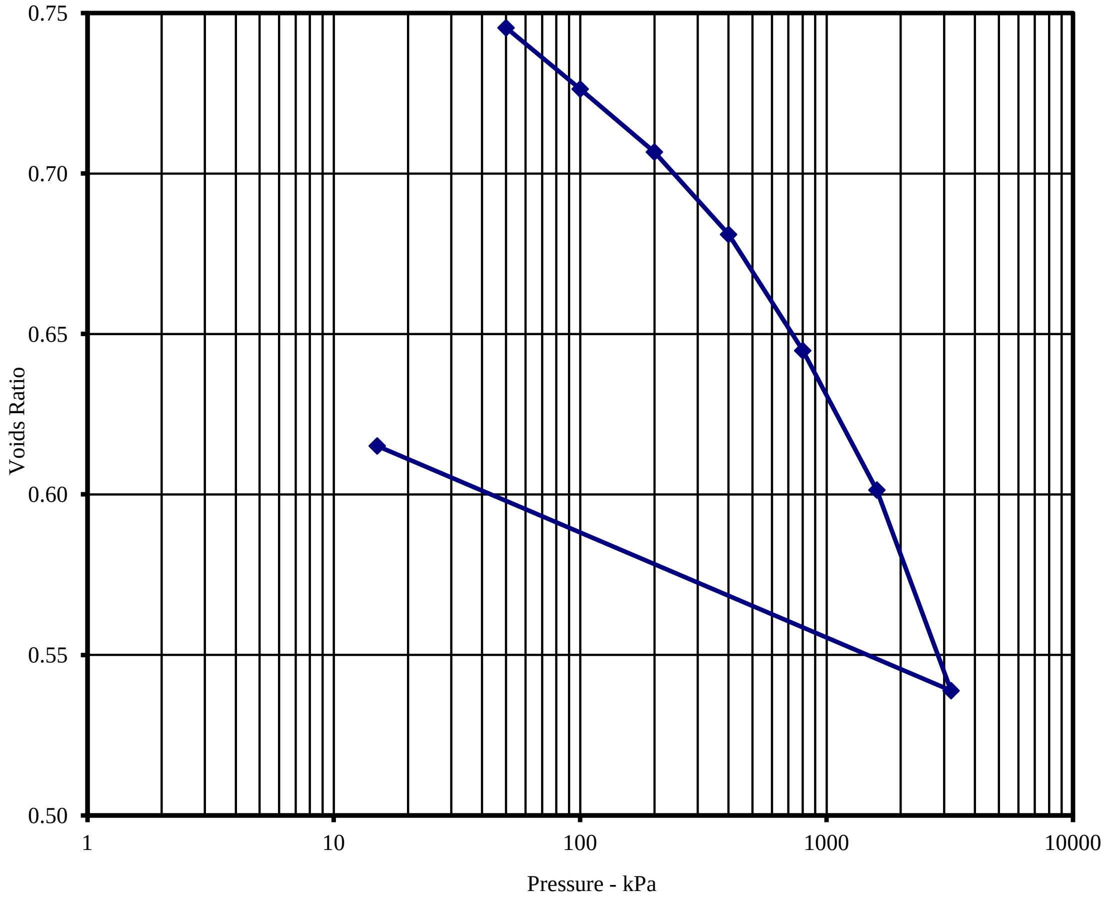
UKAS TESTING 2788

ONE DIMENSIONAL CONSOLIDATION

BS1377: Part 5: 1990

Client ref: P16005
Location: N6 Galway Bypass
Contract Number: 30522-070416
Hole/Sample Number: BH06
Depth (m): 20.00 - 20.25
Sample Type: B

Initial Conditions		Pressure Range			Mv	Cv	Method of time fitting used
Moisture Content (%):	30	kPa			m2/MN	m2/yr	Cv Calculated using t90
Bulk Density (Mg/m3):	1.94	0	-	50	0.35	18	Nominal Laboratory Temperature
Dry Density (Mg/m3):	1.49	50	-	100	0.22	15	20'C
Voids Ratio:	0.7762	100	-	200	0.11	27	Location of specimen with sample
Degree of saturation:	101.7	200	-	400	0.075	16	top
Height (mm):	19.92	400	-	800	0.054	7.0	Remarks:
Diameter (mm)	50.02	800	-	1600	0.033	21	
Particle Density (Mg/m3):	2.65	1600	-	3200	0.024	14	
Assumed		3200	-	15	0.016	7.1	



09/05/16

Checked By **Date**

09/05/16

Approved By **Date**

GSTL
GEO SITE & TESTING SERVICES LTD

UKAS TESTING 2788

Thin Section / Petrography

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 16th February 2016
Test Report Ref.: 443031

LABORATORY TEST REPORT

Test Requirements: Petrographic Examination of Natural Stone in accordance with BS EN 12047:2007

Sample details:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH04 - 48919**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**29/1/2016**
Date of Start of Test.:	**21/1/2016**
Sampling Location:	**Depth Top: 20.05 Depth Base: 20.12**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The work was carried out by our accredited, competent, sub contracted laboratory.

RESULTS

See Attached

Nick Dumbarton – Assistant Laboratory Manager

Petrographic Examination Natural Stone– BS EN 12407:2007

HAND SPECIMEN DESCRIPTION

The sample was hard, fine to very coarse grained, anisotropic limestone breccia. The sample exhibited small to very large, medium grey limestone clasts (up to >70mm across), cemented or surrounded by dark grey materials comprising chiefly much smaller limestone and calcite grains, and including some clay materials. The sample did not appear macroporous.

MICROSCOPICAL DESCRIPTION

Constituents[1]	Visual Estimated Proportions[2] %	Range of Crystal/Grain Size	Petrographic Details	Origin
Calcite	94	Up to 4mm	Fresh, angular to well rounded calcium carbonate, including abundant bioclasts. The sample was partially stained in accordance with Dickson's method. This suggested that the calcite was non-ferroan.	Primary
Clay materials	2-3	<4µm	Very fine grained materials beyond the conclusive resolution of the petrographic microscope, which could be better investigated by scanning electron microscopy (SEM).	Primary
Opaque minerals	1-2	Up to 800µm	Irregular, anhedral to euhedral, fresh to partially oxidised isotropic minerals apparently comprising both framboidal and facetted, probably pyritic materials. Scanning electron microscopy should be used if necessary for better resolution and description of the opaque minerals.	Primary
Iron oxide compounds	<<1	N/A	Small amorphous by-products of the partial or complete oxidation of opaque minerals.	Secondary

The sample was a fine to very coarse grained LIMESTONE BRECCIA, comprising chiefly calcium carbonate (chiefly as limestone clasts), with a minor proportion of clay materials and trace to minor proportion of opaque minerals.

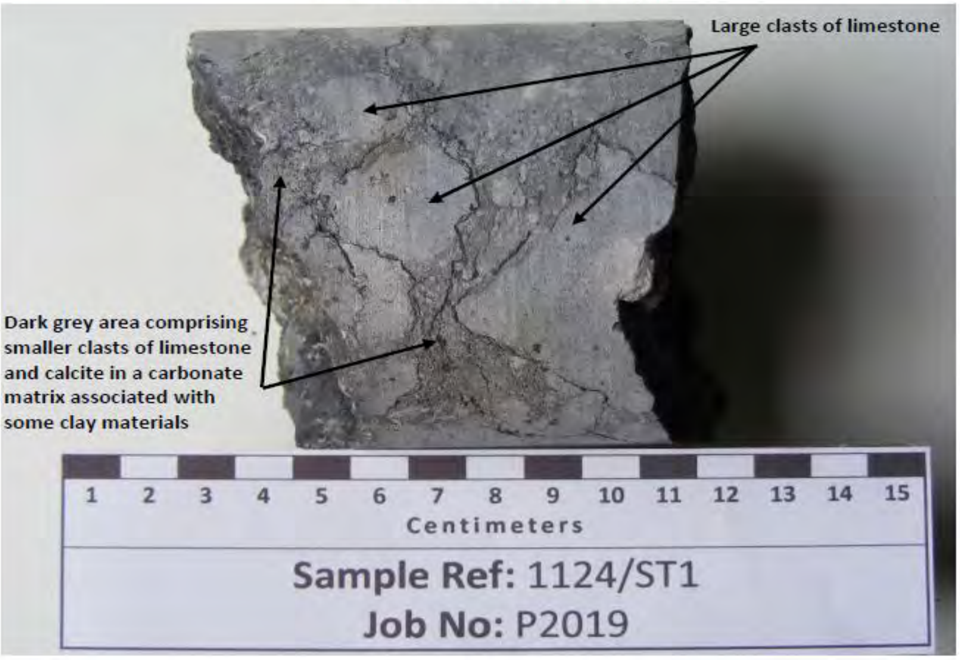
The individual limestone constituents were typically fine to medium grained. The dark grey areas of the sample comprised chiefly smaller calcium carbonate, with a minor proportion of clay materials. The opaque minerals were unevenly distributed and were frequently observed concentrated in thin, irregular and randomly orientated layers within the dark grey areas of the sample.

The sample fractured relatively easily along irregular and randomly distributed fracture surfaces within the dark grey areas of the sample during the cutting process to produce the thin section slice. This suggested that the dark grey areas of the sample exhibited frequent planes of weakness, which were probably associated with clay materials and the irregular layers of opaque minerals.

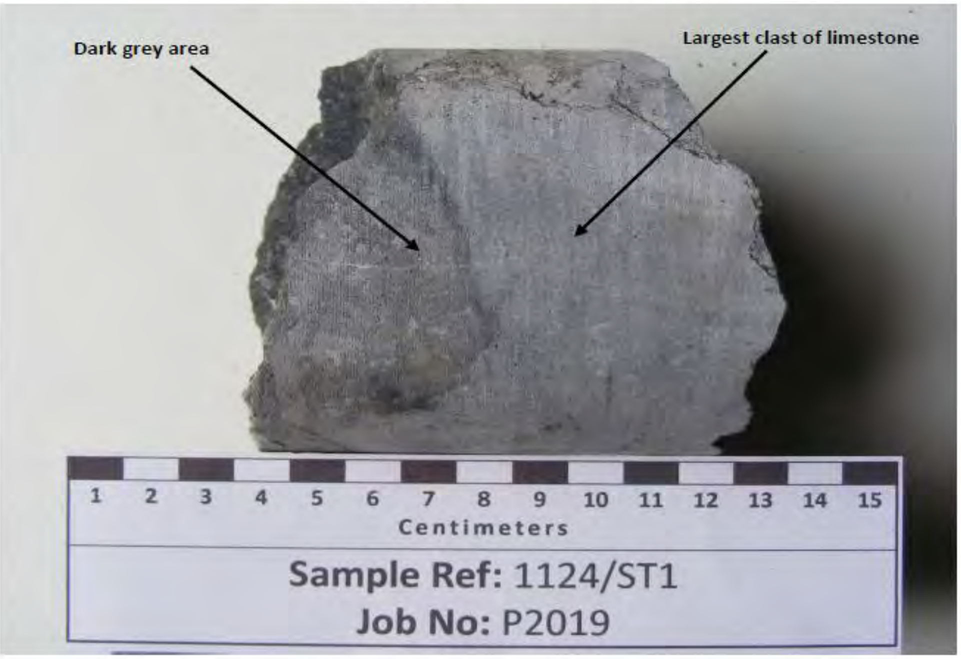
Only rare voids up to 0.4mm were observed. These voids appeared chiefly associated with loss of materials during the sampling process and did not appear interconnected. The void content was visually estimated as being well below 1%.

The sample was fresh and exhibited Grade I weathering.

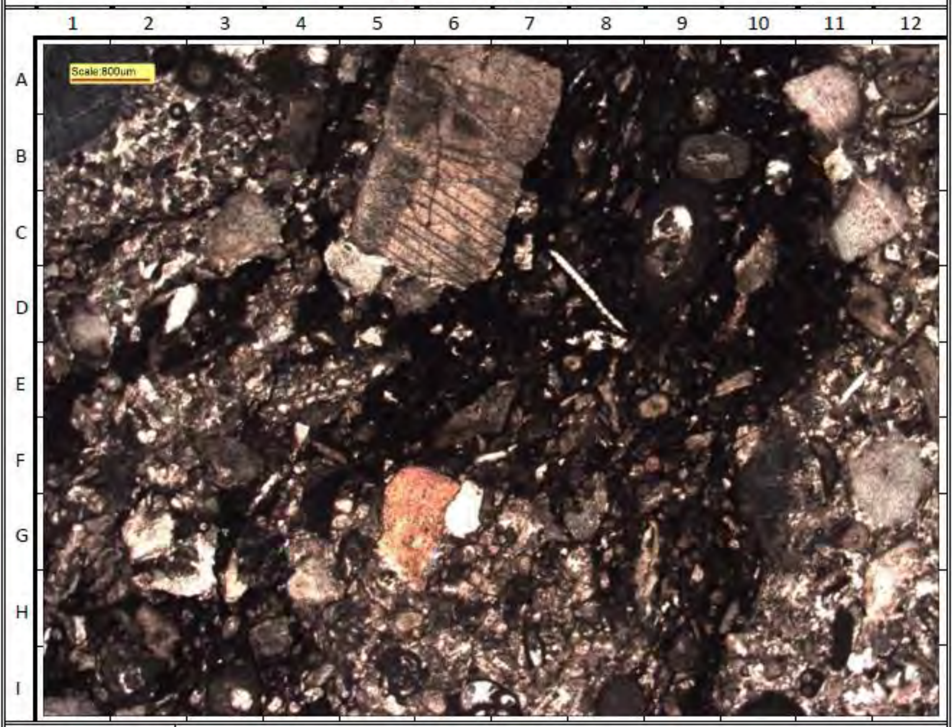
Profile view of the sample as received



Another profile view of the sample as received



RECORD PHOTOMICROGRAPH



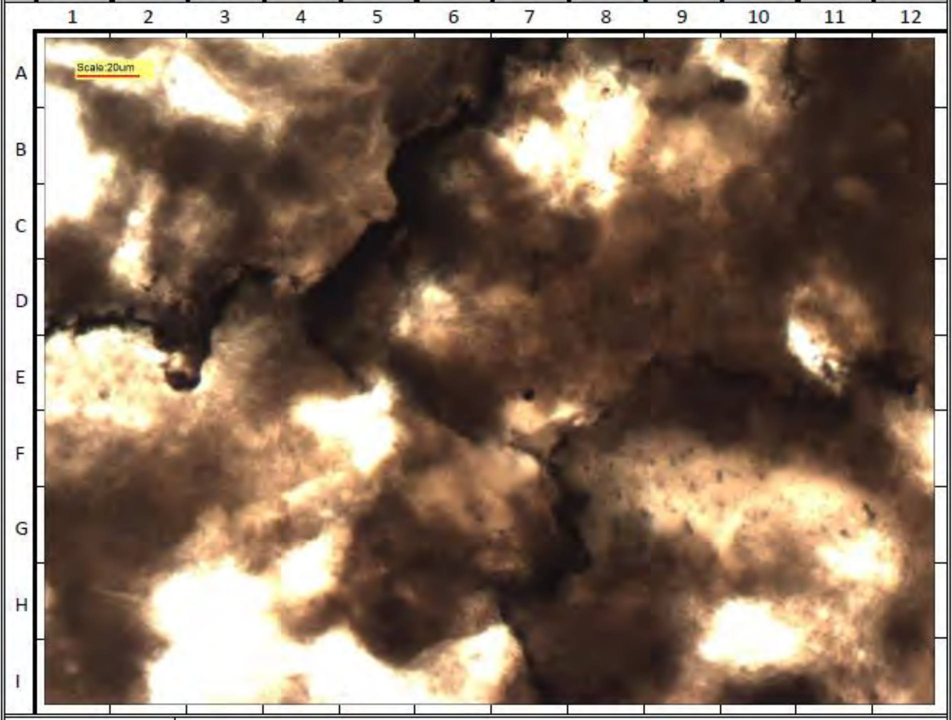
Viewing Light	Cross-polarised

Description

View of a section through the limestone, showing limestone and calcite clasts (grey/pale brown/white, pale pink/greyish brown: B2, B6, B9, B12, F2 and H6) and section of the dark grey areas (greyish black: A8, D3 and I2) comprising smaller limestone and calcite clasts/grains and some clay materials.

Petrographic Examination Natural Stone– BS EN 12407:2007

RECORD PHOTOMICROGRAPH



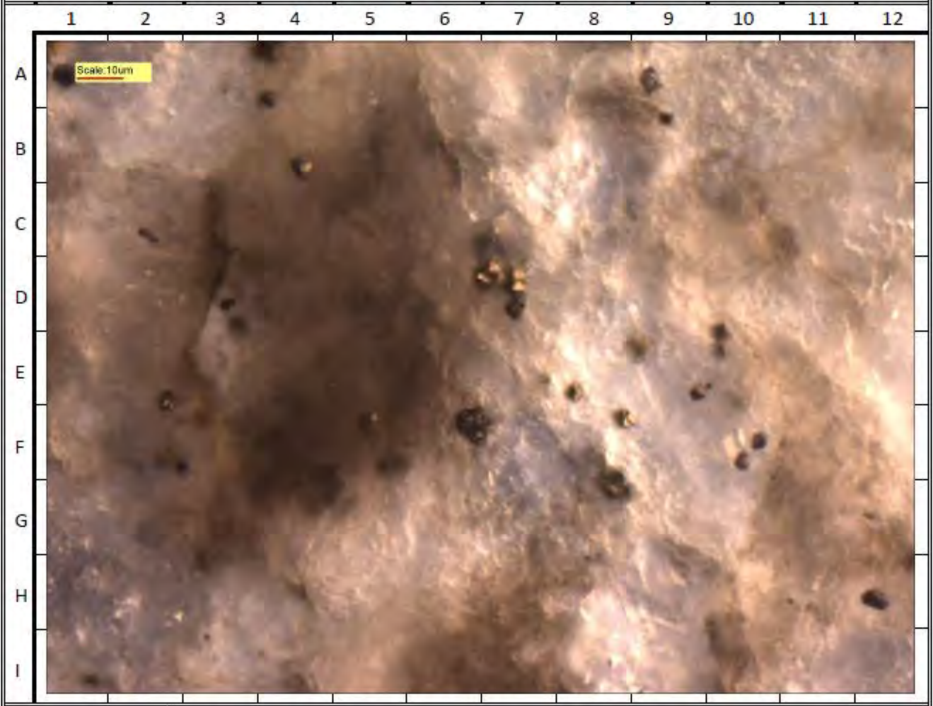
Viewing Light	Plane-polarised

Description

Closer view of a section through a dark grey area of the sample, showing clay materials (brown: A6, A11 and G1) and randomly distributed layers of opaque minerals (black: A7 to D1, D4 to F7 and E12 to I7).

Petrographic Examination Natural Stone– BS EN 12407:2007

RECORD PHOTOMICROGRAPH

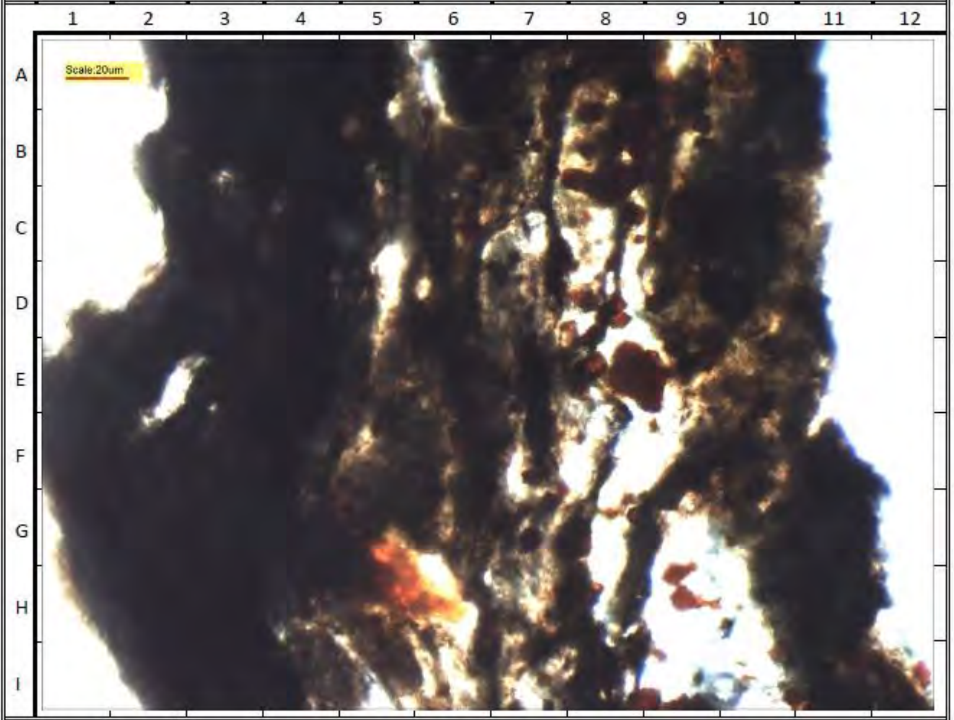


Viewing Light	Reflected light

Description

Closer view of a section through the sample, showing faceted opaque minerals (brass coloured: A9, B4, D7 and F8) and apparent framboidal opaque minerals (black/brass: A1, D7 and F6).

RECORD PHOTOMICROGRAPH



Viewing Light	Plane-polarised

Description

View of a section through the sample, showing opaque minerals (black: A3, A6 and C9) an oxidised opaque minerals (dusky red, reddish orange: A10, E8, H5/6 and H9irregular voids (yellow: B6, D6 and H9).

Glossary of Terms Used in the Descriptions

Proportions	**Major**: constituent present at a level ≥10%; **Minor**: constituent present at level ≥2% but <10; **Trace**: constituent present at <2% level
Frequency	• Rare – only found by thorough searching • Sporadic – only occasionally observed during normal examination • Common – easily observed during normal examination • Frequent – easily observed with minimal examination • Abundant – immediately apparent to initial examination
Hardness	• Very soft: can be penetrated easily by a finger • Soft: scores with a fingernail • Moderately soft: scores using a copper coin • Moderately hard: scores easily with a penknife • Hard: not easily scored with a penknife • Very hard: cannot be scored with a steel point or knife.
Weathering/ alteration	• Grade I (**Fresh**): Unchanged from original state • Grade II (**Slightly Weathered**): Slight discoloration, slight weakening; • Grade III (**Moderately Weathered**): Considerably weakened, penetrative discoloration, large pieces cannot be broken by hand • Grade IV (**Highly Weathered**): large pieces can be broken by hand, does not readily disaggregate (slake) when dry sample immersed in water • Grade V (**Completely Weathered**): considerably weakened, slakes, original texture apparent; Grade VI (**Residual Soil**) • Soil derived by in-situ weathering but retaining none of the original texture or fabric.
Origin	• **Primary constituents:** Constituents present within the rock at its formation. • **Secondary constituents:** Constituents formed by the alteration of pre-existing primary constituents or introduced from an external source after the rock was formed
Size	**Mega**: >60mm; **Macro**: 2-60mm; **Meso**: 60µm-2mm; **Micro**: 2-60µm; **Crypto**: <2µm; **Glassy**: without visible crystallinity
Bedding/Layering	**Thick**: >600mm; **Medium**: 200-600mm; **Thin**: 60-200mm; **Very thin**: 20-60mm
Lamination	**Thick**: 6-20mm; **Thin**: 2-6mm; **Very thin**: 600µm-2mm; **Extremely thin**: <600µm
Cleavage	**Extremely wide**: >2mm; **Very wide**: 600µm-2mm; **Wide**: 200-600µm; **Medium**: 60-200µm; **Close**: 20-60µm; **Very close**: 6-20µm; **Extremely close**: <6µm.
Cracks	• Fine microcracks (<1µm wide) • Microcracks (1-10µm wide) • Fine cracks (10-100µm wide) • Cracks (100µm-1mm wide) • Large cracks (>1mm wide).
Limestone Classification Schemes	**Folk**, R. L. 1959. Practical petrographic classification of limestones. *Bull. Am. Ass. Petro. Geol.* **43**, 1-38. **Dunham**, R. J. 1962. Classification of carbonate rocks according to depositional texture. In: Classification of Carbonate Rocks (Ed. By W. E. Ham), pp. 108-121. *Mem. Am. Ass. Petrol. Geol.* **1**, Tulsa.

Priority Construction Ltd
162 Clontarf Road
Dublin 3
Ireland
VAT No: 9D53971I

Date: 16th February 2016
Test Report Ref.: 443144

LABORATORY TEST REPORT

Test Requirements: Petrographic Examination of Natural Stone in accordance with BS EN 12047:2007

Sample details:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH05 - 50728**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**29/1/2016**
Date of Start of Test.:	**21/1/2016**
Sampling Location:	**Depth Top: 32.92 Depth Base: 33**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The work was carried out by our accredited, competent, sub contracted laboratory.

RESULTS

See Attached

Nick Dumbarton – Assistant Laboratory Manager

Petrographic Examination Natural Stone– BS EN 12407:2007

HAND SPECIMEN DESCRIPTION

The sample was hard, fine grained, massive, not macroporous limestone. The sample was almost isotropic, except for the presence of a small stylolite (irregular suture) typically <200µm across, running more or less perpendicular to the coring direction. Sporadic small irregular voids up to approximately 1mm across were observed chiefly associated with apparent loss of materials along the stylolite.

MICROSCOPICAL DESCRIPTION

Constituents[1]	Visual Estimated Proportions[2] %	Range of Crystal/Grain Size	Petrographic Details	Origin
Calcite	99	Up to 800µm	Fresh, angular to well rounded calcium carbonate, including frequent bioclasts. The sample was partially stained in accordance with Dickson's method. This suggested that the calcite was non-ferroan.	Primary
Opaque minerals	<1	Up to 80µm	Fresh to partially altered, chiefly euhedral isotropic minerals apparently comprising facetted, probably pyritic materials. SEM should be used if necessary for better resolution and description of the opaque minerals.	Primary
Iron oxide compounds	<<1	N/A	Rare amorphous by-products of the partial or complete oxidation of opaque minerals.	Secondary

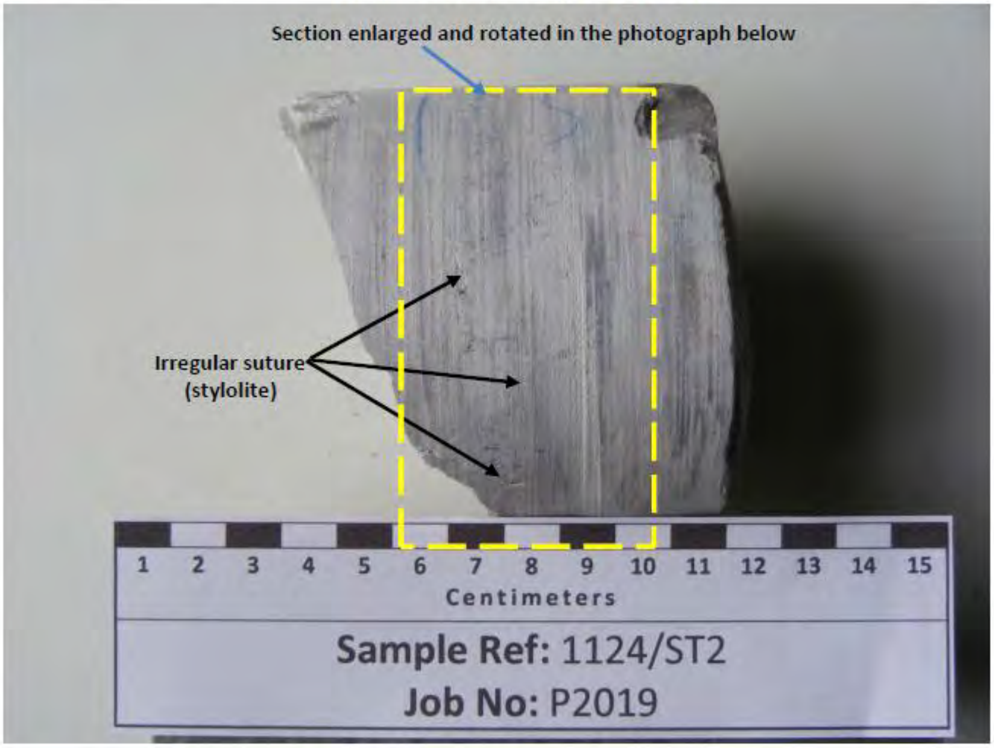
The sample was a fine grained LIMESTONE, comprising almost entirely calcium carbonate, with trace amounts of opaque minerals and associated iron oxide compounds.

The sample exhibited stylolite comprising coarser crystals of calcite.

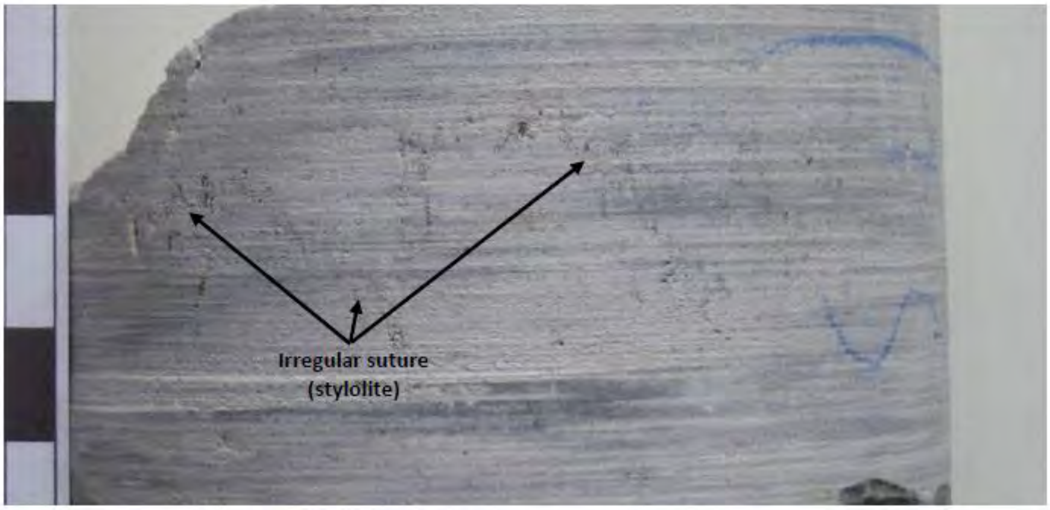
The sporadic voids observed associated with the stylolite did not appeared interconnected. The void content was visually estimated as being well below 1%.

The sample was fresh and exhibited Grade I weathering.

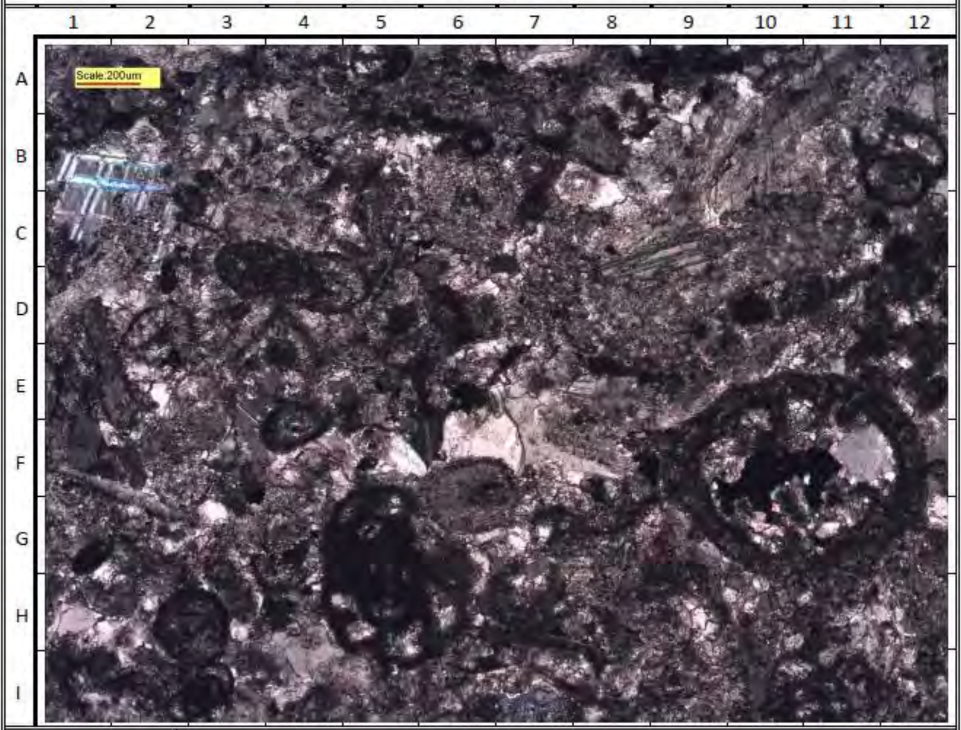
Profile view of the sample as received



Closer view of the stylolite with 90 degrees rotation of the photograph



RECORD PHOTOMICROGRAPH



Viewing Light	Cross-polarised

Description

View of a section through the limestone particles showing almost entire calcium carbonate (brown, dusky brown, greyish brown, grey/blue/green, pale pink: A9, B/C1, C9, F7 and G5), including bioclasts (dusky brown/greyish black: A5, C/D4, F10 and G5).

Petrographic Examination Natural Stone– BS EN 12407:2007

RECORD PHOTOMICROGRAPH

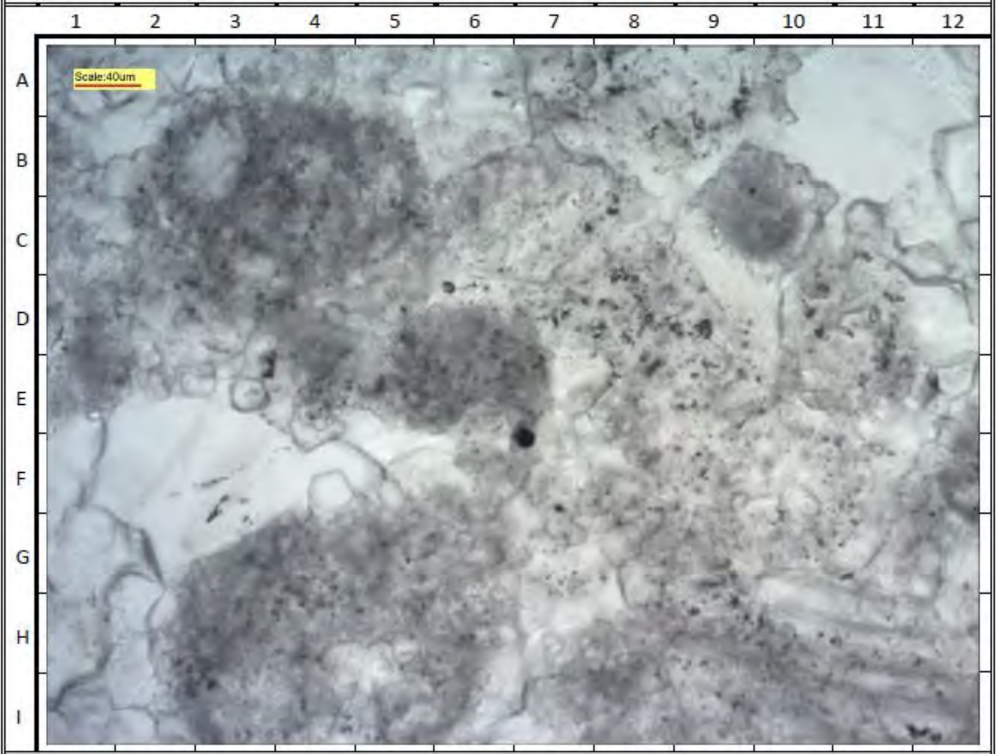
Viewing Light	Cross-polarised

Description

Closer view of a section through the limestone, showing sections of the stylolite (pale pink: A7, E5, E9, H4 and I9) and voids (yellow: B7/8, D8, F8 and I9) associated with the stylolite.

Petrographic Examination Natural Stone– BS EN 12407:2007

RECORD PHOTOMICROGRAPH



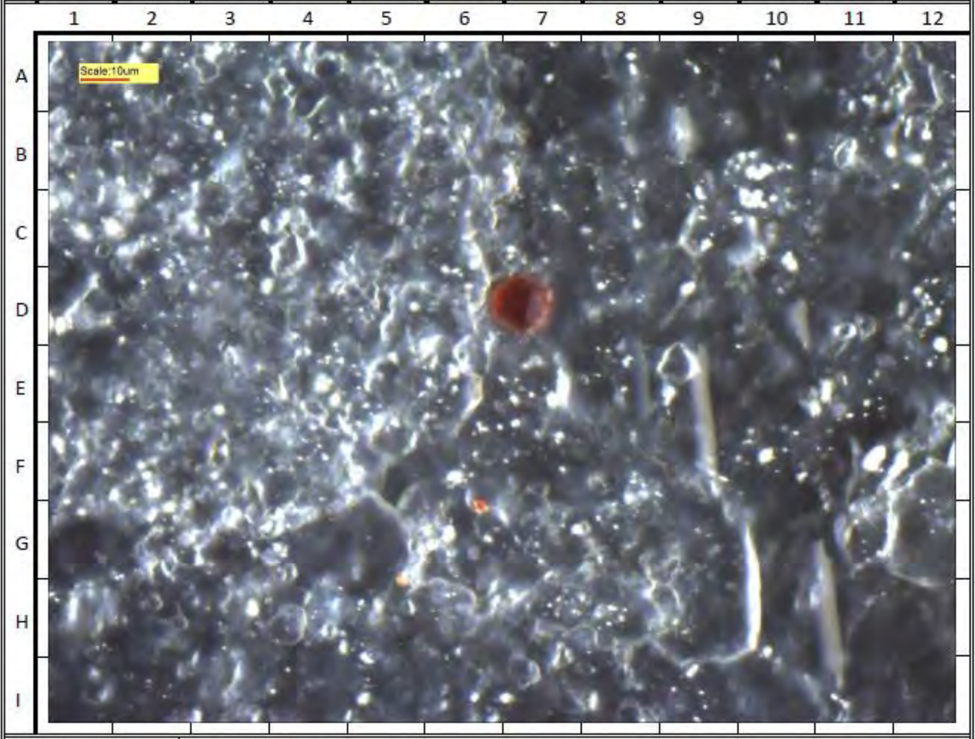
Viewing Light	Plane-polarised

Description

View of a section through the limestone, showing opaque minerals (black: E/F7).

Petrographic Examination Natural Stone– BS EN 12407:2007

RECORD PHOTOMICROGRAPH



Viewing Light	Reflected light

Description

View of a section through the limestone, showing partially oxidised opaque mineral (red: D7) and iron oxide compounds (reddish orange: G6 and G/H5).

Glossary of Terms Used in the Descriptions

Proportions	**Major**: constituent present at a level ≥10%; **Minor**: constituent present at level ≥2% but <10; **Trace**: constituent present at <2% level
Frequency	• Rare – only found by thorough searching • Sporadic – only occasionally observed during normal examination • Common – easily observed during normal examination • Frequent – easily observed with minimal examination • Abundant – immediately apparent to initial examination
Hardness	• Very soft: can be penetrated easily by a finger • Soft: scores with a fingernail • Moderately soft: scores using a copper coin • Moderately hard: scores easily with a penknife • Hard: not easily scored with a penknife • Very hard: cannot be scored with a steel point or knife.
Weathering/ alteration	• Grade I (**Fresh**): Unchanged from original state • Grade II (**Slightly Weathered**): Slight discoloration, slight weakening; • Grade III (**Moderately Weathered**): Considerably weakened, penetrative discoloration, large pieces cannot be broken by hand • Grade IV (**Highly Weathered**): large pieces can be broken by hand, does not readily disaggregate (slake) when dry sample immersed in water • Grade V (**Completely Weathered**): considerably weakened, slakes, original texture apparent; Grade VI (**Residual Soil**) • Soil derived by in-situ weathering but retaining none of the original texture or fabric.
Origin	• **Primary constituents:** Constituents present within the rock at its formation. • **Secondary constituents:** Constituents formed by the alteration of pre-existing primary constituents or introduced from an external source after the rock was formed
Size	**Mega**: >60mm; **Macro**: 2-60mm; **Meso**: 60µm-2mm; **Micro**: 2-60µm; **Crypto**: <2µm; **Glassy**: without visible crystallinity
Bedding/Layering	**Thick**: >600mm; **Medium**: 200-600mm; **Thin**: 60-200mm; **Very thin**: 20-60mm
Lamination	**Thick**: 6-20mm; **Thin**: 2-6mm; **Very thin**: 600µm-2mm; **Extremely thin**: <600µm
Cleavage	**Extremely wide**: >2mm; **Very wide**: 600µm-2mm; **Wide**: 200-600µm; **Medium**: 60-200µm; **Close**: 20-60µm; **Very close**: 6-20µm; **Extremely close**: <6µm.
Cracks	• Fine microcracks (<1µm wide) • Microcracks (1-10µm wide) • Fine cracks (10-100µm wide) • Cracks (100µm-1mm wide) • Large cracks (>1mm wide).
Limestone Classification Schemes	**Folk**, R. L. 1959. Practical petrographic classification of limestones. *Bull. Am. Ass. Petro. Geol.* **43**, 1-38. **Dunham**, R. J. 1962. Classification of carbonate rocks according to depositional texture. In: Classification of Carbonate Rocks (Ed. By W. E. Ham), pp. 108-121. *Mem. Am. Ass. Petrol. Geol.* **1**, Tulsa.

Priority Drilling Ltd.
Killimor
Ballinasloe
Co Galway
Ireland
8D23036i

Date: 6th April 2016
Test Report Ref.: 447907

LABORATORY TEST REPORT

Test Requirements: Petrographic Examination of Natural Stone in accordance with BS EN 12047:2007

Sample details:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50899**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test.:	**18/03/2016**
Sampling Location:	**Depth Top:113.00 Depth Base:113.08**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The work was carried out by our accredited, competent, sub contracted laboratory.

RESULTS

See Attached

Nick Dumbarton – Assistant Laboratory Manager

Petrographic Examination Natural Stone– BS EN 12407:2007

HAND SPECIMEN DESCRIPTION

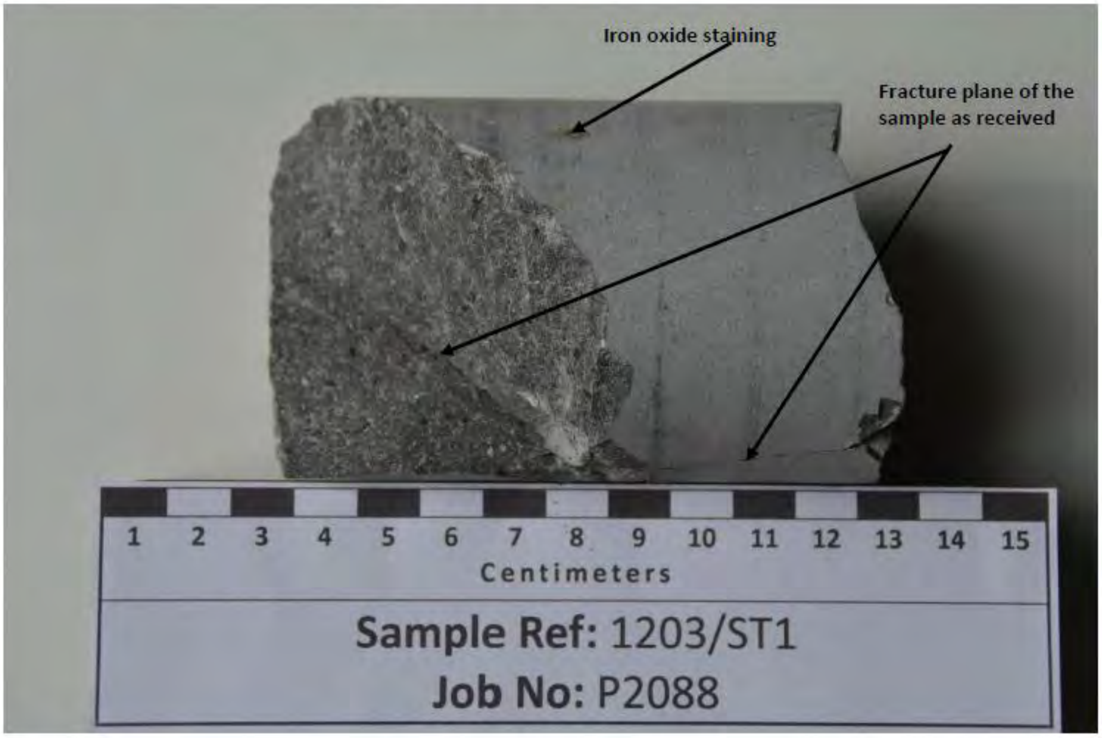
The sample was a moderately hard, fine to medium grained, massive, not macroporous limestone. The sample was chiefly medium dark grey, but exhibited common, randomly distributed, very light grey to medium grey grains that constituted the medium sized grains of the rock. The sample was almost isotropic, except for the presence of sporadic, randomly orientated small dark grey apparent stylolite (irregular suture) typically <500µm across and rare vein <400µm. Sporadic unevenly distributed patches of iron oxide compounds were observed.

MICROSCOPICAL DESCRIPTION

Constituents[1]	**Visual Estimated Proportions**[2] **%**	**Range of Crystal/Grain Size**	**Petrographic Details**	**Origin**
Calcite	99	Up to 2500µm	Fresh, anhedral to euhedral crystals comprising chiefly microcrystalline calcite (calcite crystals <4µm), with a lesser proportion of sparry calcite (calcite crystals >4µm) and large discrete calcium carbonate grains. The sparry calcite and larger discrete calcium carbonate grains were chiefly observed within randomly distributed, abundant bioclasts and rare calcite veins. The sample was partially stained in accordance with Dickson's method. This suggested that the calcite was predominantly non-ferroan, with a trace amount of possibly ferroan calcite.	Primary
Opaque minerals	<1	Up to 50µm	Fresh, chiefly anhedral isotropic minerals apparently comprising chiefly framboidal, probably pyritic grains. Scanning electron microscopy (SEM) should be used if necessary for better resolution and description of the opaque minerals.	Primary
Iron oxide compounds	<<1	N/A	Rare amorphous by-products of the oxidation of opaque minerals on the surface of the rock core.	Secondary
The sample was a fine to medium grained bioclastic LIMESTONE, comprising almost entirely calcium carbonate, with trace amounts of opaque minerals. No iron oxide compounds was observed in the thin section, suggesting that the patches observed on the hand specimen were superficial oxidation of the opaque minerals exposed to the element. The sample exhibited sporadic, unevenly distributed and randomly orientated stylolites comprising abundant opaque minerals. Rare irregular voids up to 100µm across were only observed associated with stylolites. The void content was visually estimated as being approximately 0%. The sample was fresh and exhibited Grade I weathering.				

Petrographic Examination Natural Stone– BS EN 12407:2007

Profile view of the sample as received



Petrographic Examination Natural Stone– BS EN 12407:2007

RECORD PHOTOMICROGRAPH

Viewing Light	Cross-polarised

Description

View of a section through the sample, showing bioclasts (brown, yellowish grey, pale green: A9, B3, C/D2, D6, G2, G6 and G10), discrete calcite (dark grey (I2/3) cemented by microcrystalline calcite matrix (brown/dusky brown: A8, E8 and H3).

Petrographic Examination Natural Stone– BS EN 12407:2007

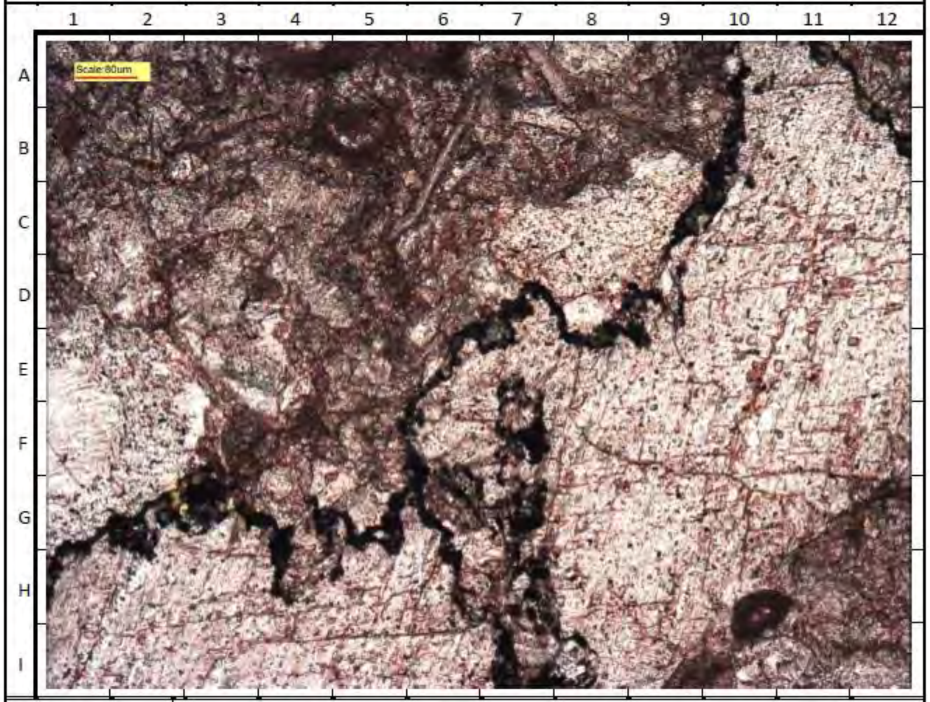
RECORD PHOTOMICROGRAPH

Viewing Light	Cross-polarised

Description

View of a section through the sample, showing calcite vein (C112 to H1)

RECORD PHOTOMICROGRAPH



Viewing Light	Plane-polarised

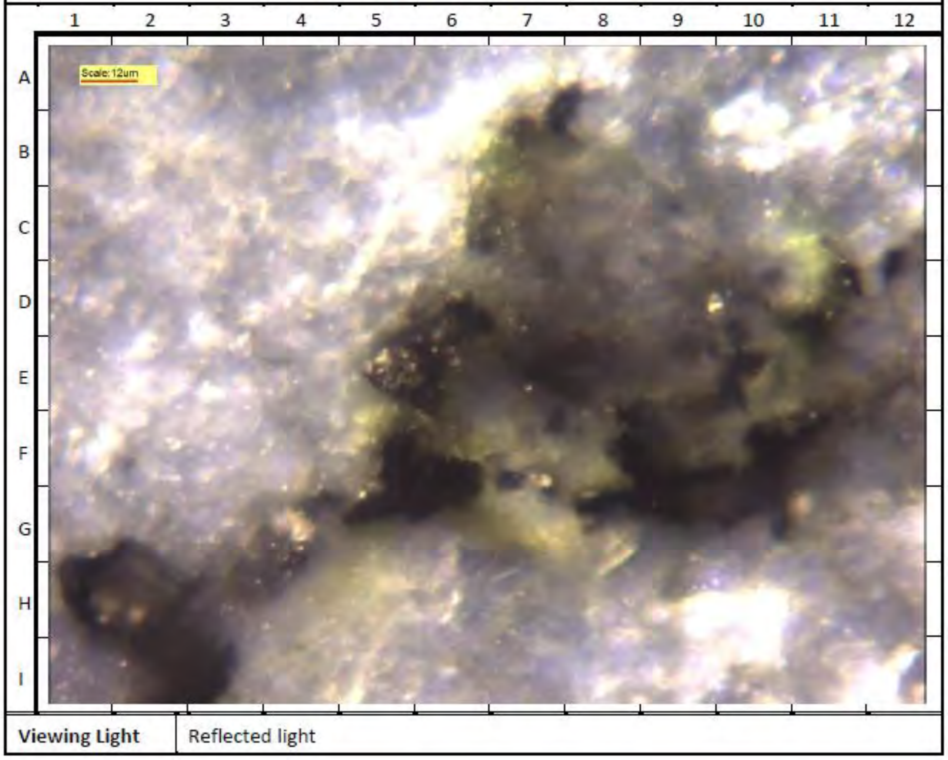
Description

View through the stained section of the sample, showing stylolite rich in opaque minerals (black: A10 to H1, A11 to B12 and G6 to I7).

The reddish brown colours (F3) observed throughout the field of view are due to the staining compound used and not due to oxidation.

Petrographic Examination Natural Stone– BS EN 12407:2007

RECORD PHOTOMICROGRAPH



Viewing Light	Reflected light

Description

Closer view of the section through a stylolite, showing apparent framboidal pyritic grains (black, bras coloured: E5, F6 and G4).

Glossary of Terms Used in the Descriptions

Proportions	**Major**: constituent present at a level ≥10%; **Minor**: constituent present at level ≥2% but <10; **Trace**: constituent present at <2% level
Frequency	• Rare – only found by thorough searching • Sporadic – only occasionally observed during normal examination • Common – easily observed during normal examination • Frequent – easily observed with minimal examination • Abundant – immediately apparent to initial examination
Hardness	• Very soft: can be penetrated easily by a finger • Soft: scores with a fingernail • Moderately soft: scores using a copper coin • Moderately hard: scores easily with a penknife • Hard: not easily scored with a penknife • Very hard: cannot be scored with a steel point or knife.
Weathering/ alteration	• Grade I (**Fresh**): Unchanged from original state • Grade II (**Slightly Weathered**): Slight discoloration, slight weakening; • Grade III (**Moderately Weathered**): Considerably weakened, penetrative discoloration, large pieces cannot be broken by hand • Grade IV (**Highly Weathered**): large pieces can be broken by hand, does not readily disaggregate (slake) when dry sample immersed in water • Grade V (**Completely Weathered**): considerably weakened, slakes, original texture apparent; Grade VI (**Residual Soil**) • Soil derived by in-situ weathering but retaining none of the original texture or fabric.
Origin	• **Primary constituents:** Constituents present within the rock at its formation. • **Secondary constituents:** Constituents formed by the alteration of pre-existing primary constituents or introduced from an external source after the rock was formed
Size	**Mega**: >60mm; **Macro**: 2-60mm; **Meso**: 60µm-2mm; **Micro**: 2-60µm; **Crypto**: <2µm; **Glassy**: without visible crystallinity
Bedding/Layering	**Thick**: >600mm; **Medium**: 200-600mm; **Thin**: 60-200mm; **Very thin**: 20-60mm
Lamination	**Thick**: 6-20mm; **Thin**: 2-6mm; **Very thin**: 600µm-2mm; **Extremely thin**: <600µm
Cleavage	**Extremely wide**: >2mm; **Very wide**: 600µm-2mm; **Wide**: 200-600µm; **Medium**: 60-200µm; **Close**: 20-60µm; **Very close**: 6-20µm; **Extremely close**: <6µm.
Cracks	• Fine microcracks (<1µm wide) • Microcracks (1-10µm wide) • Fine cracks (10-100µm wide) • Cracks (100µm-1mm wide) • Large cracks (>1mm wide).
Colour	Description based on geological rock-color chart, produced by Munsell Color, 2009 Revised, 2011 Production.
Limestone Classification Schemes	Folk, R. L. 1959. Practical petrographic classification of limestones. *Bull. Am. Ass. Petro. Geol.* **43**, 1-38. Dunham, R. J. 1962. Classification of carbonate rocks according to depositional texture. In: Classification of Carbonate Rocks (Ed. By W. E. Ham), pp. 108-121. *Mem. Am. Ass. Petrol. Geol.* **1**, Tulsa.

Priority Drilling Ltd.
Killimor
Ballinasloe
Co Galway
Ireland
8D23036i

Date: 6th April 2016
Test Report Ref.: 447934

LABORATORY TEST REPORT

Test Requirements: Petrographic Examination of Natural Stone in accordance with BS EN 12047:2007

Sample details:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50926**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test.:	**18/03/2016**
Sampling Location:	**Depth Top:148.97 Depth Base:149.05**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

COMMENTS/ DEPARTURE FROM SPECIFIED PROCEDURE

The work was carried out by our accredited, competent, sub contracted laboratory.

RESULTS

See Attached

Nick Dumbarton – Assistant Laboratory Manager

Petrographic Examination Natural Stone– BS EN 12407:2007

HAND SPECIMEN DESCRIPTION

The sample was a moderately hard, fine to very coarse grained, not macroporous limestone. The sample was anisotropic. The sample exhibited medium grey to greyish black variously thick band/layers, unevenly distributed white bioclastic calcite materials up to 8mm across and a large irregular pyritic material up to approximated 2mm across. The sample also exhibited sporadic, randomly distributed and randomly orientated calcite veins up to <200µm across.

MICROSCOPICAL DESCRIPTION

Constituents[1]	**Visual Estimated Proportions[2] %**	**Range of Crystal/Grain Size**	**Petrographic Details**	**Origin**
Calcite	97	Up to 1600µm	Fresh, anhedral to euhedral crystals comprising significant amounts of both microcrystalline calcite (calcite crystals <4µm) and sparry calcite (calcite crystals >4µm), with minor proportion of discrete calcium carbonate grains that appeared to have replaced bioclasts. The bioclasts chiefly comprised both microcrystalline calcite and sparry calcite. The sample was partially stained in accordance with Dickson's method. The result of the staining process suggests that the calcite was chiefly non-ferroan	Primary
Opaque minerals	1-2	Up to 2000µm	Fresh, chiefly anhedral isotropic minerals apparently comprising almost entirely framboidal, probably pyritic grains. Scanning electron microscopy (SEM) should be used if necessary for better resolution and description of the opaque minerals.	Primary
Clay materials	1-2	<4µm	Very fine grained materials associated with abundant microcrystalline calcite, thus beyond the conclusive resolution of the petrographic microscope. This could be investigated further by scanning electron microscopy (SEM).	Primary

The sample was a fine to very coarse grained bioclastic LIMESTONE, comprising almost entirely calcium carbonate, with trace to minor proportions of opaque minerals, and trace to minor proportions of potentially clay minerals that were beyond the resolution of the petrographic microscope.

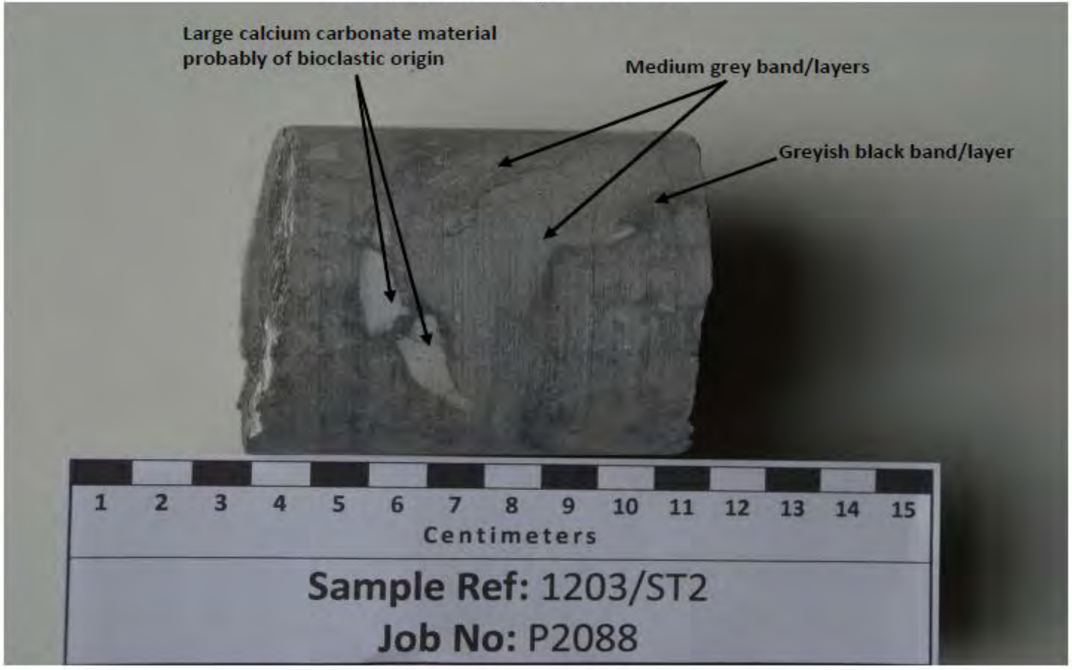
The limestone also exhibited abundant intraclasts (apparently reworked limestone fragments probably from nearby sediments).

The greyish black bands/layers appeared brecciated as they comprised limestone fragments and discrete calcite grains cemented by very fine grained matrix comprising chiefly microcrystalline calcite, with trace to minor proportions of opaque minerals and possibly trace to minor proportions of clay materials.

No void was observed. The void content was visually estimated as being 0%.

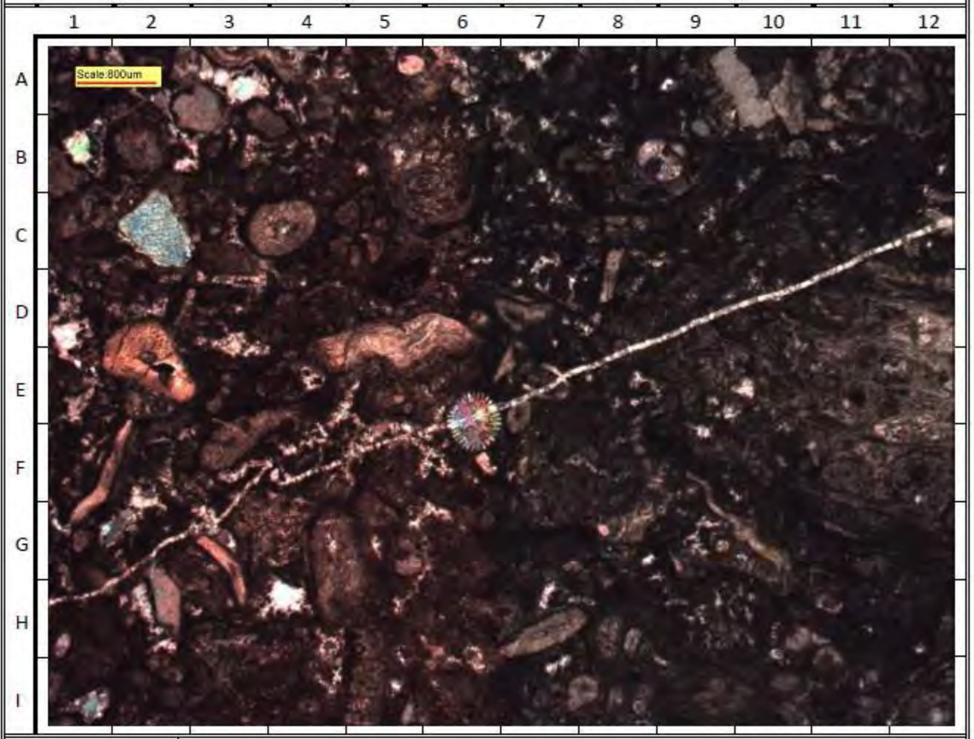
The sample was fresh and exhibited Grade I weathering.

Profile view of the sample as received



Profile view of another side of the sample as received

RECORD PHOTOMICROGRAPH



Viewing Light	Cross-polarised

Description

View of a section through a part-stained section of the sample, showing bioclasts (pink, pale ink, light brown, purple/green: A3, A11, B5, D5, E6 and E11) and calcite vein (light brown/pale pink/white: C12 to H1).

RECORD PHOTOMICROGRAPH

Viewing Light	Cross-polarised

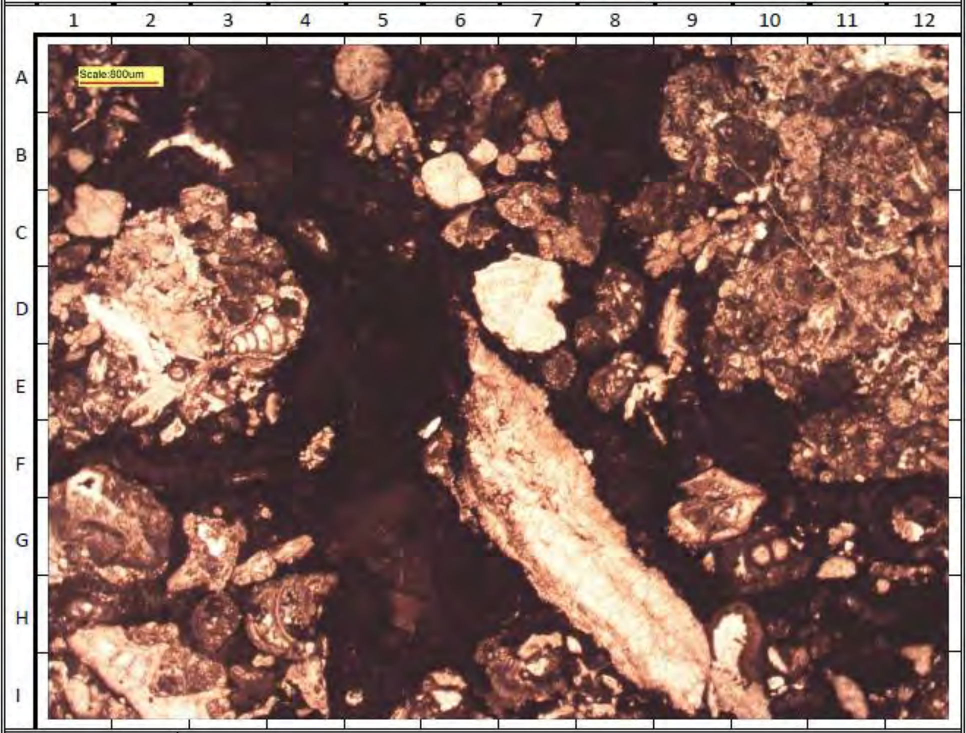
Description

View through a typical medium grey section of the sample, showing bioclasts (pale pink, light brown, pale yellow: D3, D5, D7, D8, D12 and H5) cemented by chiefly microcrystalline calcite (brownish grey: E9).

An apparent intraclasts are highlighted in yellow.

Petrographic Examination Natural Stone– BS EN 12407:2007

RECORD PHOTOMICROGRAPH



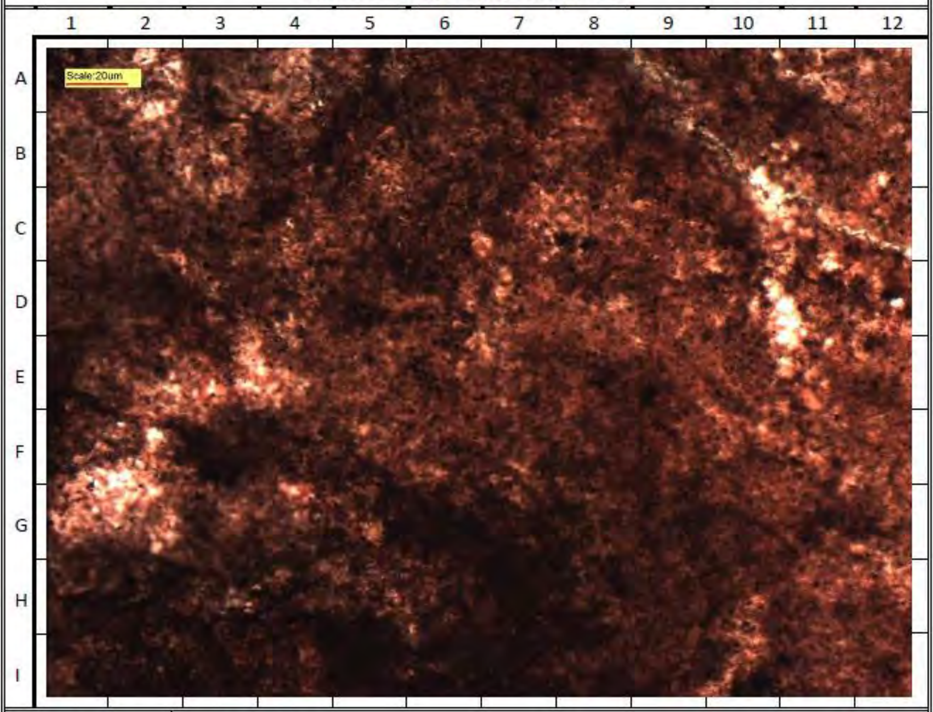
Viewing Light	Plane-polarised

Description

View of a section through a greyish black band/layer, showing apparent limestone fragments (pale pink, light brown, pale yellow: A5, C1, D2, D7, D11, G7 and G9), cemented by very fine grained matrix (dusky brown: A8, E5 and H12).

Petrographic Examination Natural Stone– BS EN 12407:2007

RECORD PHOTOMICROGRAPH



Viewing Light	Plane-polarised

Description

Closer view through the matrix of the greyish black section of the sample, showing very fine grained materials beyond the conclusive resolution of the petrographic microscope. Opaque minerals appear black (A5 and E6). The remainder of the field of view appear to comprise both microcrystalline calcite and possibly some clay minerals.

The moderate red colour (D9) observed throughout the photomicrograph are due to the staining compound used and not due to oxidation.

RECORD PHOTOMICROGRAPH

Viewing Light	Reflected light

Description

Closer view of the section through the sample, showing framboidal pyritic grains (brass colour: C7 and G5).

Glossary of Terms Used in the Descriptions

Proportions	**Major**: constituent present at a level ≥10%; **Minor**: constituent present at level ≥2% but <10; **Trace**: constituent present at <2% level
Frequency	• Rare – only found by thorough searching • Sporadic – only occasionally observed during normal examination • Common – easily observed during normal examination • Frequent – easily observed with minimal examination • Abundant – immediately apparent to initial examination
Hardness	• Very soft: can be penetrated easily by a finger • Soft: scores with a fingernail • Moderately soft: scores using a copper coin • Moderately hard: scores easily with a penknife • Hard: not easily scored with a penknife • Very hard: cannot be scored with a steel point or knife.
Weathering/ alteration	• Grade I (**Fresh**): Unchanged from original state • Grade II (**Slightly Weathered**): Slight discoloration, slight weakening; • Grade III (**Moderately Weathered**): Considerably weakened, penetrative discoloration, large pieces cannot be broken by hand • Grade IV (**Highly Weathered**): large pieces can be broken by hand, does not readily disaggregate (slake) when dry sample immersed in water • Grade V (**Completely Weathered**): considerably weakened, slakes, original texture apparent; Grade VI (**Residual Soil**) • Soil derived by in-situ weathering but retaining none of the original texture or fabric.
Origin	• **Primary constituents:** Constituents present within the rock at its formation. • **Secondary constituents:** Constituents formed by the alteration of pre-existing primary constituents or introduced from an external source after the rock was formed
Size	**Mega**: >60mm; **Macro**: 2-60mm; **Meso**: 60µm-2mm; **Micro**: 2-60µm; **Crypto**: <2µm; **Glassy**: without visible crystallinity
Bedding/Layering	**Thick**: >600mm; **Medium**: 200-600mm; **Thin**: 60-200mm; **Very thin**: 20-60mm
Lamination	**Thick**: 6-20mm; **Thin**: 2-6mm; **Very thin**: 600µm-2mm; **Extremely thin**: <600µm
Cleavage	**Extremely wide**: >2mm; **Very wide**: 600µm-2mm; **Wide**: 200-600µm; **Medium**: 60-200µm; **Close**: 20-60µm; **Very close**: 6-20µm; **Extremely close**: <6µm.
Cracks	• Fine microcracks (<1µm wide) • Microcracks (1-10µm wide) • Fine cracks (10-100µm wide) • Cracks (100µm-1mm wide) • Large cracks (>1mm wide).
Colour	Description based on geological rock-color chart, produced by Munsell Color, 2009 Revised, 2011 Production.
Limestone Classification Schemes	Folk, R. L. 1959. Practical petrographic classification of limestones. *Bull. Am. Ass. Petro. Geol.* 43, 1-38. Dunham, R. J. 1962. Classification of carbonate rocks according to depositional texture. In: Classification of Carbonate Rocks (Ed. By W. E. Ham), pp. 108-121. *Mem. Am. Ass. Petrol. Geol.* 1, Tulsa.

Total Sulphur

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INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 16 March 2016
Test Report Ref: STR 447855

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Total Sulfur Content of an Aggregate Sample in accordance with **BS EN 1744-1 : 2009 : Clause 11**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 48891**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**19/02/2016**
Sampling Location:	**Depth Top:53.80 Depth Base:453.93**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

Total Sulfur Content as S (%) =	**<0.1**
*95% Confidence limit**	*<0.06% - <0.14%*

Comments / Departure from specified Procedure

*95% Confidence limit is the expanded uncertainty which is the combined uncertainty standard multiplied by a factor (k) of 2

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: -
Eric Goulden
Technical Manager

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INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 16 March 2016
Test Report Ref: STR 447867

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Total Sulfur Content of an Aggregate Sample in accordance with **BS EN 1744-1 : 2009 : Clause 11**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50859**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:65.40 Depth Base:65.50**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

Total Sulfur Content as S (%) =	**<0.1**
*95% Confidence limit**	*<0.06% - <0.14%*

Comments / Departure from specified Procedure

*95% Confidence limit is the expanded uncertainty which is the combined uncertainty standard multiplied by a factor (k) of 2

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: -
Eric Goulden
Technical Manager

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INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 16 March 2016
Test Report Ref: STR 447887

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Total Sulfur Content of an Aggregate Sample in accordance with **BS EN 1744-1 : 2009 : Clause 11**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50879**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**19/02/2016**
Sampling Location:	**Depth Top:91.10 Depth Base:91.20**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

Total Sulfur Content as S (%) =	**<0.1**
*95% Confidence limit**	*<0.06% - <0.14%*

Comments / Departure from specified Procedure

*95% Confidence limit is the expanded uncertainty which is the combined uncertainty standard multiplied by a factor (k) of 2

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: -
Eric Goulden
Technical Manager

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INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 16 March 2016
Test Report Ref: STR 447937

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Total Sulfur Content of an Aggregate Sample in accordance with **BS EN 1744-1 : 2009 : Clause 11**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50929**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:152.97 Depth Base:153.04**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

Total Sulfur Content as S (%) =	**<0.1**
*95% Confidence limit**	*<0.06% - <0.14%*

Comments / Departure from specified Procedure

*95% Confidence limit is the expanded uncertainty which is the combined uncertainty standard multiplied by a factor (k) of 2

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: -
Eric Goulden
Technical Manager

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INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 16 March 2016
Test Report Ref: STR 447965

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Total Sulfur Content of an Aggregate Sample in accordance with **BS EN 1744-1 : 2009 : Clause 11**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50955**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:193.60 Depth Base:193.68**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

Total Sulfur Content as S (%) =	**<0.1**
*95% Confidence limit**	*<0.06% - <0.14%*

Comments / Departure from specified Procedure

*95% Confidence limit is the expanded uncertainty which is the combined uncertainty standard multiplied by a factor (k) of 2

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: -
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Technical Manager

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INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 16 March 2016
Test Report Ref: STR 448000

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Total Sulfur Content of an Aggregate Sample in accordance with **BS EN 1744-1 : 2009 : Clause 11**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. No:	**BH01 - 50990**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**17/02/2016**
Sampling Location:	**Depth Top:235.64 Depth Base:235.73**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Testing**
Target Specification:	**N/A**

RESULTS:

Total Sulfur Content as S (%) =	**<0.1**
*95% Confidence limit**	*<0.06% - <0.14%*

Comments / Departure from specified Procedure

*95% Confidence limit is the expanded uncertainty which is the combined uncertainty standard multiplied by a factor (k) of 2

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: - EGoulden
Eric Goulden
Technical Manager

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INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 15 February 2016
Test Report Ref: STR 443067

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Total Sulfur Content of an Aggregate Sample in accordance with **BS EN 1744-1 : 2009 : Clause 11**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH04 - 48954**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**21/12/2015**
Sampling Location:	**Depth Top: 31.66 Depth Base: 31.7**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

Total Sulfur Content as S (%) =	**<0.1**
*95% Confidence limit**	*<0.06% - <0.14%*

Comments / Departure from specified Procedure

*95% Confidence limit is the expanded uncertainty which is the combined uncertainty standard multiplied by a factor (k) of 2

Certificate
Prepared by:-

Mathew Sayer
Assistant Laboratory Manager

Approved by: - EGoulden

Eric Goulden
Technical Manager

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INDEPENDENT MATERIALS TESTING I DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 15 February 2016
Test Report Ref: STR 443131

Page 1 of 1

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Total Sulfur Content of an Aggregate Sample in accordance with **BS EN 1744-1 : 2009 : Clause 11**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. No:	**BH05 - 50715**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**21/12/2015**
Sampling Location:	**Depth Top: 29.09 Depth Base: 29.18**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

Total Sulfur Content as S (%) =	**<0.1**
*95% Confidence limit**	*<0.06% - <0.14%*

Comments / Departure from specified Procedure

*95% Confidence limit is the expanded uncertainty which is the combined uncertainty standard multiplied by a factor (k) of 2

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: - EGoulden
Eric Goulden
Technical Manager

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INDEPENDENT MATERIALS TESTING | DIAMOND DRILLING & SAWING

Priority Drilling Ltd,
Killimor,
Ballinasloe,
Co. Galway,
Ireland

Date: 10 March 2016
Test Report Ref: STR 447821a
Revision 1

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Uniaxial Compressive Strength in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56595**
Client Ref. :	**Various**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**18/01/2016**
Date of Start of Test:	**18/01/2016**
Sampling Location:	**Various**
Name of Source:	**Lackagh Quarry**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rock Cores**
Target Specification:	**N/A**

RESULTS:

See attached

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: - EGoulden
Eric Goulden
Technical Manager

Test Report Ref: STR 447821a - Page 2 of 2

BH	Core Diameter (mm)	Height/ Diameter Ratio	Uniaxial compressive strength (MPa)	Mode of Failure	EN ISO 14689-1 Term	Water content (%)
BH01 48863	60.7	3.5:1	**97**	N	Strong	0.3
Bh01 48870	60.8	3.5:1	**59**	N	Strong	0.2
BH01 48873	60.7	3.5:1	**73**	N	Strong	0.1
BH01 48878	60.7	3:1	**100**	N	Strong	0.1
BH01 48883	60.7	3:1	**69**	N	Strong	0.3
BH01 48887	60.7	3:1	**83**	N	Strong	0.2
BH01 50943	60.8	3:1	**76**	N	Strong	0.1
BH01 48895	61	3.4:1	**138**	N	Very Strong	0.3
BH01 48900	60.8	2.5:1	**65**	N	Strong	0.1
BH01 50863	60.6	1.7:1	**104**	N	Very Strong	0.2
BH01 50873	60.7	3:1	**62**	N	Strong	0.2
BH01 50884	60.6	3:1	**76**	N	Strong	0.2
BH01 50894	60.7	3.4:1	**107**	N	Very Strong	0.2
BH01 50902	60.7	3:1	**104**	N	Very Strong	0.1
BH01 50909	60.8	2.1:1	**79**	N	Strong	0.2
Bh01 50915	60.8	3.1:1	**110**	N	Very Strong	0.3
Bh01 50924	60.7	1.4:1	**100**	N	Very Strong	0.2
BH01 50934	60.7	3.1:1	**86**	N	Strong	0.4
BH01 50938	60.6	3.4:1	**83**	N	Strong	0.2
BH01 50945	60.8	3.4:1	**86**	N	Strong	0.2
BH01 50952	60.6	3.2:1	**97**	N	Strong	0.5
BH01 50958	60.8	3.2:1	**114**	N	Very Strong	0.3
BH01 50963	60.6	3.1:	**132**	N	Very Strong	0.2
BH01 50968	60.6	3.3:1	**111**	N	Very Strong	0.1
BH01 50971	60.5	3.5:1	**52**	N	Strong	0.3
BH01 50980	60.5	2.8:1	**77**	N	Strong	0.2
BH01 50986	60.5	3:1	**111**	N	Very Strong	0.4
BH01 50991	60.6	3.5:1	**80**	N	Strong	0.2
BH01 50992	60.6	2.3:1	**76**	N	Strong	0.2
BH01 50994	60.6	3:1	**118**	N	Very Strong	0.2
BH01 50998	60.7	2.1:1	**121**	N	Very Strong	0.3
BH01 51002	60.4	3.3:1	**143**	N	Very Strong	0.2

BH01 51004	60.4	2.6:	**66**	N	Strong	0.2
BH01 51007	60.8	2.5:1	**83**	N	Strong	0.3
BH01 51010	60.6	2.5:1	**90**	N	Strong	0.3
BH01 51011	60.3	2.9:1	**91**	N	Strong	0.2

Comments

1) The uniaxial compressive strength was carried out in accordance with ISRM guidelines.
2) Stress Rate: 0.7Mpa/s.

3)

EN ISO 14689-1 : 2003 Rock Strength Terms	
Compressive Strength mpa	Term
<1.0	Extremely Weak
1 to 5	Very Weak
5 to 25	Weak
25 to 50	Meduim Strong
50 to 100	Strong
100 to 250	Very Strong
> 250	Extremely Strong

celtest
INDEPENDENT MATERIALS TESTING | DIAMOND DRILLING & SAWING

Priority Construction Ltd
162 Clontarf Road

Dublin 3
Ireland
VAT No: 9D53971I

Date: 21 December 2015
Test Report Ref: STR 443020

Contract: Lackagh Quarry

LABORATORY TEST REPORT

TEST REQUIREMENTS: To determine the Uniaxial Compressive Strength in accordance with **ISRM Guidelines**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S56158**
Client Ref. :	**Various**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**08/12/2015**
Date of Start of Test:	**08/12/2015**
Sampling Location:	**Various**
Name of Source:	**Lackagh Quarry SI**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Core**
Target Specification:	**N/A**

RESULTS:

See attached

Certificate
Prepared by:-
Mathew Sayer
Assistant Laboratory Manager

Approved by: -
Eric Goulden
Technical Manager

Test Report Ref: STR 443020 - Page 2 of 2

BH	**Core Diameter (mm)**	**Height/ Diameter Ratio**	**Uniaxial compressive strength (MPa)**	**Mode of Failure**	**EN ISO 14689-1 Term**	**Water content (%)**
BH04 48908	82	2.6:1	**76**	N	Strong	0.1
BH04 48912	82.3	1.9:1	**86**	N	Strong	0.3
BH04 48921	82.3	1.5:1	**55**	N	Strong	0.1
BH04 48927	82.1	1.6:1	**53**	N	Strong	0.2
BH04 48931	82.2	2.6:1	**111**	N	Very Strong	0.1
BH04 48933	82	2.1:1	**91**	N	Strong	0.2
BH04 48950	82	2.5:1	**76**	N	Strong	0.2
BH04 48957	82	2:1	**78**	N	Strong	0.3
BH04 48963	82.2	2.4:1	**92**	N	Strong	0.1
BH05 48982	82	1.8:1	**91**	N	Strong	0.2
BH05 48986	81.5	2.6:1	**86**	N	Strong	0.4
BH05 48991	81.4	2.5:1	**94**	N	Strong	0.1
BH05 48994	82	1.9:1	**72**	N	Strong	0.2
BH05 48998	82.2	2.6:1	**77**	N	Strong	0.2
BH05 50711	78.5	1.8:1	**79**	N	Strong	0.2
BH05 50729	79	2.5:1	**116**	N	Very Strong	0.3
BH05 50731	81.4	2.6:1	**51**	N	Strong	0.1
BH05 50733	81.6	2.1:1	**54**	N	Strong	0.2
BH05 50737	82	1.5:1	**131**	N	Very Strong	0.2

Comments

1) The uniaxial compressive strength was carried out in accordance with ISRM guidelines.
2) Stress Rate: 0.7Mpa/s.

3)

EN ISO 14689-1 : 2003 Rock Strength Terms	
Compressive Strength mpa	Term
<1.0	Extremely Weak
1 to 5	Very Weak
5 to 25	Weak
25 to 50	Meduim Strong
50 to 100	Strong
100 to 250	Very Strong
> 250	Extremely Strong

Water Tests

Independent Analytical Supplies

Test Report

Lab Report Number:	2165I01	**Analysis Number:**	99A/89470

Customer ID:	BRG.L1	**Analysis Type:**	Misc. Tests (99A)
Contact Name:	DAVID BLANEY	**Delivery By:**	An Post
Company Name:	BRG LTD	**Sample Card Number:**	AAAQ1194/3
Address:	8B UNIT 3 ATHY BUSINESS CAMPUS ATHY CO KILDARE	**Sample Condition:**	Acceptable
Sample Type:	Ground Water	**Date Sample Received:**	15/03/2016
Sample Reference:	GROUND WATER	**Date Analysis Commenced:**	15/03/2016
Sample Description:	BH-04	**Date Certificate Issued:**	29/03/2016

Parameter	Method	Result	Unit
Calcium	ICP-MS	82.9	mg/l
Chloride	Konelab Aquakem SOP 2065	32.10	mg/l
Potassium	ICP-MS	0.94	mg/l
Magnesium	ICP-MS	2.50	mg/l
Sodium	ICP-MS	17.1	mg/l
Nitrite	Konelab Aquakem SOP 2059	<0.03	mg/l NO2
Sulphate	Konelab Aquakem SOP 2062	6.26	mg/l SO4

Signed: W McCall Date: 29/03/2016

Wendy McCall - Laboratory Manager

*** = not INAB Accredited ^ = Subcontracted**

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ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.275T

IAS LABORATORIES

Independent Analytical Supplies

Test Report

Lab Report Number:	2165I02	**Analysis Number:**	99A/89471

Customer ID:	BRG.L1	**Analysis Type:**	Misc. Tests (99A)
Contact Name:	DAVID BLANEY	**Delivery By:**	An Post
Company Name:	BRG LTD	**Sample Card Number:**	AAAQ1194/3
Address:	8B UNIT 3 ATHY BUSINESS CAMPUS ATHY CO KILDARE	**Sample Condition:**	Acceptable
Sample Type:	Ground Water	**Date Sample Received:**	15/03/2016
Sample Reference:	GROUND WATER	**Date Analysis Commenced:**	15/03/2016
Sample Description:	BH-05	**Date Certificate Issued:**	29/03/2016

Parameter	Method	Result	Unit
Calcium	ICP-MS	92.6	mg/l
Chloride	Konelab Aquakem SOP 2065	25.38	mg/l
Potassium	ICP-MS	6.26	mg/l
Magnesium	ICP-MS	2.98	mg/l
Sodium	ICP-MS	14.4	mg/l
Nitrite	Konelab Aquakem SOP 2059	0.03	mg/l NO2
Sulphate	Konelab Aquakem SOP 2062	15.41	mg/l SO4

Signed: W McCall Date: 29/03/2016

Wendy McCall - Laboratory Manager

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ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.275T

IAS LABORATORIES

Independent Analytical Supplies

Test Report

Lab Report Number:	2165I03	**Analysis Number:**	99A/89472

Customer ID:	BRG.L1	**Analysis Type:**	Misc. Tests (99A)
Contact Name:	DAVID BLANEY	**Delivery By:**	An Post
Company Name:	BRG LTD	**Sample Card Number:**	AAAQ1194/3
Address:	8B UNIT 3 ATHY BUSINESS CAMPUS ATHY CO KILDARE	**Sample Condition:**	Acceptable
Sample Type:	Ground Water	**Date Sample Received:**	15/03/2016
Sample Reference:	GROUND WATER	**Date Analysis Commenced:**	15/03/2016
Sample Description:	BH-06	**Date Certificate Issued:**	29/03/2016

Parameter	Method	Result	Unit
Calcium	ICP-MS	430.1	mg/l
Chloride	Konelab Aquakem SOP 2065	152.22	mg/l
Potassium	ICP-MS	39.3	mg/l
Magnesium	ICP-MS	<0.5	mg/l
Sodium	ICP-MS	306.1	mg/l
Nitrite	Konelab Aquakem SOP 2059	1.02	mg/l NO2
Sulphate	Konelab Aquakem SOP 2062	36.32	mg/l SO4

Signed: W McCall Date: 29/03/2016

Wendy McCall - Laboratory Manager

*** = not INAB Accredited ^ = Subcontracted**

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ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.275T

APPENDIX VIII

Monitoring Well Sampling Log

Well Number:BH-04

Project Details

Project No.:	Lackagh	Location (GPS):	530150 728400
Date:	12-3-16	Sampler:	Ronan Doyle

Sample Details

Well No.:	BH-04	Measurement Point:	TOR
Stick Up:		T.O.C Elevation:	
Water Level:	19.65m	Well Depth:	33.06m
Head:	13.41m	Well Diameter:	
Volume in Well (L):		Volume Purged (L):	Pumped for 1 hr
Decon. Procedure:		Bailer Type:	Watterra Pump
Containers Used:			

Field Parameters

Observed Colour:	Brown Tint	Odour:	None
Temperature (°C):	10.5C	Conductivity (µS):	295
pH:	7.47	pHMV:	-58mv ORP=231mv

Comments

DO=0.21mg/l   1.8%

Monitoring Well Sampling Log

Well Number:BH-05

Project Details

Project No.:	Lackagh	Location (GPS):	530186 728378
Date:	12-3-16	Sampler:	Ronan Doyle

Sample Details

Well No.:	BH-05	Measurement Point:	TOR
Stick Up:		T.O.C Elevation:	
Water Level:	21.70m	Well Depth:	39.53m
Head:	17.83m	Well Diameter:	
Volume in Well (L):		Volume Purged (L):	Pumped for 1 hr
Decon. Procedure:		Bailer Type:	Watterra Pump
Containers Used:			

Field Parameters

Observed Colour:	Brown Tint	Odour:	None
Temperature (°C):	10.5C	Conductivity (µS):	420
pH:	7.77	pHMV:	-74.8mv ORP=216.9mv

Comments

DO=0.8mg/l 9.2%

Ronan Doyle Monitoring Solutions,

Castlebar Road, Ballinrobe, County Mayo.

Monitoring Well Sampling Log

Well Number:BH-06

Project Details

Project No.:	Lackagh	Location (GPS):	530125 728383
Date:	12-3-16	Sampler:	Ronan Doyle

Sample Details

Well No.:	BH-06	Measurement Point:	TOR
Stick Up:		T.O.C Elevation:	
Water Level:	4.02m	Well Depth:	7.48m
Head:	3.46m	Well Diameter:	
Volume in Well (L):		Volume Purged (L):	Pumped for 30min
Decon. Procedure:		Bailer Type:	Watterra Pump
Containers Used:			

Field Parameters

Observed Colour:	Milky brown	Odour:	None
Temperature (°C):	9.8C	Conductivity (µS):	6187
pH:	12.53	pHMV:	-333mv ORP=51.7mv

Comments

DO=0.8mg/l 9.4%

Ronan Doyle Monitoring Solutions,

Castlebar Road, Ballinrobe, County Mayo.

APPENDIX IX

Borehole ID **BH5**

Water Level Start **19.45m**

Water volume inserted **215 ltrs**

Time (min)	Water Level (m)
1	18.1
1.5	18.52
2	18.82
2.5	19
3	19.14
3.5	19.22
4	19.26
4.5	19.29
5	19.31
5.5	19.32
6	19.33
8	19.35
11	19.38
14	19.39
18	19.4
22	19.405
26	19.41
30	19.41
34	19.415
40	19.42

Borehole ID **BH5**
Water Level Start **19.42m**
Water volume inserted **1000 ltrs**

Time (min)	Water Level (m)	Comments
1	17.62	
1.5	18.22	
2	18.51	
2.5	18.74	
3	18.93	
3.5	19.04	
4	19.11	
4.5	19.17	
5	19.21	
5.5	19.24	
6	19.26	
6.5	19.28	
7.5	19.29	
9	19.31	
12	19.33	
14	19.335	
17	19.34	
20	19.345	
24	19.345	
30	19.35	
40	19.34	Could feel material in the hole test stopped - driller reports clearing clay after test in oreder to install piezometer.

APPENDIX X

BH04 - Packer Test 18/12/15 **Water Depth** **Start** 16.8m **Finish** 16.8m

Depth **Time minutes** →

Top	**Bottom**	**Midpoint**	**Packer Pressure (psi)**	**Pressure (psi)**	**Flow (litres)**	1	2	3	4	5	6	7	8	9	10		
28	30	29	175	49	↓	59	113	168	225	282	343	399	456	518	579	**Total**	
						59	57	56	56	56	57	57	57	58	58	**l/m**	Unable to continue at
24	26	25	175	50		18.5	35	52	70	86	103	121	138	155.6	174	**Total**	
						19	18	17	18	17	17	17	17	17	17	**l/m**	
				65		29	58	87	117	147	176	207	236	267	297	**Total**	
						29	29	29	29	29	29	30	30	30	30	**l/m**	
				84		44	89	134	179	224	270	316	363	410	456	**Total**	
						44	45	45	45	45	45	45	45	46	46	**l/m**	
				65		32	73	113	152	193	232	273	313	354	395	**Total**	
						32	37	38	38	39	39	39	39	39	40	**l/m**	
				50		34	67	101	135	169	202	236	270	303	337	**Total**	
						34	34	34	34	34	34	34	34	34	34	**l/m**	
21	23	22	175	40		60	120	179	237	296	355	414	473	533	591	**Total**	
						60	60	60	59	59	59	59	59	59	59	**l/m**	
				50		67	134	200	266	331	397	464	530	576	662	**Total**	
						67	67	67	67	66	66	66	66	64	66	**l/m**	Unable to continue at
18	20	19	160	40		20	42	66	91	115	140	164	189	214	240	**Total**	
						20	21	22	23	23	23	23	24	24	24	**l/m**	
				60		31	64	96	128	160	192	225	257	289	322	**Total**	
						31	32	32	32	32	32	32	32	32	32	**l/m**	
				80		37	75	113	152	190	228	267	306	345	383	**Total**	
						37	38	38	38	38	38	38	38	38	38	**l/m**	
				60		33	66	99	132	165	198	231	264	297	328	**Total**	
						33	33	33	33	33	33	33	33	33	33	**l/m**	
				40		25	50	75	101	126	150	175	200	224	249	**Total**	
						25	25	25	25	25	25	25	25	25	25	**l/m**	

BH05 - Packer Test 6/1/16 **Water Depth Start** 19.26m **Finish** 19.2

Depth						**Time minutes** →										
Top	**Bottom**	**Midpoint**	**Packer Pressure (psi)**	**Pressure (psi)**	**Flow (litres)**	1	2	3	4	5	6	7	8	9	10	
36	38	37	160	30		58.9	117.1	176.1	234.4	292.9	350.1	408.7	466.7	524.9	581.7	**Total**
						59	59	59	59	59	58	58	58	58	58	**l/m**
				45		70.1	139.9	209.1	279.1	348.7	417.9	485.1	554.6	620.5	686.1	**Total**
						70	70	70	70	70	70	69	69	69	69	**l/m**
				60		76.8	153.7	231.2	304.4	383.7	461.5	537.7	613.7	691.6	768.4	**Total**
						77	77	77	76	77	77	77	77	77	77	**l/m**
				45		73	145.7	212.8	278.1	351.5	421.4	493.3	564.4	634.6	705.9	**Total**
						73	73	71	70	70	70	70	71	71	71	**l/m**
				30		64.2	128.6	192.7	256.3	319.1	383.6	448.5	513.7	576.7	641.5	**Total**
						59	59	59	59	59	58	58	58	58	58	**l/m**
30	32	31	175	30		54.2	110.3	166.4	222.2	278.7	335.7	392.4	448.1	505.2	561.7	**Total**
						54	55	55	56	56	56	56	56	56	56	**l/m**
				45		67.3	135.1	204.1	273.5	342.4	411.7	481.2	530.4	619.3	688.1	**Total**
						67	68	68	68	68	69	69	66	69	69	**l/m**
				60		78.7	155.8	234.8	311.7	390.1	468.4	546.7	633.5	701.3	779.4	**Total**
						79	78	78	78	78	78	78	79	78	78	**l/m**
				45		69.7	139.7	209.6	286.5	346.5	414.5	481.7	550.7	621.8	693	**Total**
						70	70	70	72	69	69	69	69	69	69	**l/m**
				30		61.1	122.4	184.7	247.5	309.7	372.5	435.1	498.3	563.5	626.7	**Total**
						61	61	62	62	62	62	62	62	63	63	**l/m**
24	27	25.5	175	30		54.1	111.4	166.5	222.3	277	332.4	387.4	462.1	497.1	551.7	**Total**
						54	56	56	56	55	55	55	58	55	55	**l/m**
				45		67.1	135.4	200.4	268.2	335.3	402.1	468.3	535.3	602.7	667.1	**Total**
						67	68	67	67	67	67	67	67	67	67	**l/m**
				60		77.3	153.7	231.2	308.9	385.7	463.7	540.1	617.5	695	772.6	**Total**
						77	77	77	77	77	77	77	77	77	77	**l/m**
				45		65.6	130.5	196.3	261.1	326.7	391.6	457.5	512.9	587.2	652.5	**Total**
						66	65	65	65	65	65	65	64	65	65	**l/m**
				30		56.9	112.5	167.7	223.5	279.4	335.2	390.1	446	501.7	557.1	**Total**
						57	56	56	56	56	56	56	56	56	56	**l/m**
20	23	21.5	175	30		54.2	108.5	162	216.7	270.3	324.5	378	421.7	480	539	**Total**
						54	54	54	54	54	54	54	53	53	54	**l/m**
				45		65.6	131.8	197.3	262.5	328.3	394.5	459.8	524.7	590.3	655.7	**Total**
						66	66	66	66	66	66	66	66	66	66	**l/m**
				60		77.1	154.1	230.4	306.9	383.7	459.7	536.2	611.9	688.5	764.1	**Total**
						77	77	77	77	77	77	77	76	77	76	**l/m**
				45		67.7	135.2	203.1	271.4	337.9	403.3	468.2	530.7	592.8	656.7	**Total**
						68	68	68	68	68	67	67	66	66	66	**l/m**
				30		57.7	115.4	173.2	230.8	287.1	342.9	399.1	455.5	512.5	567.1	**Total**
						58	58	58	58	57	57	57	57	57	57	**l/m**

APPENDIX XI

A2

TRIAL PIT RECORD

REPORT NUMBER	18963
CONTRACT	N6 Galway City Transport Project - Phase 3
TRIAL PIT NO.	**TP3/24**
SHEET	Sheet 1 of 1
LOGGED BY	A.Chryst
CO-ORDINATES	529,752.24 E 728,388.27 N
GROUND LEVEL (m)	13.69
DATE STARTED	26/01/2016
DATE COMPLETED	26/01/2016
CLIENT	Galway County Council
ENGINEER	ARUP
EXCAVATION METHOD	Hitachi Zaxis 80

	Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples			Vane Test (KPa)	Hand Penetrometer (KPa)
						Sample Ref	Type	Depth		
0.0	TOPSOIL		0.10	13.59						
	Light brown clayey slightly sandy very gravelly angular COBBLES and BOULDERS of limestone					AA49456 AA49457	D B	0.50 0.50		
	Obstruction - Possible Rockhead End of Trial Pit at 0.70m		0.70	12.99						
1.0										
2.0										
3.0										
4.0										

Groundwater Conditions
Dry

Stability
Good

General Remarks
0.75hr Tracking to stone wall en route to trial pit location. 0.15hr Taking down stone wall. 0.50hr Reinstating wall upon trial pit completion.

TRIAL PIT RECORD

REPORT NUMBER	18963
CONTRACT	N6 Galway City Transport Project - Phase 3
TRIAL PIT NO.	**TP3/41**
SHEET	Sheet 1 of 1
LOGGED BY	A.Chryst
CO-ORDINATES	529,897.01 E 728,377.37 N
GROUND LEVEL (m)	22.57
DATE STARTED	19/04/2016
DATE COMPLETED	19/04/2016
CLIENT	Galway County Council
ENGINEER	ARUP
EXCAVATION METHOD	Hitachi Zaxis 80

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
TOPSOIL		0.40	22.17						
Firm orange brown sandy gravelly CLAY with a high cobble and boulder content. Cobbles and boulders are of limestone.		0.80	21.77		AA43057 AA43058	B D	0.50 0.50		
Possible Highly Weathered Rockhead recovered as Grey COBBLES and BOULDERS of limestone		1.40	21.17						
Obstruction - Possible Rockhead End of Trial Pit at 1.40m									

Depth scale: 0.0, 1.0, 2.0, 3.0, 4.0

Groundwater Conditions
Dry

Stability
Good

General Remarks
Pit terminated on possible shallow rockhead

TRIAL PIT RECORD

REPORT NUMBER	18963

CONTRACT	N6 Galway City Transport Project - Phase 3	**TRIAL PIT NO.**	**TP3/42**
		SHEET	Sheet 1 of 1
LOGGED BY	A.Chryst	**DATE STARTED**	19/04/2016
CO-ORDINATES	529,931.08 E 728,410.99 N	**DATE COMPLETED**	19/04/2016
GROUND LEVEL (m)	23.89	**EXCAVATION METHOD**	Hitachi Zaxis 80
CLIENT	Galway County Council		
ENGINEER	ARUP		

Scale	Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0	TOPSOIL									
	Firm dark brown slightly sandy silty CLAY with frequent rootlets		0.20	23.69						
	Firm light grey slightly sandy slightly gravelly silty CLAY		0.50	23.39		AA43059	B	0.40		
						AA43060 AA43061	B D	0.80 0.80		
1.0	Brown slightly gravelly fine to coarse SAND		1.40	22.49		AA43062	B	1.50		
2.0						AA43063	B	2.50		
3.0	Grey brown slightly clayey very sandy subangular to rounded fine to coarse GRAVEL		3.20	20.69		AA43064	B	3.50		
4.0	End of Trial Pit at 4.40m		4.40	19.49						

Groundwater Conditions
Dry

Stability
Good

General Remarks

Low resistivity values indicate overburden or weathered/karstified rock

Low resistivity values indicate weathered or karstified limestone

Low resistivity values indicate weathered or karstified limestone
Core hole recommended at 10760

High resistivities indicate a clean limestone

Minerex
Geophysics Limited
Unit F4, Maynooth Business Campus
Maynooth, Co. Kildare
Tel. (01) 6510030
Fax. (01) 6510033
Email: info@mgx.ie
Web: www.mgx.ie

CLIENT	IGSL ARUP
PROJECT	N6 GCTP Phase 3 Geophysical Survey
TITLE	Plan 1g: Survey Locations and Models for GP3/08

SCALE:	Hor 1:1000 @ A1, Ver 1:100 @ A1, VE x 10
PROJECT:	6031
DRAWN:	RJ
DATE:	18/02/2016
MGX FILE:	6031d_Plans.dwg
STATUS:	Draft

LEGEND: Geophysical Survey Locations:

🟦	R2	2D-Resistivity Profile
🟥	S1	Seismic Refraction Profile

Chainage based on Alignment received 12.02.2016

Locations are in Irish Transverse Mercator, Elevations are in mOD (Malin Head)

Geophysical Survey Locations:

🟨	Ground Surface along Survey Profile
🟩	Existing Ground Level along Centre Line
🟦	Proposed Vertical Alignment Centre Line

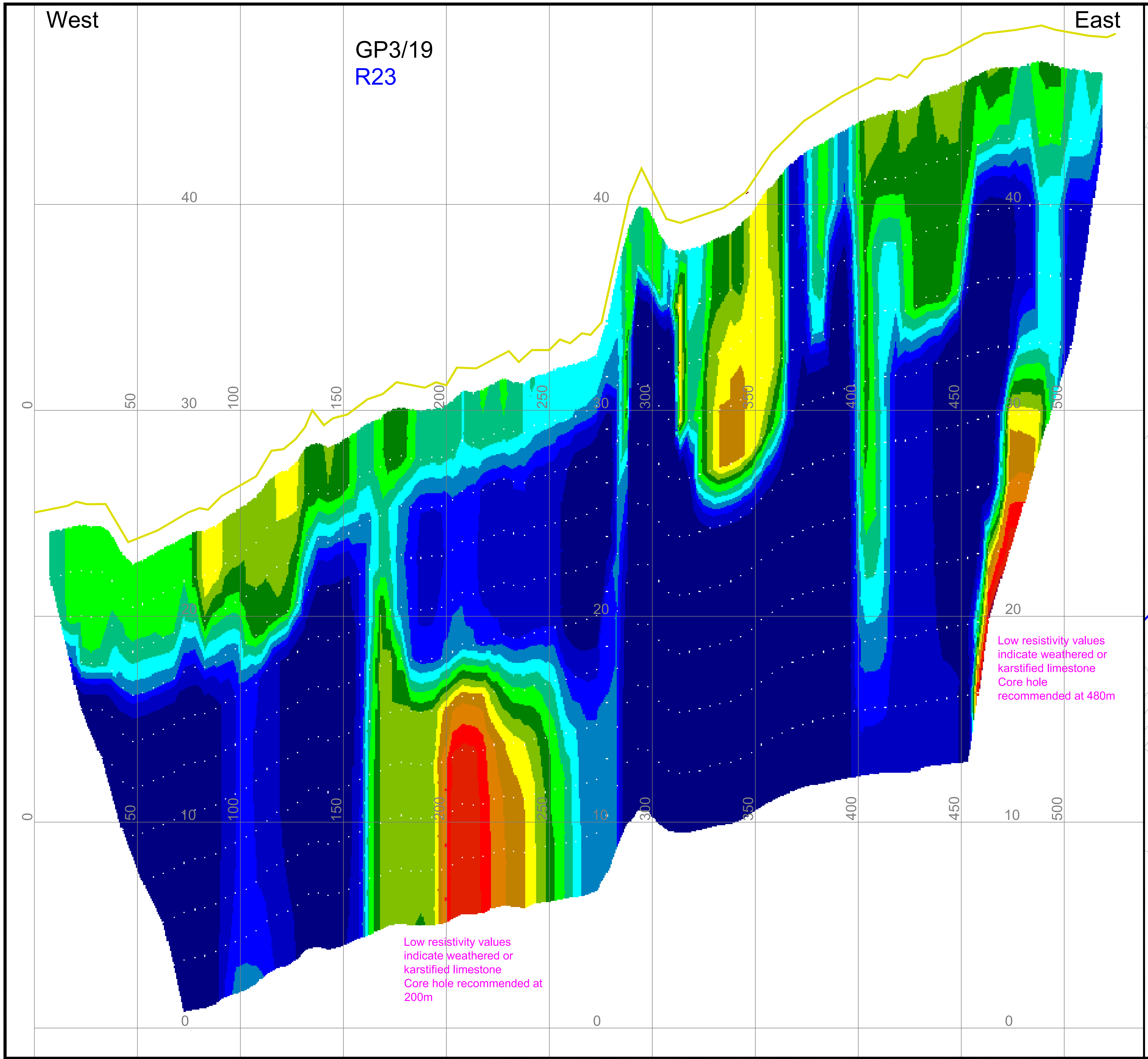
2D Resistivity and Seismic Refraction results are projected onto the Centre Line

2D-Resistivity Model Values:

Resistivities (Ohmm) for 2D-Resistivity Model

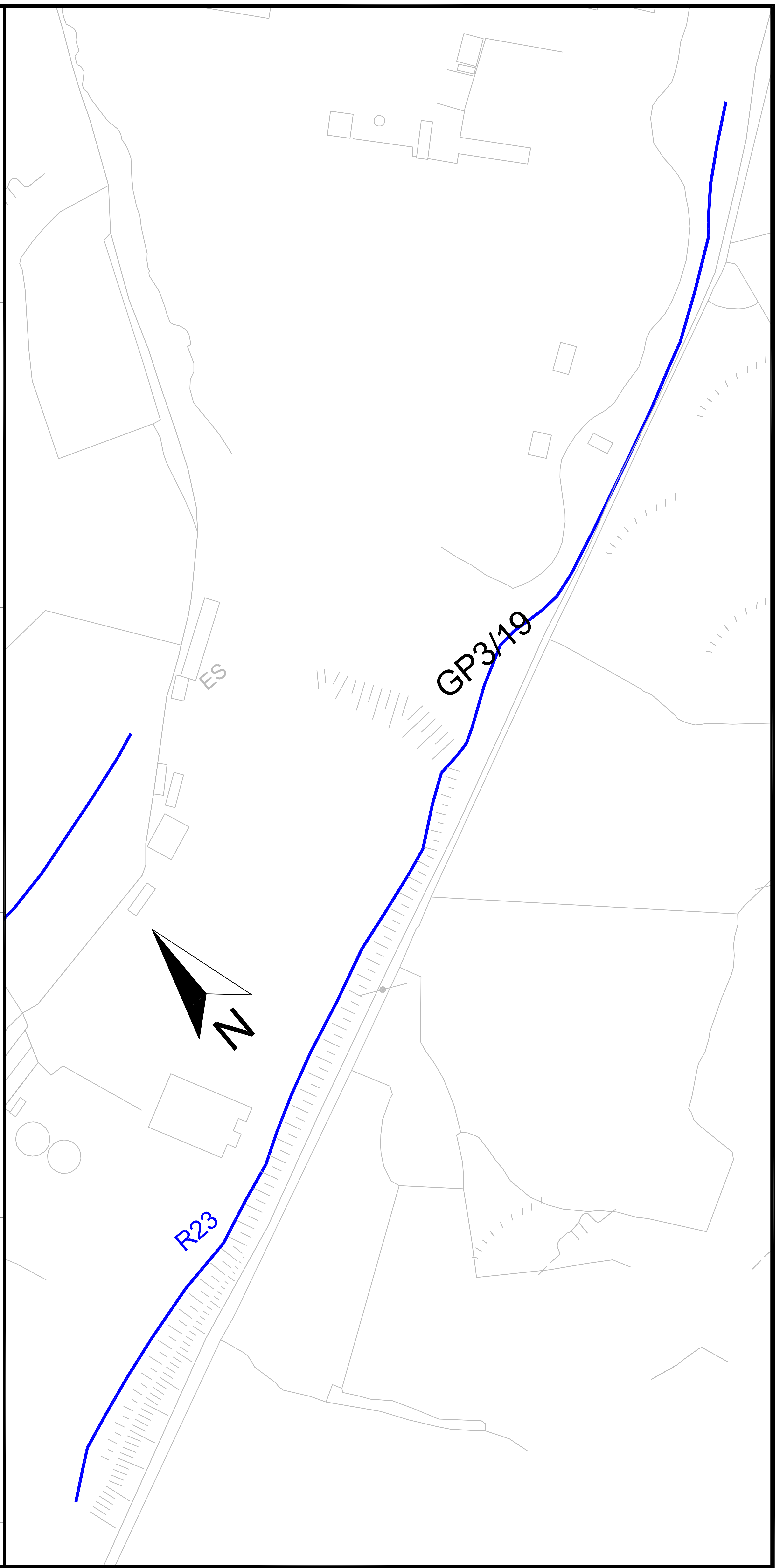
20.0 40.0 80.0 160 320 640 1280 2560

A draft interpretation is indicated by yellow/magenta text.
At this stage of the project this is intended to give guidance for targeted boreholes and coreholes.



Low resistivity values indicate weathered or karstified limestone Core hole recommended at 480m

Low resistivity values indicate weathered or karstified limestone Core hole recommended at 200m



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Web: www.mgx.ie

CLIENT	IGSL ARUP
PROJECT	N6 GCTP Phase 3 Geophysical Survey
TITLE	Plan 1n: Survey Locations and Models for GP3/19

SCALE:	Hor 1:1000 @ A1, Ver 1:100 @ A1, VE x 10
PROJECT:	6031
DRAWN:	RJ
DATE:	18/02/2016
MGX FILE:	6031d_Plans.dwg
STATUS:	Draft

LEGEND: Geophysical Survey Locations:

🟦	R2	2D-Resistivity Profile
🟥	S1	Seismic Refraction Profile

Chainage based on Alignment received 12.02.2016

Locations are in Irish Transverse Mercator, Elevations are in mOD (Malin Head)

Geophysical Survey Locations:

- Ground Surface along Survey Profile
- Existing Ground Level along Centre Line
- Proposed Vertical Alignment Centre Line

2D Resistivity and Seismic Refraction results are projected onto the Centre Line

Layers from Seismic Refraction Model:

- Ground Surface/Top of Layer 1 (200 - 340 m/s)
- Top of Layer 2 (1000 - 1200 m/s)
- Top of Layer 3 (2000 - 2400 m/s)
- Top of Layer 4 (4500 - 5000 m/s)

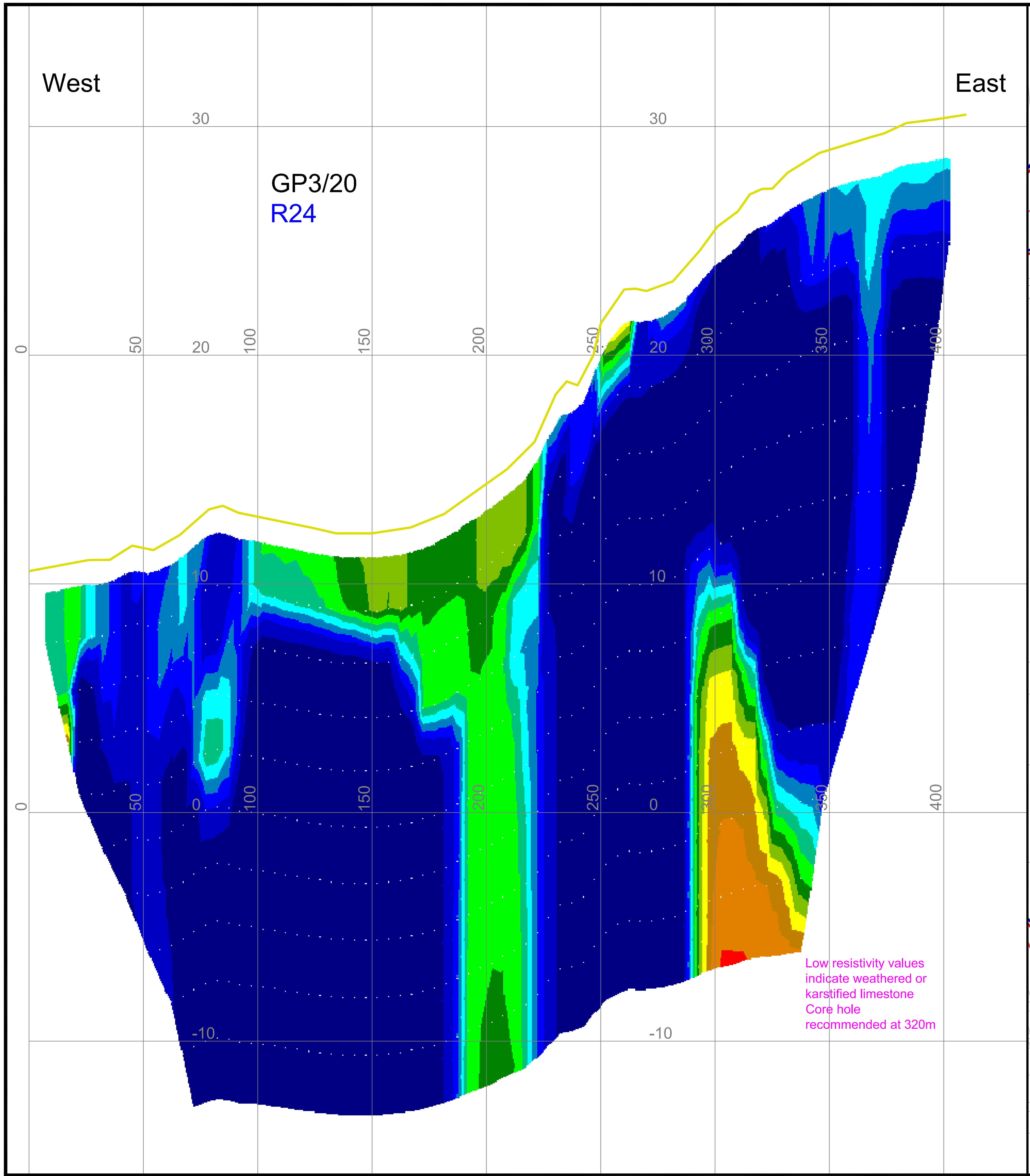
1800 Seismic Velocity in m/s

2D-Resistivity Model Values:

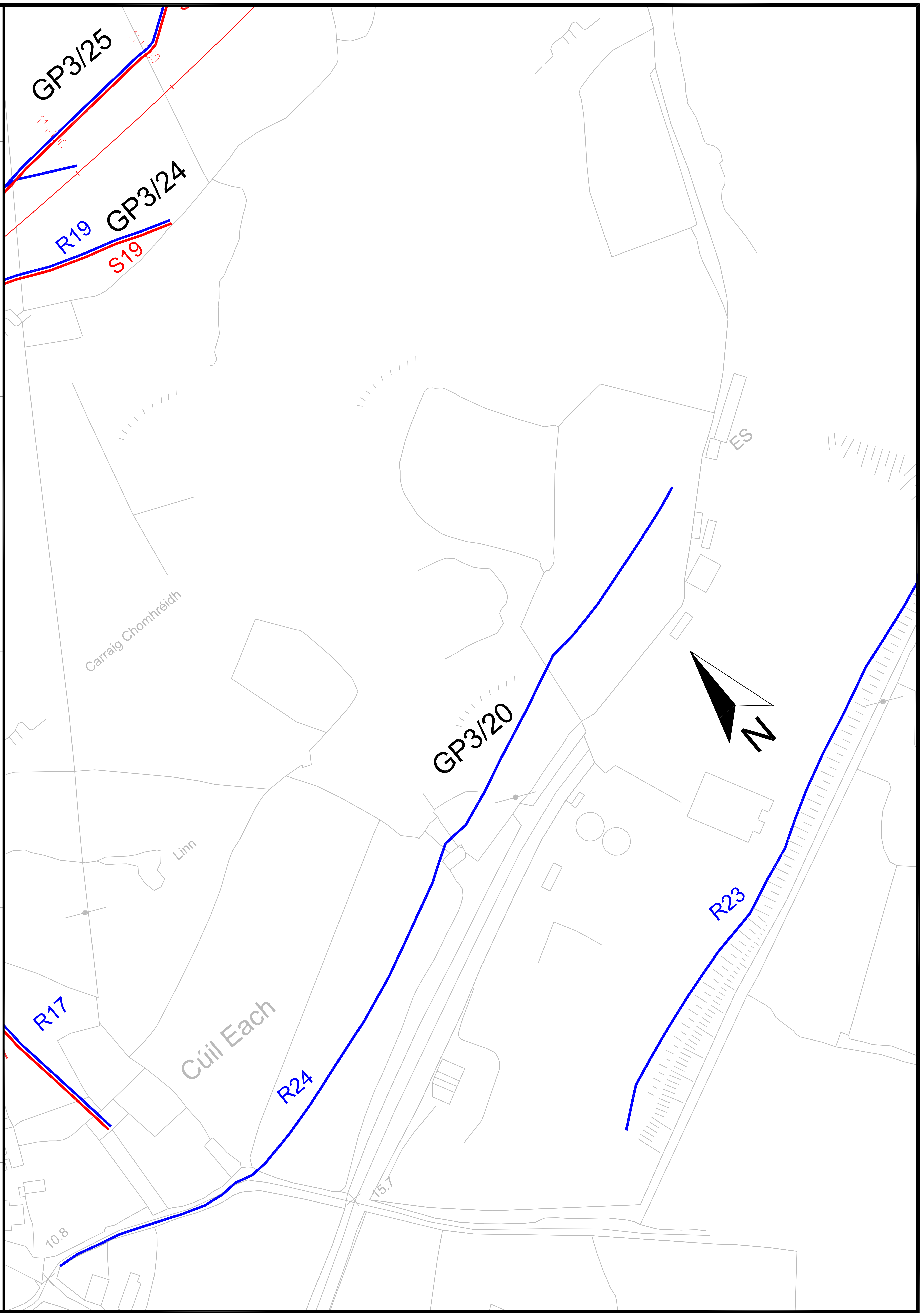
Resistivities (Ohmm) for 2D-Resistivity Model

20.0 40.0 80.0 160 320 640 1280 2560

A draft interpretation is indicated by yellow/magenta text.
At this stage of the project this is intended to give
guidance for targeted boreholes and coreholes.



Low resistivity values indicate weathered or karstified limestone
Core hole recommended at 320m



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CLIENT	IGSL ARUP
PROJECT	N6 GCTP Phase 3 Geophysical Survey
TITLE	Plan 1o: Survey Locations and Models for GP3/20

SCALE:	Hor 1:1000 @ A1, Ver 1:100 @ A1, VE x 10
PROJECT:	6031
DRAWN:	RJ
DATE:	18/02/2016
MGX FILE:	6031d_Plans.dwg
STATUS:	Draft

LEGEND: Geophysical Survey Locations:

🟦	R2	2D-Resistivity Profile
🟥	S1	Seismic Refraction Profile

Chainage based on Alignment received 12.02.2016

Locations are in Irish Transverse Mercator, Elevations are in mOD (Malin Head)

Geophysical Survey Locations:

🟨	Ground Surface along Survey Profile
🟩	Existing Ground Level along Centre Line
🟦	Proposed Vertical Alignment Centre Line

2D Resistivity and Seismic Refraction results are projected onto the Centre Line

Layers from Seismic Refraction Model:

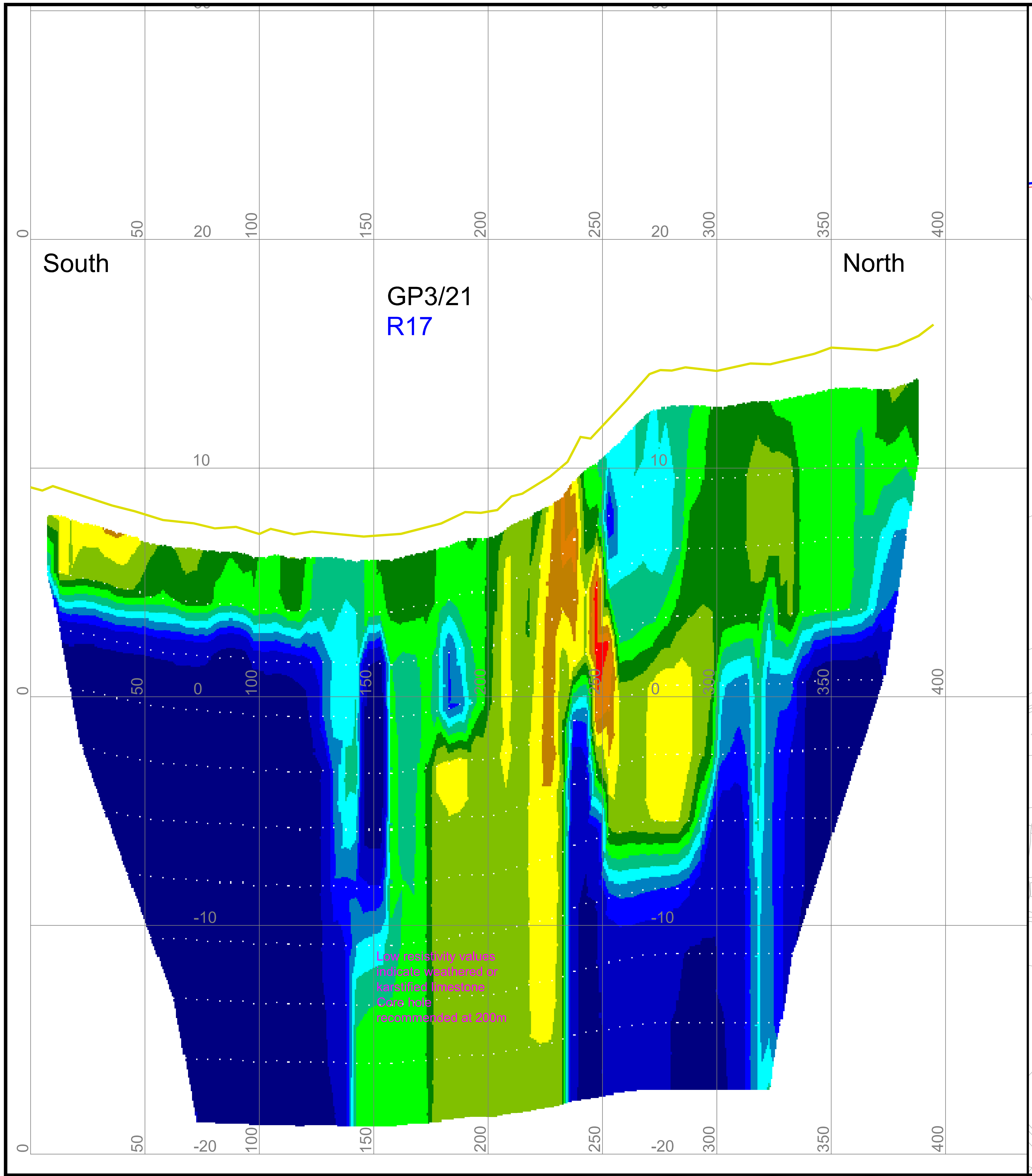
🟨	Ground Surface/Top of Layer 1 (200 - 340 m/s)
⬛	Top of Layer 2 (1000 - 1200 m/s)
🟪	Top of Layer 3 (2000 - 2400 m/s)
🟥	Top of Layer 4 (4500 - 5000 m/s)
1800	Seismic Velocity in m/s

2D-Resistivity Model Values:

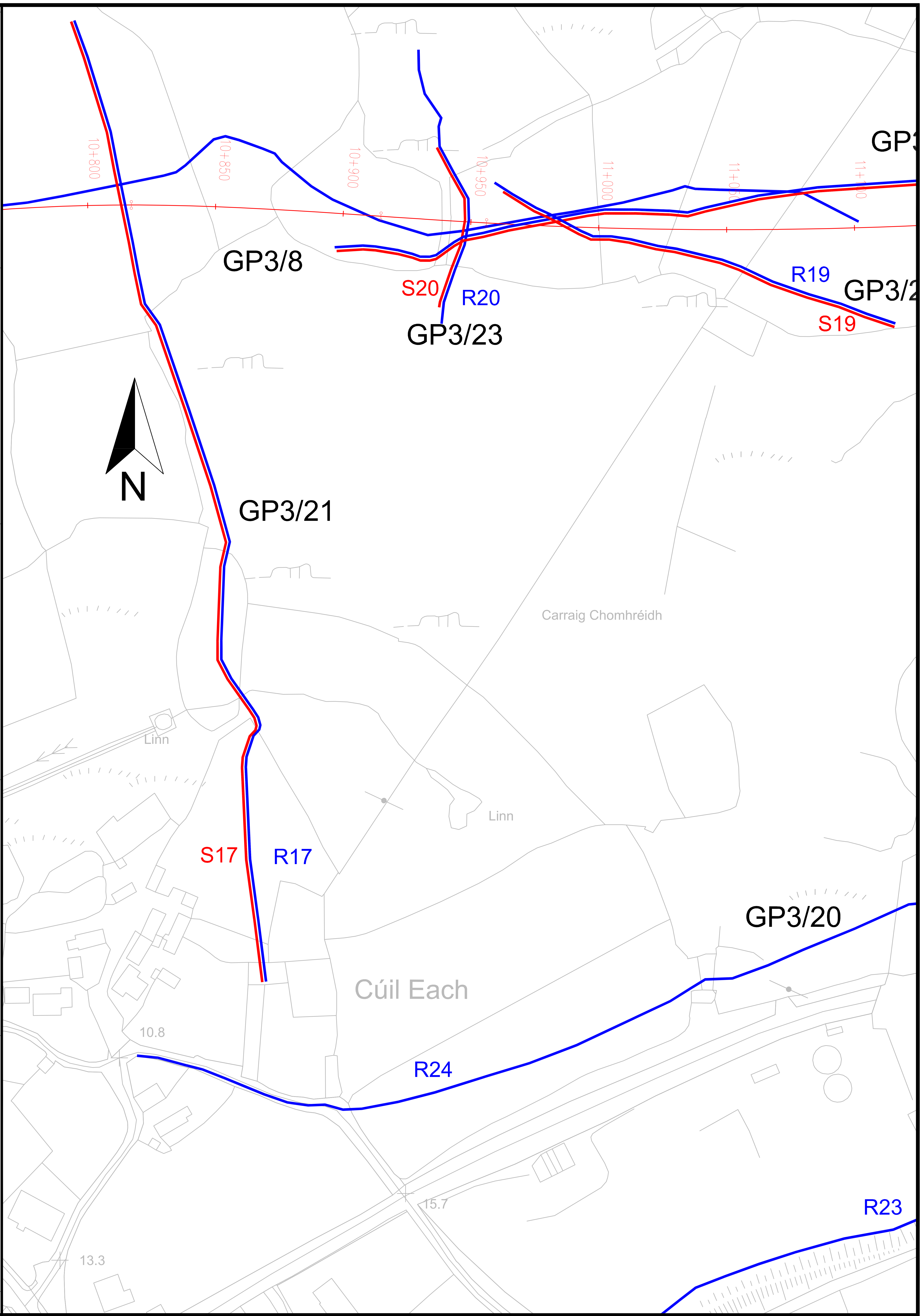
Resistivities (Ohmm) for 2D-Resistivity Model

20.0 40.0 80.0 160 320 640 1280 2560

A draft interpretation is indicated by yellow/magenta text.
At this stage of the project this is intended to give guidance for targeted boreholes and coreholes.



Low resistivity values indicate weathered or karstified limestone. Core hole recommended at 200m



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CLIENT	IGSL ARUP
PROJECT	N6 GCTP Phase 3 Geophysical Survey
TITLE	Plan 1p: Survey Locations and Models for GP3/21

SCALE:	Hor 1:1000 @ A1, Ver 1:100 @ A1, VE x 10
PROJECT:	6031
DRAWN:	RJ
DATE:	13/04/2016
MGX FILE:	6031d_Plans.dwg
STATUS:	Draft

LEGEND: **Geophysical Survey Locations:**

R2	2D-Resistivity Profile
S1	Seismic Refraction Profile

Chainage based on Alignment received 12.02.2016

Locations are in Irish Transverse Mercator, Elevations are in mOD (Malin Head)

Geophysical Survey Locations:

- Ground Surface along Survey Profile
- Existing Ground Level along Centre Line
- Proposed Vertical Alignment Centre Line

2D Resistivity and Seismic Refraction results are projected onto the Centre Line

Layers from Seismic Refraction Model:

- Ground Surface/Top of Layer 1 (200 - 340 m/s)
- Top of Layer 2 (1000 - 1200 m/s)
- Top of Layer 3 (2000 - 2400 m/s)
- Top of Layer 4 (4500 - 5000 m/s)

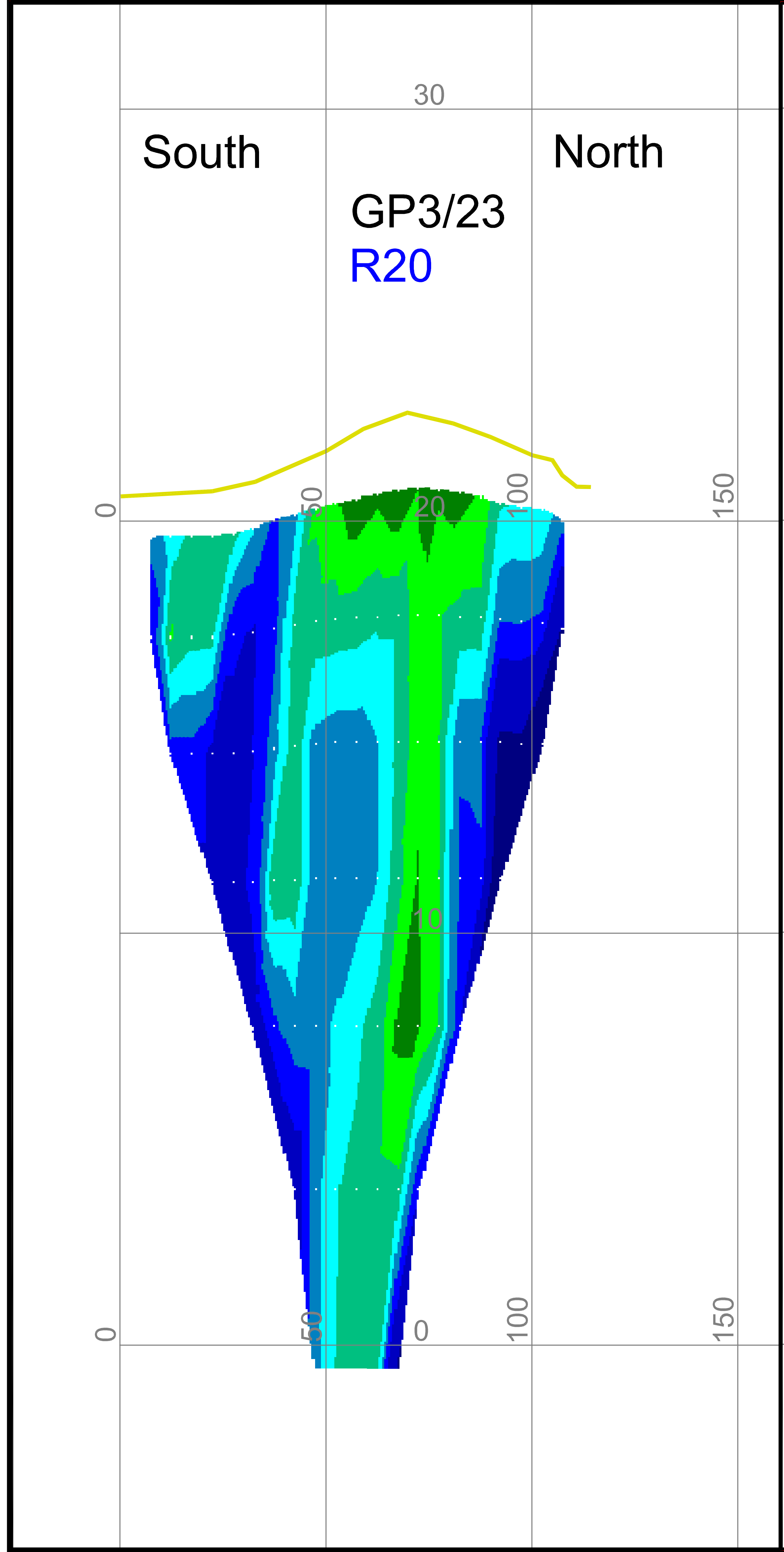
1800 Seismic Velocity in m/s

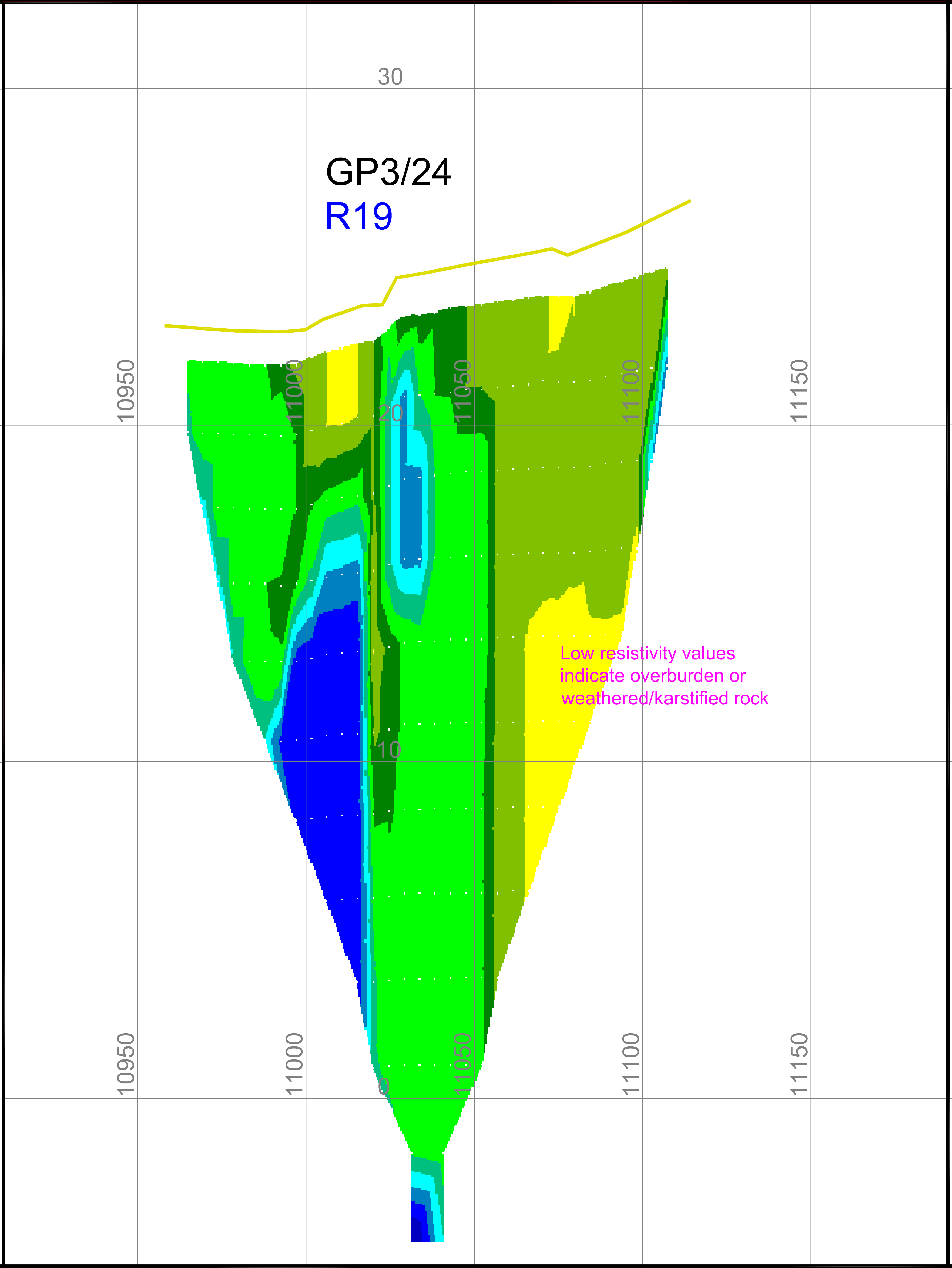
2D-Resistivity Model Values:

Resistivities (Ohmm) for 2D-Resistivity Model

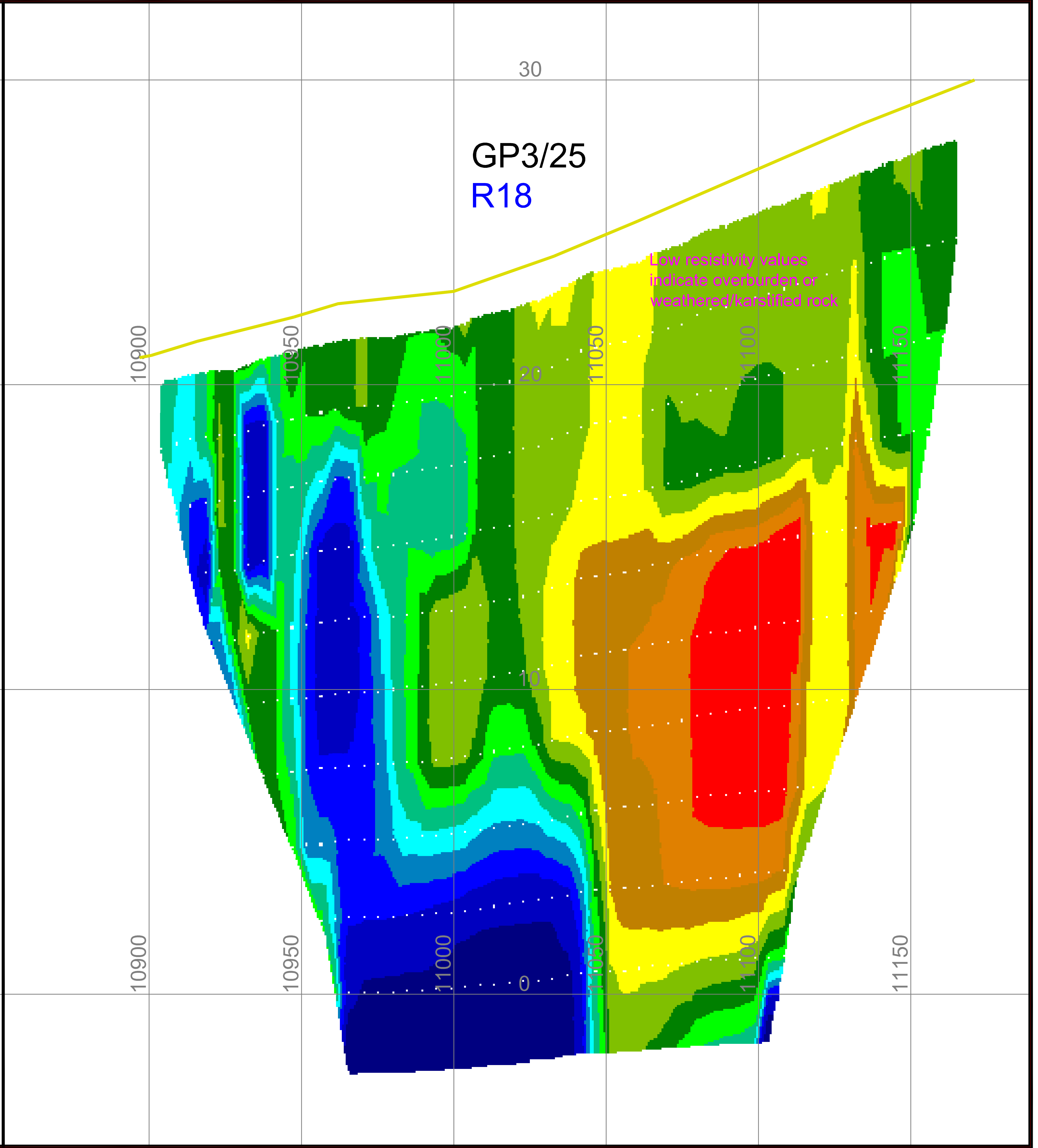
20.0 40.0 80.0 160 320 640 1280 2560

A draft interpretation is indicated by yellow/magenta text. At this stage of the project this is intended to give guidance for targeted boreholes and coreholes.





Low resistivity values indicate overburden or weathered/karstified rock



Low resistivity values indicate overburden or weathered/karstified rock

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CLIENT	IGSL ARUP
PROJECT	N6 GCTP Phase 3 Geophysical Survey
TITLE	Plan 1m: Survey Locations and Models for GP3/23,GP3/24,GP3/25

SCALE:	Hor 1:1000 @ A1, Ver 1:100 @ A1, VE x 10
PROJECT:	6031
DRAWN:	RJ
DATE:	18/02/2016
MGX FILE:	6031d_Plans.dwg
STATUS:	Draft

LEGEND:

Geophysical Survey Locations:

🟦	R2	2D-Resistivity Profile
🟥	S1	Seismic Refraction Profile

Chainage based on Alignment received 12.02.2016

Locations are in Irish Transverse Mercator, Elevations are in mOD (Malin Head)

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- Top of Layer 4 (4500 - 5000 m/s)

1800 Seismic Velocity in m/s

2D-Resistivity Model Values:

Resistivities (Ohmm) for 2D-Resistivity Model

20.0 40.0 80.0 160 320 640 1280 2560

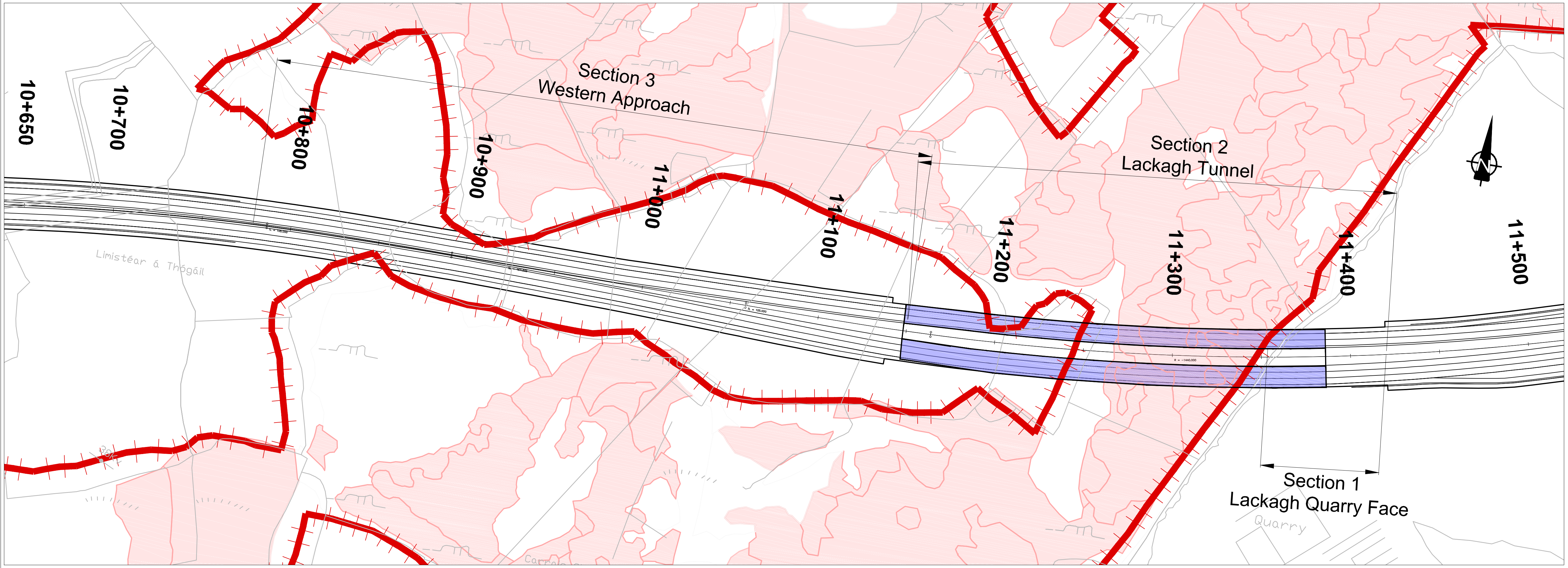
A draft interpretation is indicated by yellow/magenta text.
At this stage of the project this is intended to give guidance for targeted boreholes and coreholes.

Appendix B

Section 1 - Lackagh Tunnel cross sections

B1

A3



FOR INFORMATION

Legend:

Plan

▤	Proposed Geometry Plan
🟦	Proposed Tunnel Section
┼┼┼	Lough Corrib cSAC Boundary
🟥	Annex I Habitat

Profile

- - - -	Existing Ground (Indicative Levels based on 2m grid LiDAR Data DTM.)
────	Proposed Geometry Profile

MX REFERENCE INFO
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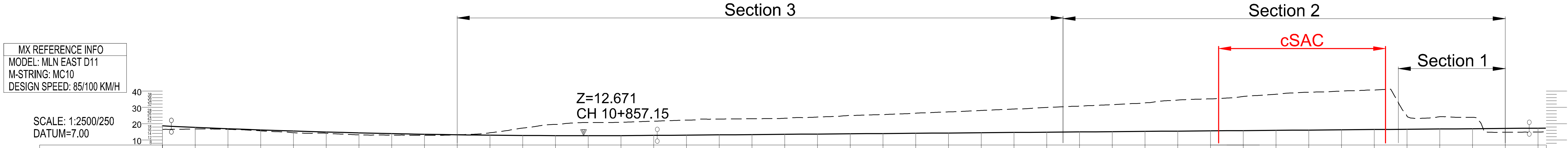
M-STRING: MC10
DESIGN SPEED: 85/100 KM/H

SCALE: 1:2500/250
DATUM=7.00



CHAINAGE	10+600	10+620	10+640	10+660	10+680	10+700	10+720	10+740	10+760	10+780	10+800	10+820	10+840	10+860	10+880	10+900	10+920	10+940	10+960	10+980	11+000
PROPOSED LEV	18.68	17.78	16.96	16.20	15.52	14.92	14.38	13.92	13.53	13.21	12.97	12.80	12.70	12.67	12.72	12.84	13.00	13.16	13.33	13.49	13.66
GROUND LEV.	16.47	16.77	16.54	15.62	14.50	14.14	13.16	12.96	12.84	13.22	14.42	17.31	19.54	20.67	20.88	21.55	22.19	22.83	23.03	23.31	24.05
HORIZ. SCHEM.	R=1440.00 L=463.78									CL=105.00						D=167.33					
VERT. SCHEM.	R=-10000.00 L=736.02 R=5500.00 L=296.81															P=0.82% L=532.50					
SUPER. SCHEM.						S=2.5%		S=2.5%										S=2.5%		S=2.5%	
GRADIENT (%)	-4.47	-4.47	-4.13	-3.77	-3.40	-3.04	-2.68	-2.31	-1.95	-1.58	-1.22	-0.86	-0.49	-0.13	0.23	0.60	0.82	0.82	0.82	0.82	0.82

CHAINAGE	11+020	11+040	11+060	11+080	11+100	11+120	11+140	11+160	11+180	11+200	11+220	11+240	11+260	11+280	11+300	11+320	11+340	11+360	11+380	11+400	11+420	11+440
PROPOSED LEV	13.82	13.98	14.15	14.31	14.47	14.64	14.80	14.97	15.13	15.29	15.46	15.62	15.78	15.95	16.11	16.27	16.44	16.60	16.77	16.93	17.09	17.26
GROUND LEV.	25.04	25.59	26.46	27.22	28.10	29.01	29.97	30.77	31.65	32.79	34.45	35.23	36.66	38.03	39.28	39.96	40.61	24.65	24.27	23.90	14.78	14.92
HORIZ. SCHEM.			CL=105.00					R=-1440.00 L=378.02														
VERT. SCHEM.																						
SUPER. SCHEM.				S=2.5%														S=2.5% S=2.5%				
GRADIENT (%)	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.83

N6 - LACKAGH TUNNEL PROFILE

San áireamh tá sonraíocht Shuirbhéireacht Ordanáis Éireann arna atáirgeadh faoi Cheadúnas OSI Uimh. 2010/16CCMA/Comhairle Contae na Gaillimhe.Sáraíonn atáirgeadh neamhúdaraithe cóipcheart Shuirbhéireacht Ordanáis Éireann agus Rialtas na hÉireann. © Suirbhéireacht Ordanáis Éireann, 2010.

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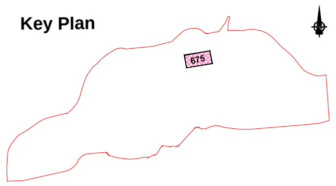
Design shown is draft only and is subject to change. More detailed assessments, ongoing studies and the information received from the public may result in changes to parts, or all of the Design. Any changes to the Design may affect the other information.

Nóta Séanta:
Tá an Dearadh ina bhfoirm dréacht, d'fhéadfaí athraithe teacht air. Is mar toradh ar mheasúnaithe níos mionchruinne, ar staidéar leanúnach agus ar eolas ón bpobal a dhéanfaí athruithe teacht ar an Dearadh ina iomláine nó ar chuid de. D'fhéadfadh ag aon athrú ar an Dearadh tionchar a bheith aige ar an eolas eile.

Clients

Key Plan



Consultant
ARUP
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Job Title
N6 Galway City Transport Project

Scale 1:2500 @ A3
Date: May 2016

Issue	Date	By	Chkd	Appd
I2	07/06/2016	KJ	MH	EMC
I1	27/05/2016	KJ	MH	EMC

Drawing Title
Lackagh Tunnel Plan & Profile

Drawing Status
For Information

Job No **233985**
Drawing No **GCOB-SK-D-675**
Issue **I2**

Do not scale

J:\233000\233985-00\4. Internal\4-02 Drawings\4-02-13 Sketches\13.3 Design Rep\GCOB-SK-D-675_Lackagh Tunnel Plan & Profile_I2.dwg

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Appendix C

Rock Arch Cover

C1

ARUP		Job No. 233985-00	Sheet No. 1 of 4		Rev.
		Member/Location			
Job Title	N6 Galway City Ring Road	Drg. Ref.			
Calculation	Appendix C: Rock Arch Cover	Made by PS	Date 02/06/2016	Chd. PC	

Introduction: A tunnel is proposed at Lackagh Quarry which connects Section 1-Lackagh Quarry Face to Section 3 - Western Approach. This note is prepared to calculate the minimum rock cover required before standard tunnelling works have to cease.
The rock arch cover from ground level to the crown of the proposed tunnel at the eastern extent of the Lough Corrib cSAC is approximately 15m and 13m at the western extent.

Geology: For this note the calculation will assume the tunnel is entirely within limestone bedrock.

Limestone rock parameters:

Geotechnical site investigation work (Phase 3 GI Contract 2) has been carried out along the proposed tunnel alignment and rock samples have been taken from various depths to assess the engineering geological parameters of the ground.

Based on a preliminary assessment the following parameters were developed:

Intact Parameters for limestone rock at Lackagh Quarry

Unit weight	27	kN/m^3
Young's Modulus	14	GPa
Poisson's ratio	0.2	
Cohesion	1.9	MPa
Friction Angle	61	°

The above parameters represent a typical set of parameters for the limestone at Lackagh Quarry, however taking a conservative approach and to ensure the worst case scenario is covered a reduced set of rock strength parameters will be used in this assessment.

Intact Lower Bound Parameters for limestone rock at Lackagh Quarry

Unit weight	27	kN/m^3
Young's Modulus	1	GPa
Poisson's ratio	0.3	
Cohesion	0.2	MPa
Friction Angle	45	°

Methodolgy: The lower bound parameters above will be used to determine the stability of the tunnel using Plaxis, a finite element computer program used to analyse excavations and other geotechnical engineering problems

The twin mined tunnel at Lackagh Quarry will be modelled sequentially and assessed in Plaxis. The model includes a sprayed concrete lining and rock bolts. A typical pattern of 5m long rock bolts at 2m spacing will be used with a 150mm thick sprayed concrete lining. In the long term condition a 500mm reinforced concrete lining is used in the model.

ARUP	Job No.	Sheet No.	Rev.
	233985-00	2 of 4	
	Member/Location		
Job Title: N6 Galway City Ring Road	Drg. Ref.		
Calculation: Appendix C: Rock Arch Cover	Made by: PS	Date: 02/06/2016	Chd.: PC

<u>**Inputs**</u>

The standard practice in calculating rock cover is to set a minimum rock cover at half the tunnel span. Each tunnel bore at Lackagh Quarry is approximatley 16m wide, therefore a minimum rock cover of 8m is used in the calculation.

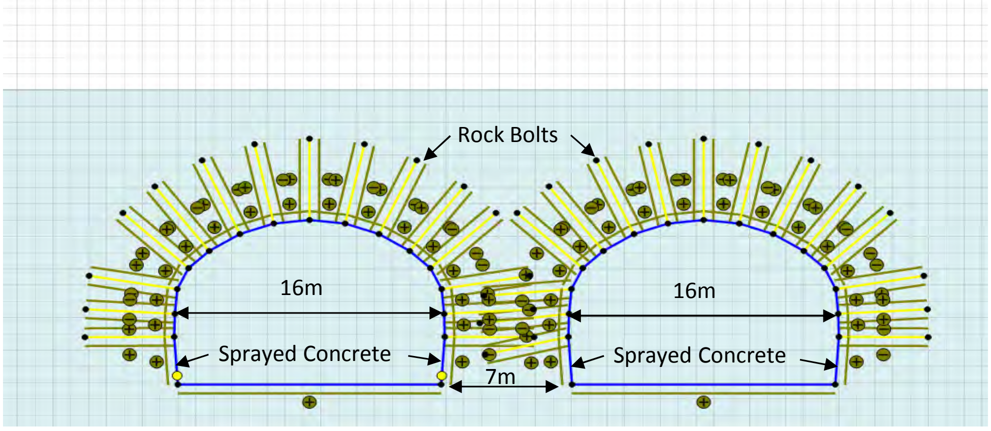
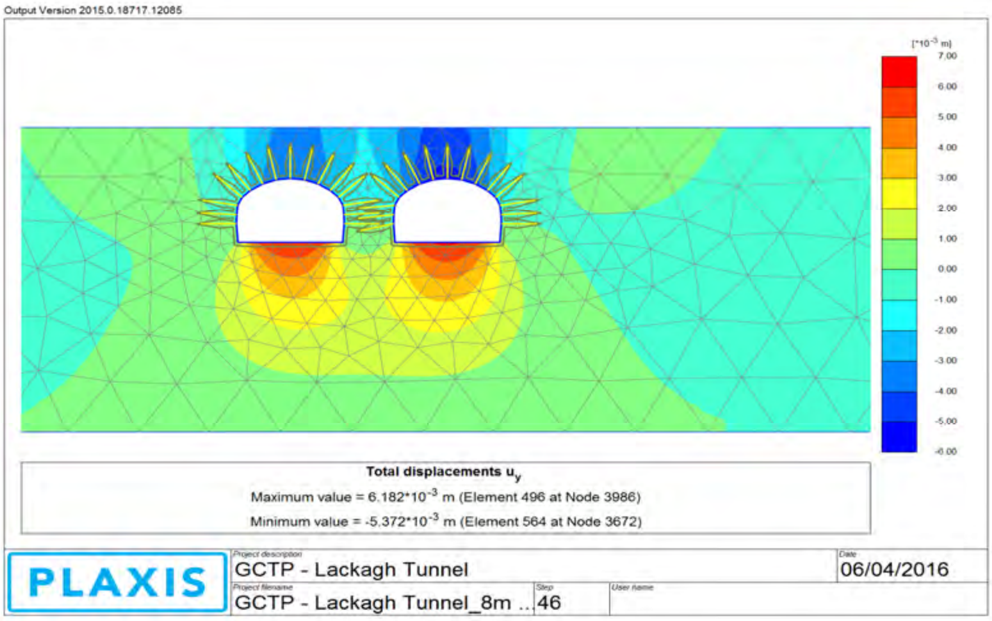


Figure C1: Model graphics showing twin mined tunnel with rock bolts installed around the lining.

The tunnels were excavated and modelled sequentially. The rock stress is allowed to relax up to 50% prior to the installation of the tunnel lining. Relaxing the rock stress allows Plaxis to realistically model the behaviour of the tunnel between the short term condition (during excavation) and the long term condition (tunnel lining support installed).

The diagram below shows the expected movement of the ground around the tunnels before installation of the permanent lining. In total a settlement of 6mm is observed directly above the tunnel crown this is less than 3mm of movement occurring at the surface.



Output Version 2015.0.18717.12085

Total displacements u_y

Maximum value = 6.182×10^{-3} m (Element 496 at Node 3986)

Minimum value = -5.372×10^{-3} m (Element 564 at Node 3672)

Project description: GCTP - Lackagh Tunnel

Date: 06/04/2016

Project filename: GCTP - Lackagh Tunnel_8m ...

Step: 46

User name

Figure C2: Vertical ground movement after excavation

The figure below shows the principal (major and minor) stresses and stress directions in the rock. The direction of the major stress indicates that the rock arch load is being transferred effectively into the rock pillar between the tunnels and the ground either side. This demonstrates that an effective rock arch is forming above the tunnels where the depth of rock is least (8m from ground level to the tunnel crown).

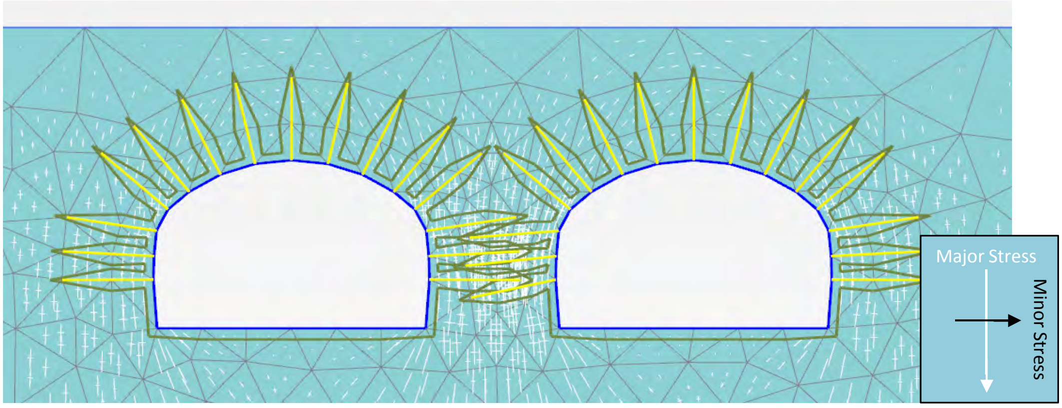
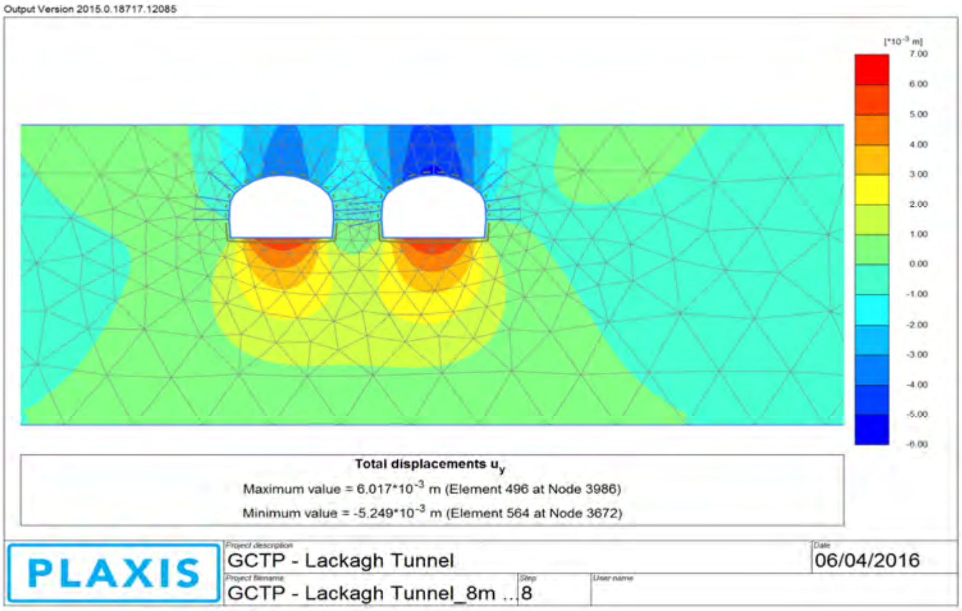


Figure C3 Principal stresses and stress directions in the limestone rock

The below figure illustrates the ground model and the anticipated stresses around the twin bore tunnel post construction. When compared with Figure C2 it can be observed that little or no additional settlement occurs during the operational stage (after the installation of the permanent lining).


Output Version 2015.0.18717.12085

Total displacements u_y

Maximum value = $6.017 \cdot 10^{-3}$ m (Element 496 at Node 3986)

Minimum value = $-5.249 \cdot 10^{-3}$ m (Element 564 at Node 3672)

PLAXIS	Project description: GCTP - Lackagh Tunnel		Date: 06/04/2016
	Project filename: GCTP - Lackagh Tunnel_8m ...	Step: 8	User name:

Figure C4 - Vertical ground movement after permanent lining

ARUP	Job No.	Sheet No.	Rev.
	233985-00	4 of 4	
	Member/Location		
Job Title: N6 Galway City Ring Road	Drg. Ref.		
Calculation: Appendix C: Rock Arch Cover	Made by: PS	Date: 02/06/2016	Chd.: PC

Conclusion: This preliminary analysis shows the potential impact of Lackagh Tunnel on the ground within the Lough Corrib cSAC. The expected movement of 6 mm due to the tunnelling works will have minimal impact on the surface within the Lough Corrib cSAC environment. Additionally 8m of rock cover is sufficient to allow an effective rock arch to form. It is recommended that the minimum rock cover used for the Lackagh Tunnel is 8m.

Figure C5 illustrates the proposed vertical alignment profile and Figure C6 presents the tunnel cross section. Based on this information the depth of rock cover below the Lough Corrib cSAC, presented in Table C1, is in excess of 8m.

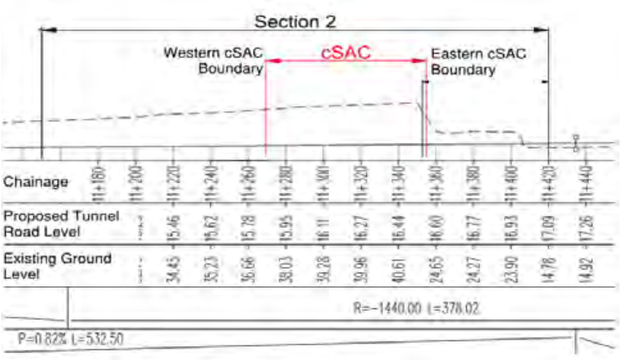


Figure C5 - Proposed vertical alignment profile and exisiting ground level

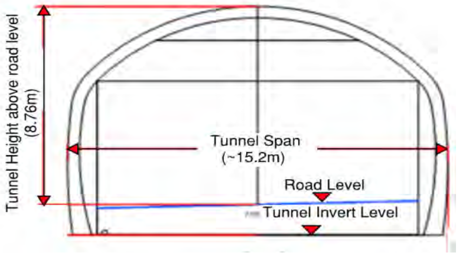


Figure C6 - Proposed tunnel cross section

Table C1 - Rock Cover below Lough Corrib cSAC

	Western Extent	Eastern Extent
Chainage	11+270	11+350
Proposed Tunnel Road level (mOD)	15.85	16.5
Existing Ground level (mOD)	37.55	40.61
Tunnel height (m)	8.76	8.76
Rock Cover (m)	**12.94**	**15.35**

Appendix D

Tunnel Bore Separation

D1

ARUP	Job No.		Sheet No.		Rev.
	233985-00		1 of 6		
	Member/Location	Appendix D			
Job Title: N6 Galway City Ring Road	Drg. Ref.				
Calculation: Appendix D: Rock Pillar Calculation	Made by	PS	Date 02/06/2016	Chd.	PC

Introduction: This calculation is prepared to determine the minimum separation between the twin mined tunnel bores for Lackagh Tunnel (Section 2) . The tunnel bores are expected to be approximately 16m wide each through limestone bedrock. The bore separation is based on the Phase 3 Ground Investigation Contract 2 including laboratory test results.

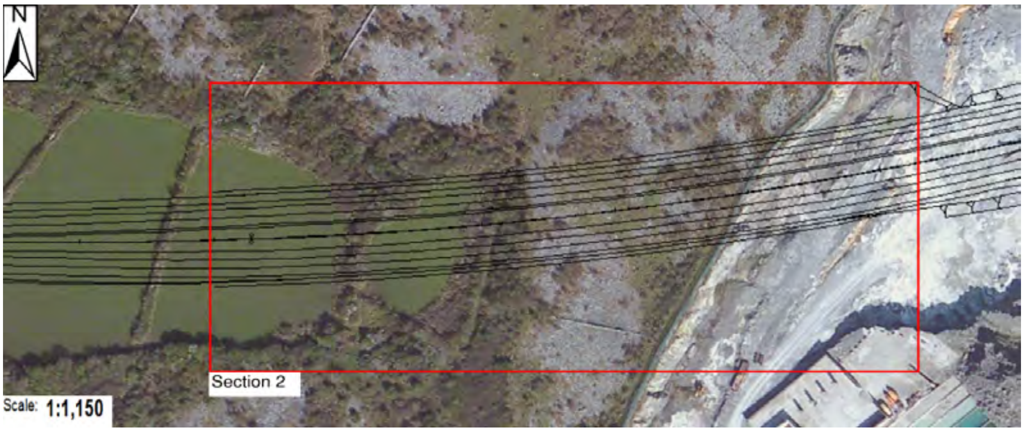


Figure D1(a) - Site overview of Lackagh Tunnel (Section 2)

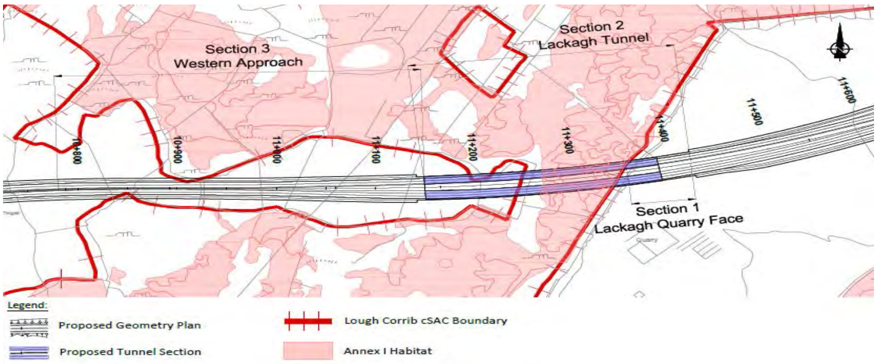


Figure D1(b) - Plan overview of Lackagh Tunnel (Section 2)

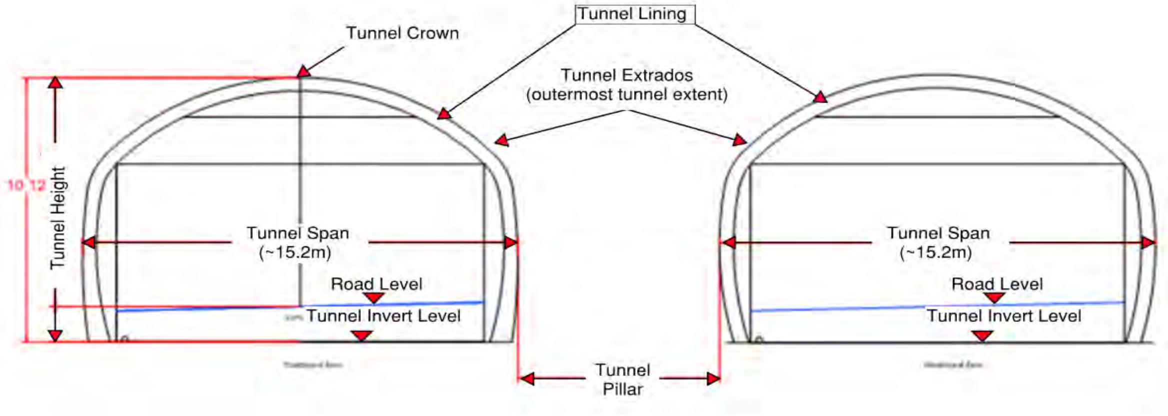


Figure D2 - Tunnel cross section, showing 7m separation between bores

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Calculation: Appendix D: Rock Pillar Calculation	Made by: PS	Date: 02/06/2016	Chd.: PC

Geology: The tunnel bores will be excavated through limestone bedrock and the separation calculated here is for this the limestone only.

If the tunnel bores advance into the clay then the separation will need to be increased.

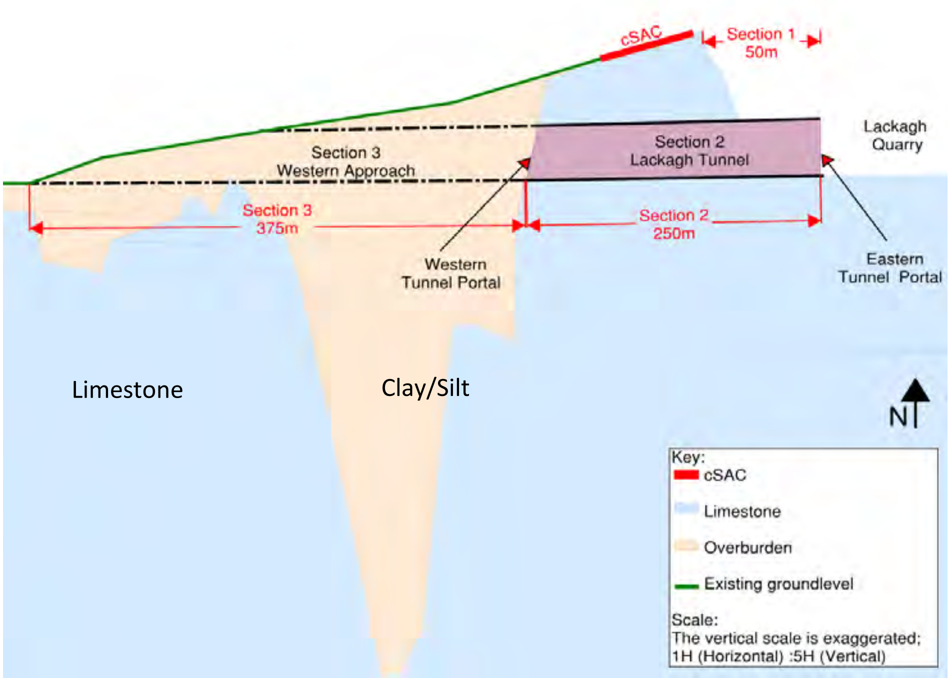

Figure D3 - Schematic geological long section showing the approximate geological boundaries

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Calculation	Appendix D: Rock Pillar Calculation	Made by	PS	Date	02/06/2016	Chd.	PC

Methodology: Typically the rock surrounding a tunnel in hard rock is supported through an arching effect caused by the confining stress. If the rock cover is too low then the surrounding rock could become unstable and lead to progressive collapse to ground level. It is essential that the minimum rock cover of 8m from ground level to the tunnel crown is maintained. Details of the minimum rock cover analysis are provided in Appendix C.

An empirical method for calculating the width of rock pillars in tunnels and mining was developed by Martin & Maybee (2000) where the width and height of the pillar has a direct relationship the the pillar stress.

Figure D4 shows a summary of empirical data for rock pillars where σc is the Unconfined Compressive Strength (UCS) of the rock. A Factor of Safety (FOS) = 1.4 line will be used for the Lackagh Tunnel calculation. As illustrated in Figure D4, a FOS of 1.4 is aconservative approach.

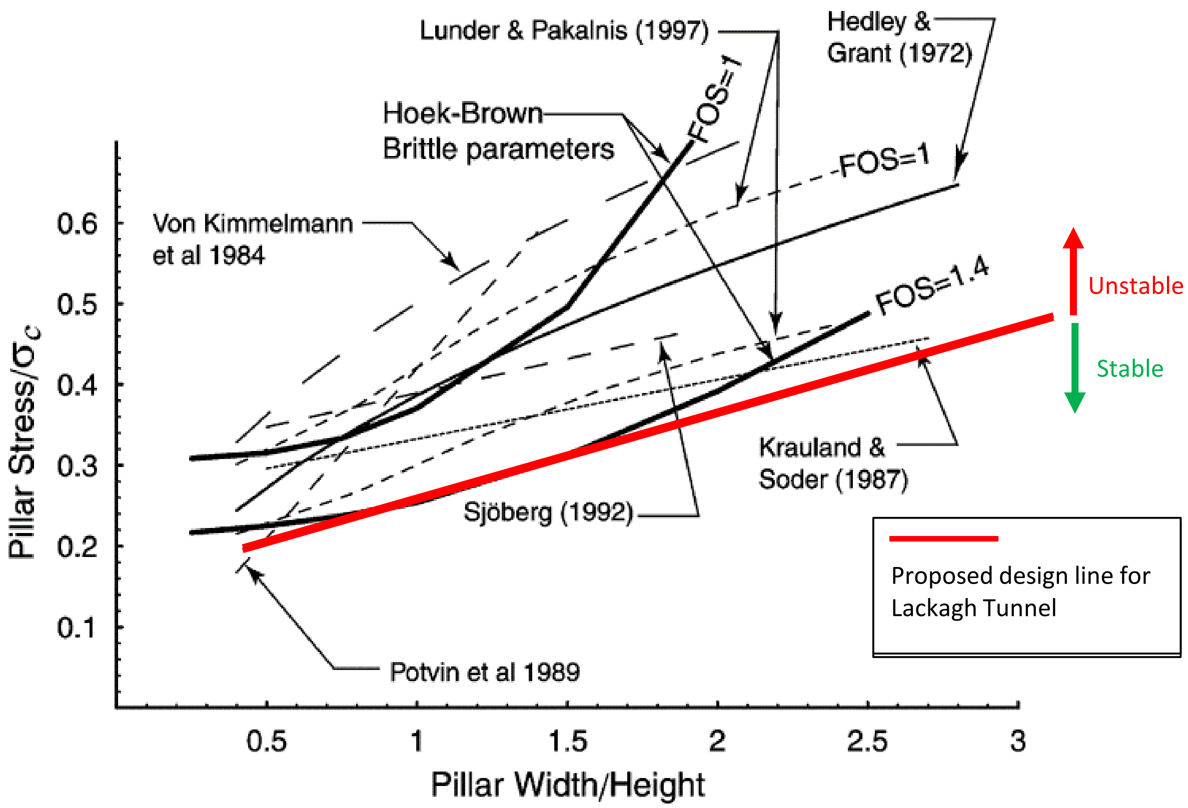

Figure D4 - Hard rock pillar design (after Martin & Maybee, 2000)

Inputs: Conservative values for rock strength have been selected to determine the minimum rock pillar width . A factor of safety (FOS) of 2 on the lower bound UCS values has been used. This ensures that the rock pillar will remain stable during the temporary and permanent works. Figure D5 illustrates a plot of the UCS strength values versus depth below ground level.

UCS and point load laboratory test results from 69 samples that were taken from the Lackagh Tunnel site specific ground investigation are presented in Figure D5 . Based on this information an unconfined compressive strength (UCS) of 15MPa is used in the calculation, this value is the lower bound UCS value.

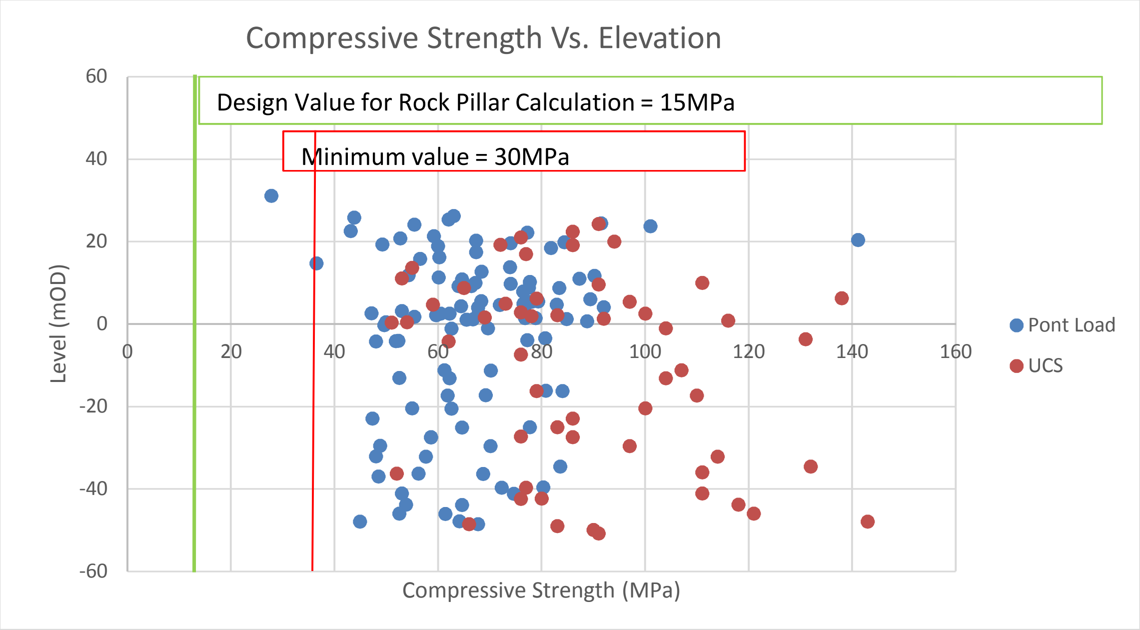

Figure D4 - Compressive strength of rock Vs. Sample level (mOD)

Calculation: *Calculation Input:*

Tunnel span	16	m	(At the widest tunnel span to extrados)
Tunnel height	10.2	m	(At centre to extrados)
Unconfined compressive strength	15	Mpa	(Assumed damaged)
Unit weight of limestone rock	27	kN/m^3	

The above design values are applicable only to Lackagh Tunnel.

Based on the alignment and geology the range of rock cover is expected

Highest calculated rock cover above tunnel crown	20	m
Minimum calculated rock cover above tunnel crown	8	m

Results

Table D1 - Hard rock pillar design (after Martin & Maybee, 2000)

Separation	Stress at Invert (kPa)		Width	Stress/UCS	
(m)	20m	8m	/Height	20m	8m
20	1468	885	2.0	0.10	0.06
19	1502	905	1.9	0.10	0.06
18	1540	928	1.8	0.10	0.06
17	1583	954	1.7	0.11	0.06
16	1631	983	1.6	0.11	0.07
15	1685	1016	1.5	0.11	0.07
14	1747	1053	1.4	0.12	0.07
13	1819	1096	1.3	0.12	0.07
12	1903	1147	1.2	0.13	0.08
11	2001	1206	1.1	0.13	0.08
10	2120	1278	1.0	0.14	0.09
9	2265	1365	0.9	0.15	0.09
8	2446	1474	0.8	0.16	0.10
7	2679	1615	0.7	0.18	0.11 *
6	2990	1802	0.6	0.20	0.12
5	3425	2064	0.5	0.23	0.14
4	4077	2457	0.4	0.27	0.16
3	5164	3112	0.3	0.34	0.21
2	7339	4423	0.2	0.49	0.29
1	13862	8354	0.1	0.92	0.56

*Critical point for pillar width

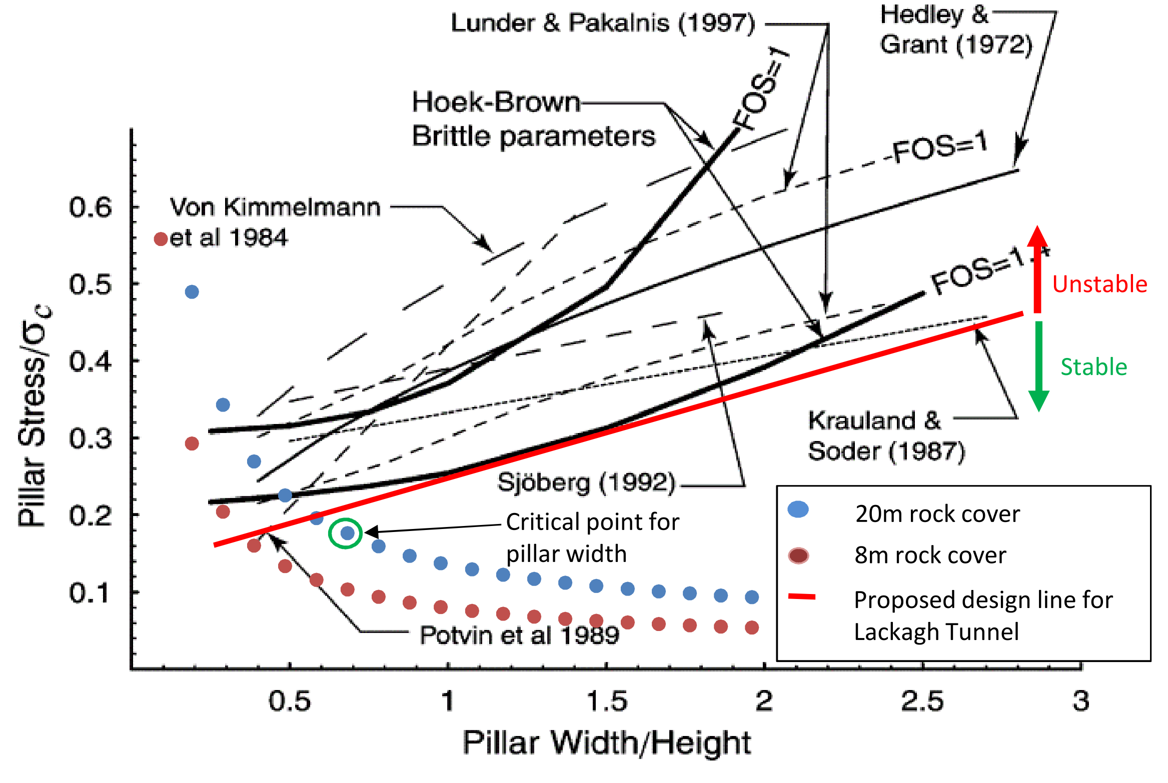

Figure D6: Pillar Stress versus pillar width/height

Table D1 and Figure D6 show the stress in the pillar for each separation from 1-20m. The resulting Width/Height (W/H) values and stress/UCS values are plotted above.

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From the above analysis, the minimum separation between the two bores is 7m, as this is the lowest separation which results in a stable point plotted in Figure D6 (highlighted in green).

References

Martin & Maybee (2000), The Strength of Hard Rock Pillars. International Journal of Rock Mechanics and Mining Sciences 37 (2000) 1239-1246.

Guideline for the Geotechnical Design of Underground Structures with Conventional Excavation, Austrian Society of Geomechanics (2010)

Marcher & Aydogmus (2013). Some Aspects on the Design of Near Surface Tunnels - Theory and Practice. - 6th Colloquium Rock Mechanics "Theory and Practice", Vienna 2013

Appendix E

Drill and blast assessment

E1

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	Member/Location			
Job Title	N6 Galway City Ring Road	Drg. Ref.	Appendix E	
Calculation	Appendix E: Blasting assessment	Made by PS	Date 02/06/2016	Chd. PC

Introduction: Section 2, Lackagh Tunnel, is expected to be excavated by mined (drill and blast) methods. This note is prepared to demonstrate that there will be no impact to the Lough Corrib cSAC at ground surface from the effects of blasting. This note also demonstrates the blasting limitations due to vibration limits on sensitive receptors.

Geology: The Lackagh Tunnel is expected to be excavated entirely through limestone rock as shown in Figure E1.

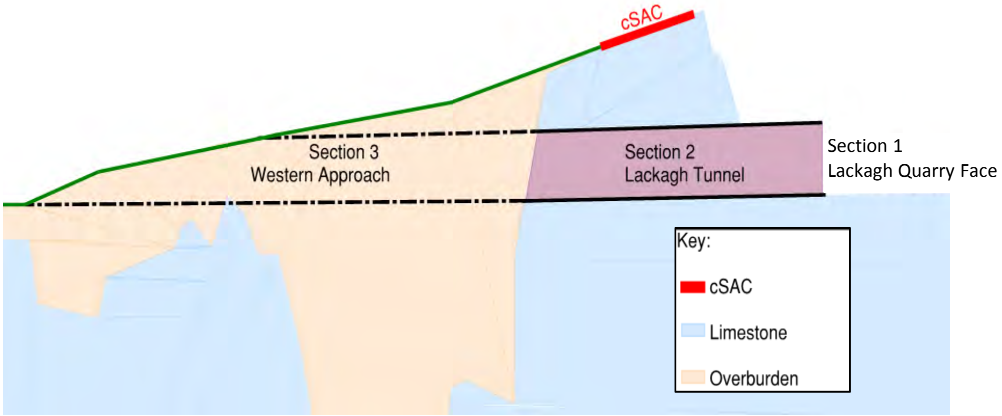

Figure E1 - Schematic geological section showing Lackagh Tunnel and Lough Corrib cSAC

The minimum rock cover at Lough Corrib cSAC is approximately 13m, however a minimum rock cover of 8m (Appendix C) is used for this blast assessment.

An equation for calculating the peak particle velocity due to blasting is shown below (from US Bureau of Mines):

Equation E1: $PPV = K \cdot (R / \sqrt{W})^{-B}$

Where:

PPV is the predicted peak particle velocity (mm/sec)
K is the rock transmission constant
R is the distance between the blast and the monitoring point (m)
W is the maximum charge weight per interval (kg)
B is the attenuation exponent

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The common practice to reduce vibration is to introduce a sequential blast pattern with a delay between successive blasts, generally 8 milliseconds delay is standard. Having successive blasts leads to lower blast vibrations. An example successive blast pattern is shown in Figure E2.

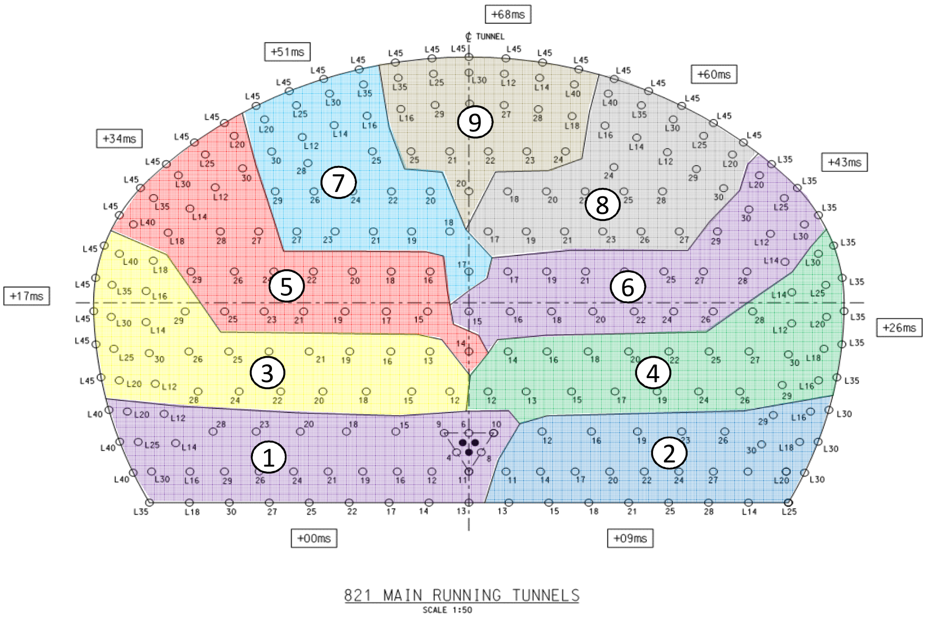

Figure E2 - Example blast pattern and sequence for a rail tunnel in Hong Kong (XRL C821)

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Calculation: Appendix E: Blasting assessment	Made by	PS	Date	02/06/2016	Chd.	PC

Assessment: For the Lackagh Tunnel the above method can be used to calculate the maximum instantaneous charge that can be used during drill and blast. There is no guidance on vibration limits for the environments of a Speacil Area of Conservation and as a result typical limits for structures are introduced for the purpose of this calculation. This assessment is based on a vibration limit of 25mm/sec. However during the blasting period the Limestone pavement within Lough Corrib cSAC will be monitored to establish if vibration in excess of 25mm/sec are feasible.

Vibration Limit for Lough Corrib cSAC

A limit of 25mm/sec has been applied below in Table E1. This is based on the recommended criteria for damage to buildings in BS 7385-2:1993 as per clause 7.4.3 Table 1 a 50% reduction is applied.

Typical K and B values (refer to equation E1) have been applied. Site specific values will be determined during trial blasts.

Calculation:

Vibration limit 25 mm/sec
K= 600
B= 1.22

Table E1 - MIC limits in Lackagh tunnel due to cSAC

Distance of the blast from the ground surface (cSAC)	Vibration Limit	Maximum Instantaneous Charge
(m)	(mm/sec)	(kg)
8	25	0.32
9	25	0.41
10	25	0.50
11	25	0.61
12	25	0.72
13	25	0.85
14	25	0.98
15	25	1.13
16	25	1.28
17	25	1.45
18	25	1.62
19	25	1.81
20	25	2.00

Depth from Lough Corrib cSAC ground level to the proposed tunnel crown.

Reference: BS 7385-2:1993 : Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration.

Results: This preliminary blasting assessment shows that for a vibration limit of 25 mm/sec, the Maximum Instantaneous Charge ranges from 0.85kg to 1.28 directly below the Lough Corrib cSAC.

Conclusion: Vibrations of 25mm/sec from blasting are acceptable.

During the blasting period the Limestone pavement will be monitored to establish if vibration in excess of 25mm/sec are feasible.

Appendix G

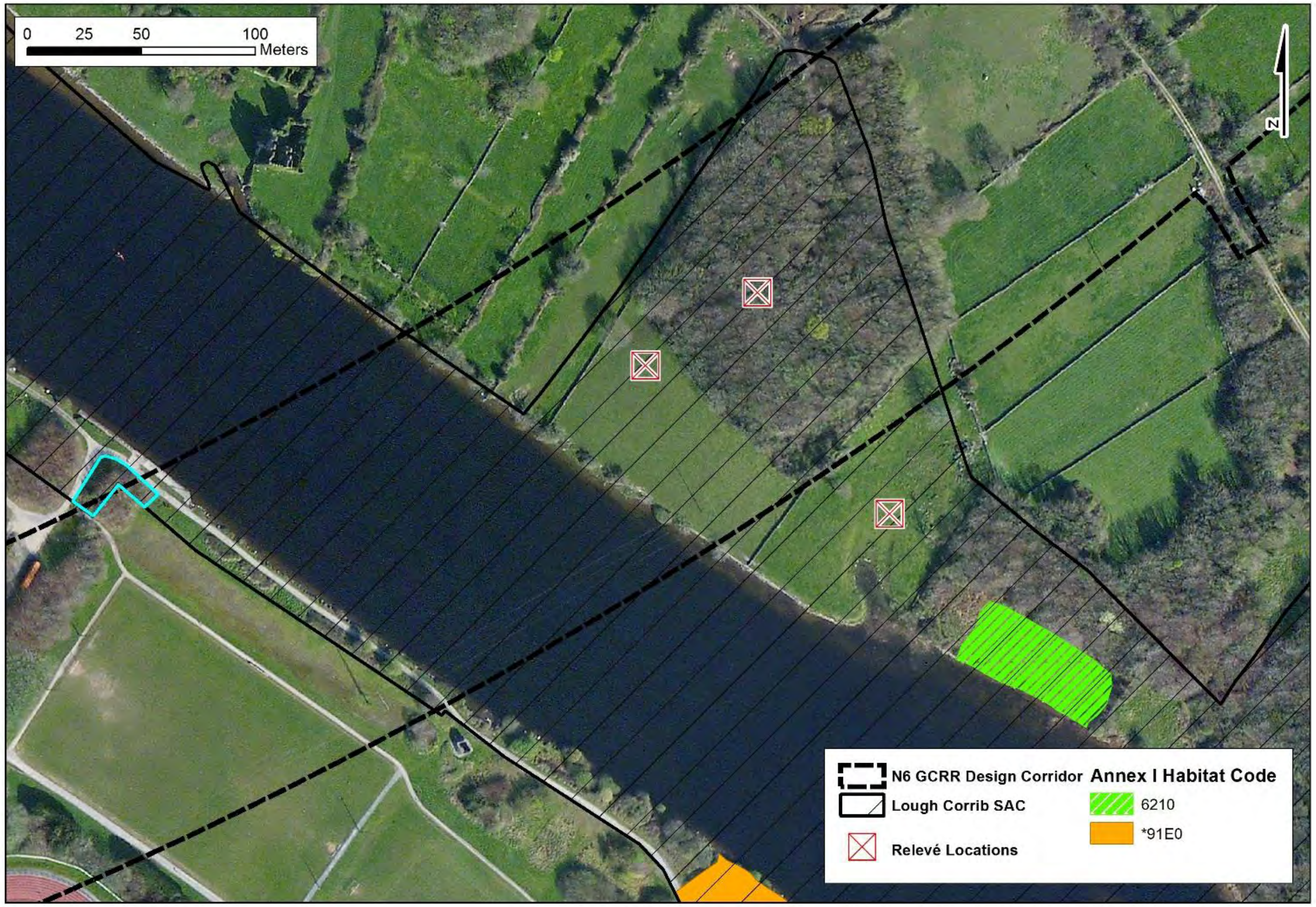
Habitat Information Relating to Lough Corrib SAC

Areas of Potential Habitat Loss within the N6 GCRR Corridor

G1

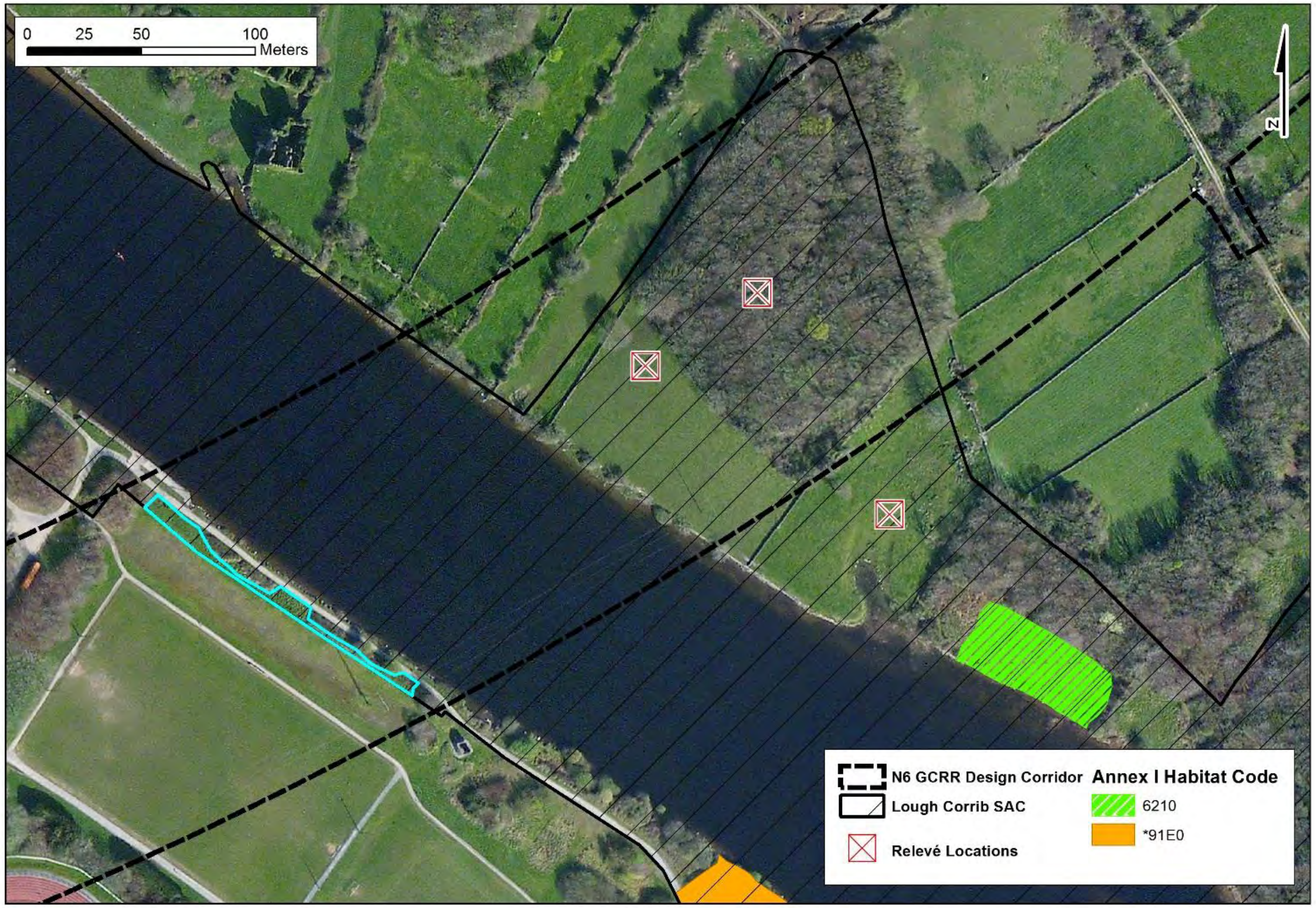
This appendix presents supporting information relating to habitat areas within Lough Corrib SAC where there is a risk of habitat loss as a result of construction works associated with the N6 GCRR project proposed under the GTS.

Figure 1: Description of habitat areas within Lough Corrib SAC at risk of habitat loss as a result of the N6 GCRR – Area 1 (highlighted cyan area)



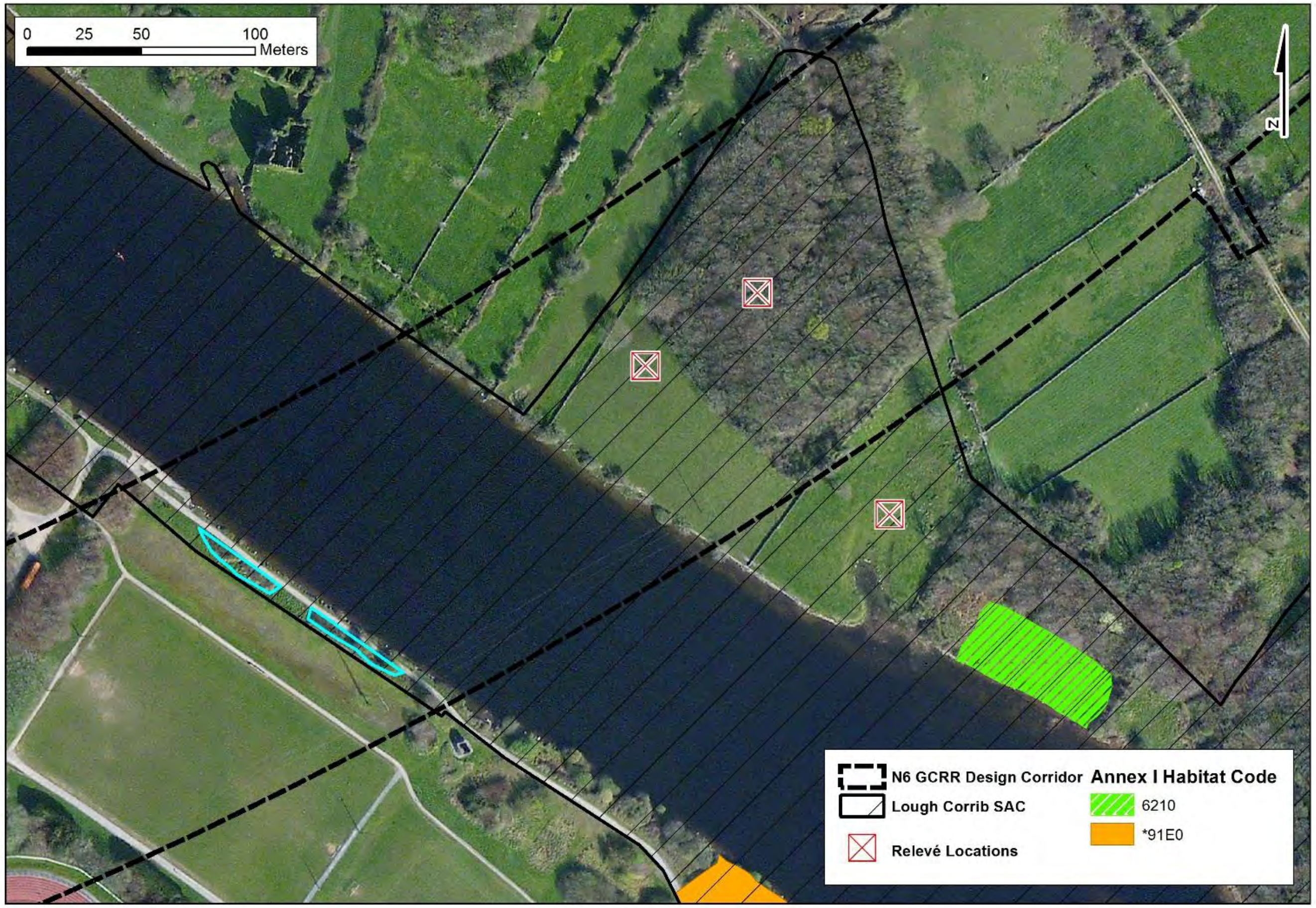
This habitat area highlighted in cyan above corresponded with the Fossitt (2000) category Mixed broadleaved woodland (WD1) and was dominated by Beech *Fagus sylvatica*. This habitat type does not correspond with any Annex I woodland habitat type.

Figure 2: Description of habitat areas within Lough Corrib SAC at risk of habitat loss as a result of the N6 GCRR – Area 2 (highlighted cyan area)



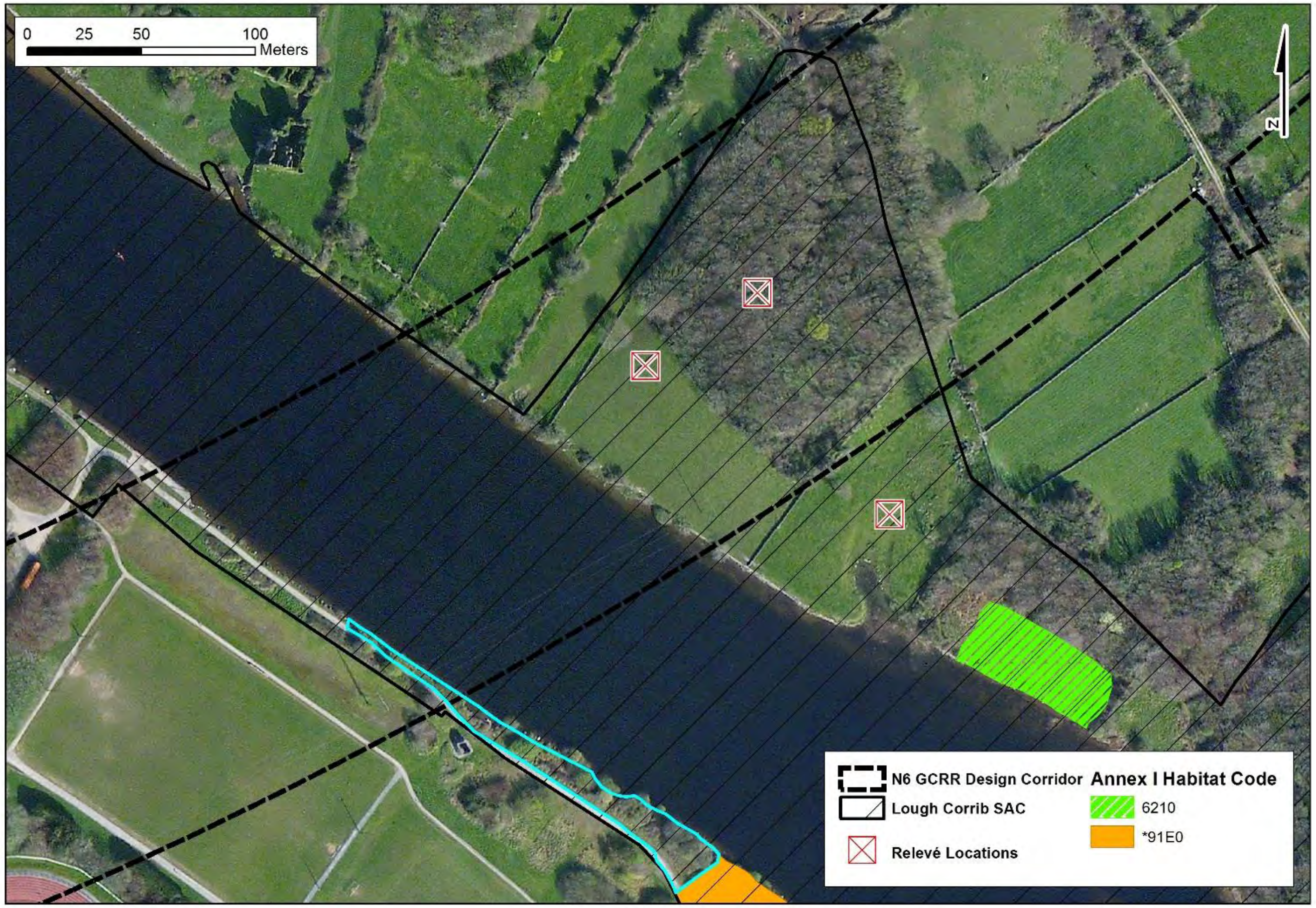
This habitat area highlighted in cyan above corresponded with the Fossitt (2000) category Dry meadows and grassy verges (GS2). Typical species included Cock's-foot *Dactylis glomerata*, False-oat-grass *Arrhenatherum elatius* and Glaucous sedge *Carex flacca*. This habitat area did not correspond with any of the Annex I grassland habitat types.

Figure 3: Description of habitat areas within Lough Corrib SAC at risk of habitat loss as a result of the N6 GCRR – Area 3 (highlighted cyan area)



This habitat area highlighted in cyan above corresponded with the Fossitt (2000) category Scrub (WS1). The scrub was dominated by Bramble *Rubus fruticosus* agg. in association with rank grasses such as Cock's-foot *Dactylis glomerata* and False-oat-grass *Arrhenatherum elatius*, and Great willowherb *Epilobium hirsutum*. This habitat area did not correspond with any of the Annex I grassland habitat types.

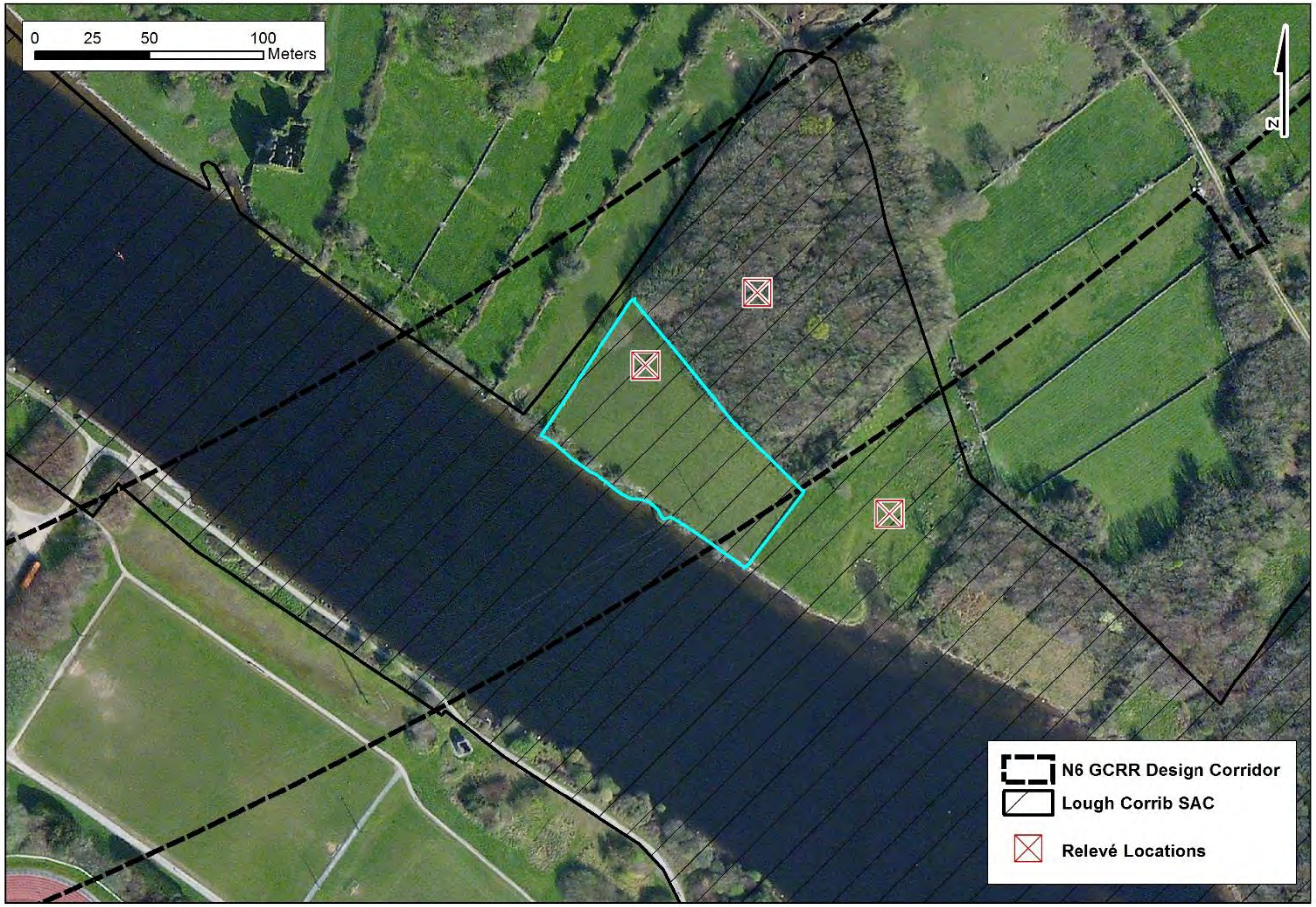
Figure 4: Description of habitat areas within Lough Corrib SAC at risk of habitat loss as a result of the N6 GCRR – Area 4 (highlighted cyan area)



This habitat area highlighted in cyan above corresponded with the Fossitt (2000) category Wet Willow-Alder-Ash Woodland (WN6) and the *Salix cinerea – Equisetum fluviatile* (Grey willow – Water horsetail) vegetation community (WN6_3c). This habitat lacked the requisite ground flora

and structure (and could equally be classified as a treeline) to correspond with the priority Annex I habitat type Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0] which the area to the south-east was classified as.

Figure 5: Description of habitat areas within Lough Corrib SAC at risk of habitat loss as a result of the N6 GCRR – Area 5 (highlighted cyan area)



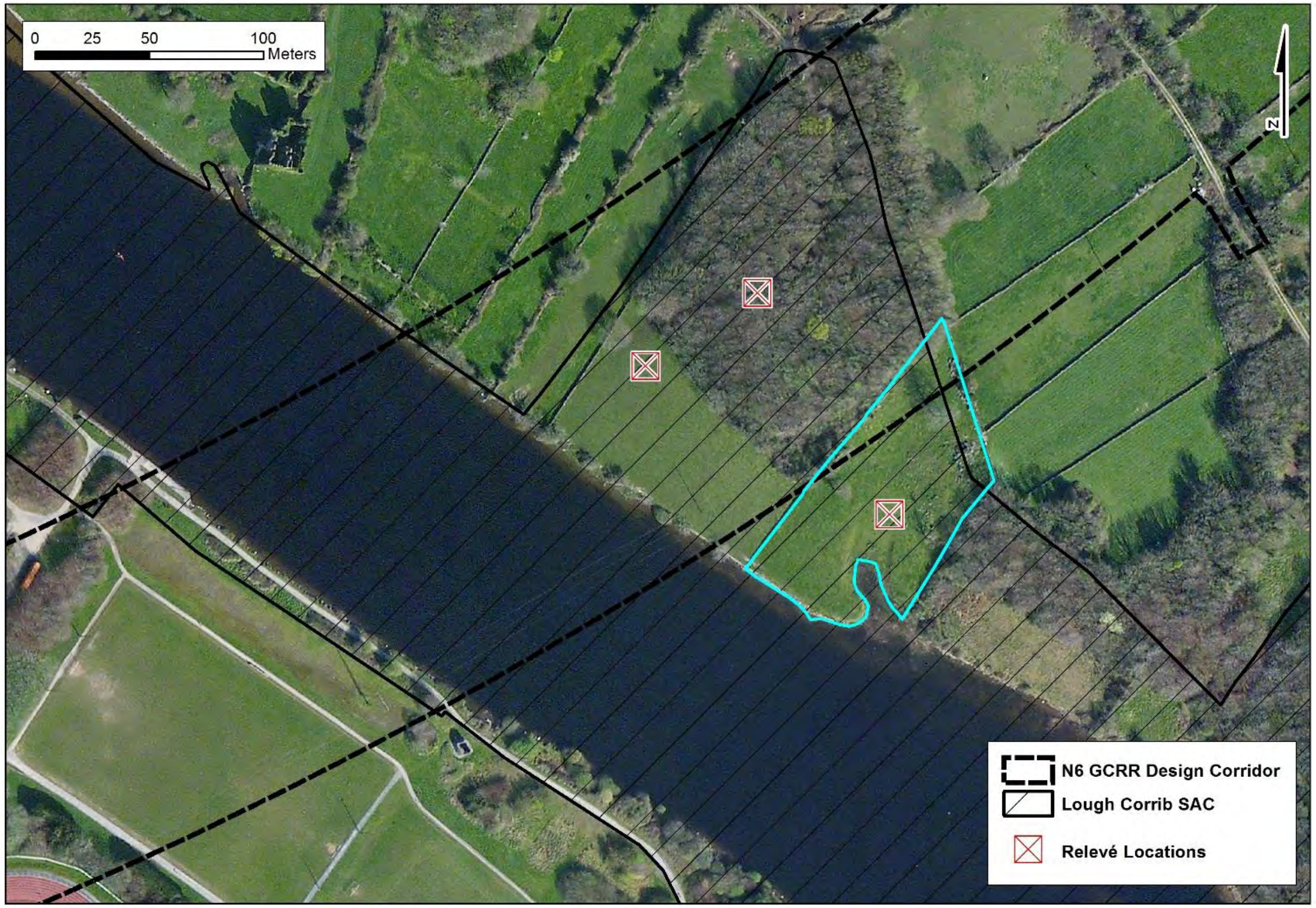
This habitat area highlighted in cyan above corresponded with the Fossitt (2000) category Dry calcareous and neutral grassland (GS1) and the *Cynosurus cristatus – Trifolium repens* (Crested dog's-tail and Red clover) grassland vegetation community (GS1_3b).

This habitat type does not correspond to the (priority) Annex I habitat type Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometea) (* important orchid sites) [6210/*6210] on the basis that it does not support the required species composition for this habitat type. None of the requisite High Quality Positive Indicator Species nor any of the required seven Positive Indicator Species were present. Table 1 below is a record of the plant species recorded in a relevé recorded here.

Table 1: Species list for the habitat area shown on Figure 5

Species	% Cover	Species	% Cover
Lolium perenne	50	*Carex hirta*	3
Ranunculus repens	40	*Rumex acetosa*	1
Trifolium repens	30	*Holcus lanatus*	1
Trifolium pratense	20	*Dactylis glomerata*	1
Festuca rubra	15	*Centaurea nigra*	1
Cynosurus cristatus	10	*Agrostis stolonifera*	1
Ranunculus acris	5	*Calliergonella cuspidata*	0.5
Plantago lanceolata	5	*Carex disticha*	0.3
Taraxacum officinale agg.	3	*Elytrigia repens*	0.1
Rumex crispus	3	*Cerastium fontanum*	0.1

Figure 6: Description of habitat areas within Lough Corrib SAC at risk of habitat loss as a result of the N6 GCRR – Area 6 (highlighted cyan area)



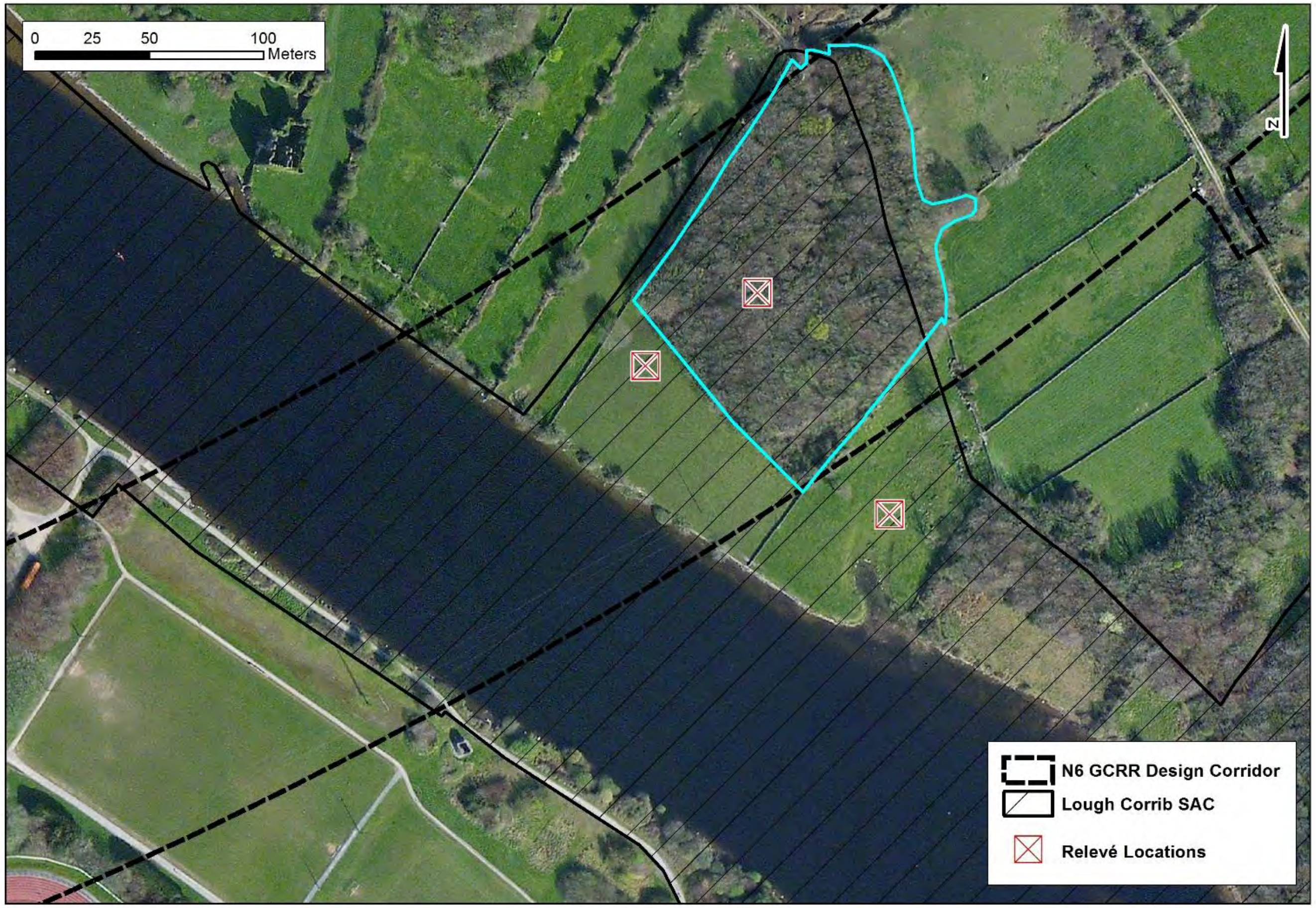
This habitat area highlighted in cyan above corresponded with the Fossitt (2000) category Dry calcareous and neutral grassland (GS1) and the *Cynosurus cristatus – Trifolium pratense* (Crested dog's-tail and Red clover) grassland vegetation community (GS1_3d).

This habitat type does not correspond to the (priority) Annex I habitat type *Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometea) (* important orchid sites)* [6210/*6210] on the basis that it does not support the required species composition for this habitat type. None of the requisite High Quality Positive Indicator Species for were present and only one of the requisite seven Positive Indicator Species was present. Table 2 below is a record of the plant species recorded in a relevé recorded here—indicator species for the Annex I habitat type are highlighted in **bold** font.

Table 2: Relevé data and species list for the Habitat area shown on Figure 6

Species	% Cover	Species	% Cover
Festuca rubra	20	*Ranunculus repens*	3
Rhytidiadelphus squarrosus	15	*Rumex obtusifolius*	3
Holcus lanatus	10	*Bellis perennis*	1
Plantago lanceolata	10	*Cerastium fontanum*	1
Ranunculus acris	7	*Luzula campestris*	1
Trifolium pratense	7	*Medicago lupulina*	1
Agrostis capillaris	5	*Prunella vulgaris*	1
Anthoxanthum odoratum	5	*Taraxacum officinale* agg.	1
Cynosurus cristatus	5	*Tortella tortuosa*	1
Lolium perenne	5	*Trifolium repens*	1
Calliergonella cuspidata	3	***Carex flacca***	0.5
Cirsium arvense	3		

Figure 7: ***Description of habitat areas within Lough Corrib SAC at risk of habitat loss as a result of the N6 GCRR – Area 7 (highlighted cyan area)***

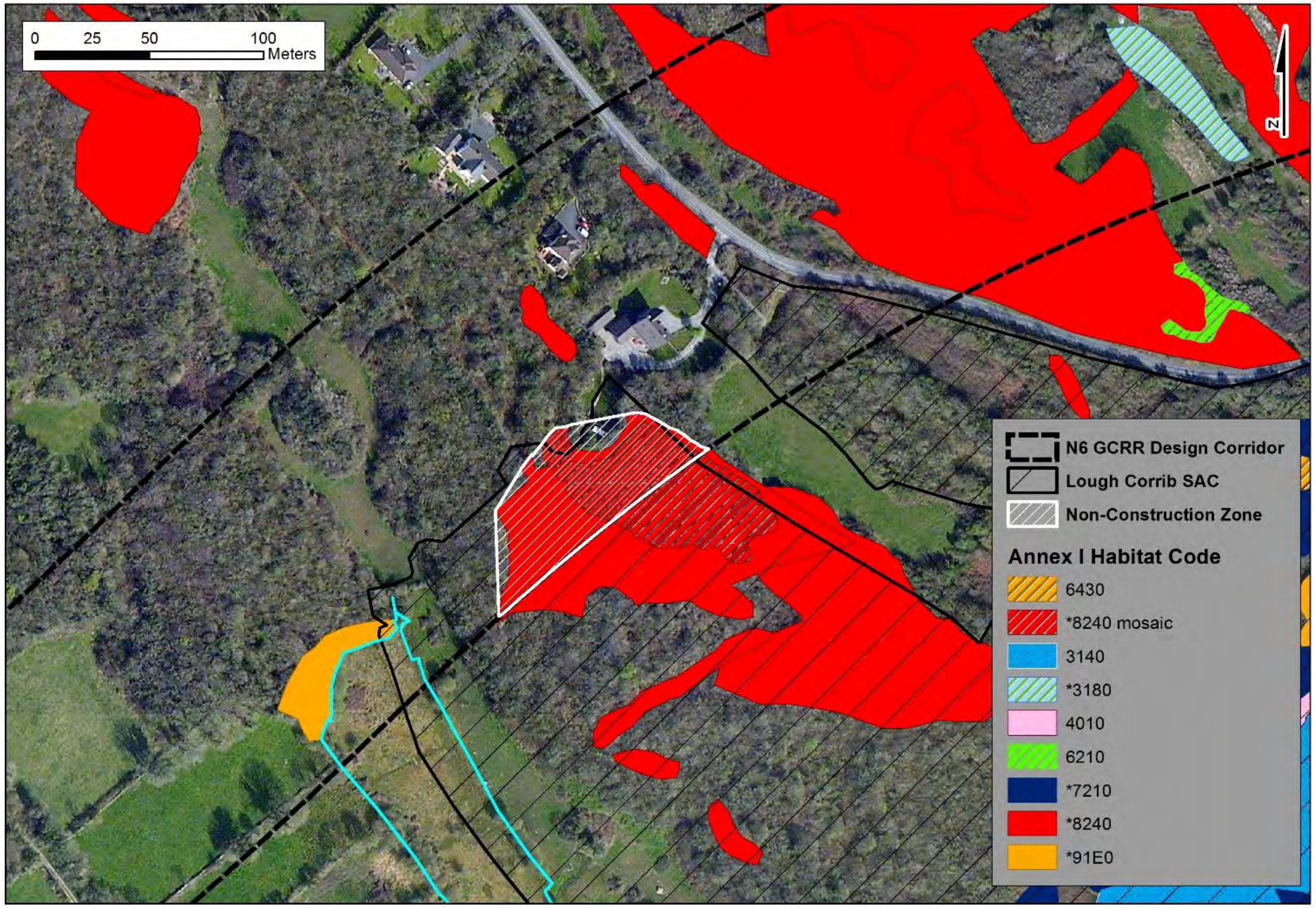


This habitat area highlighted in cyan above corresponded with the Fossitt (2000) category Mixed broadleaved woodland (WD1) and the *Fagus sylvatica – Prunus laurocerasus* (Beech and Cherry laurel) vegetation community (WD1_2f). This habitat type does not correspond with any Annex I woodland habitat types.

Table 3: Species list for the Habitat area shown on Figure 7

Species	**% Cover**	**Species**	**% Cover**
Fagus sylvatica	80	*Kindbergia praelonga*	0.1
Ilex aquifolium	50	*Lejeunea cavifolia*	0.1
Thamnobryum alopecurum	15	*Metzgeria furcata*	0.1
Fraxinus excelsior	10	*Neckera complanata*	0.1
Isothecium alopecuroides	0.3	*Radula complanata*	0.1
Arum maculatum	0.1	*Rhynchostegiella tenella*	0.1
Hedera helix	0.1	*Tortella tortuosa*	0.1

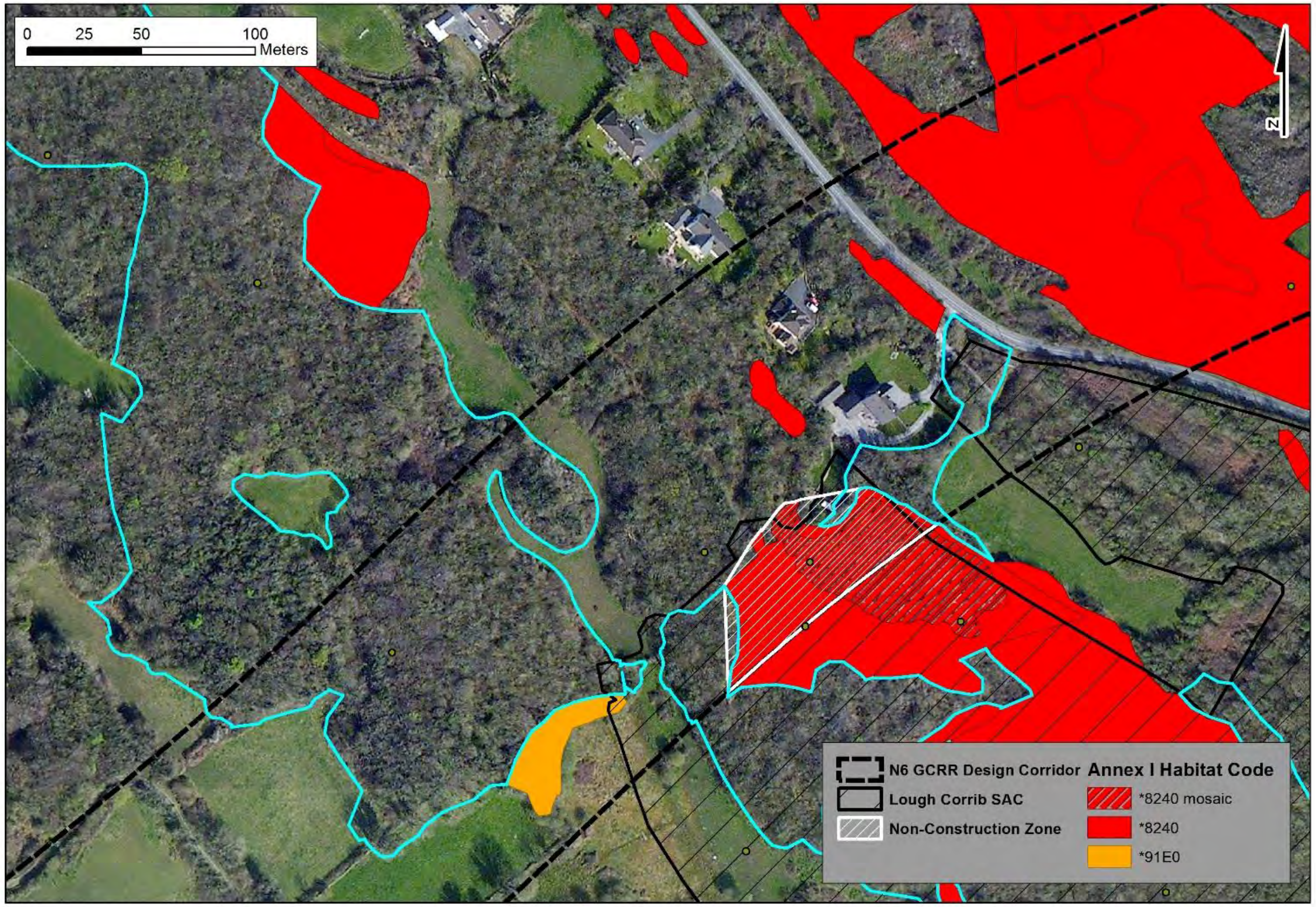
***Figure 8:* Description of habitat areas within Lough Corrib SAC at risk of habitat loss as a result of the N6 GCRR – Area 8 (highlighted cyan area)**



This habitat area highlighted in cyan above corresponded with the Fossitt (2000) category Wet grassland (GS4) and the *Juncus effusus – Holcus lanatus* (Soft rush – Yorkshire fog) grassland vegetation community (GS4_2b). Typical species included Soft rush, Yorkshire fog, Creeping bent

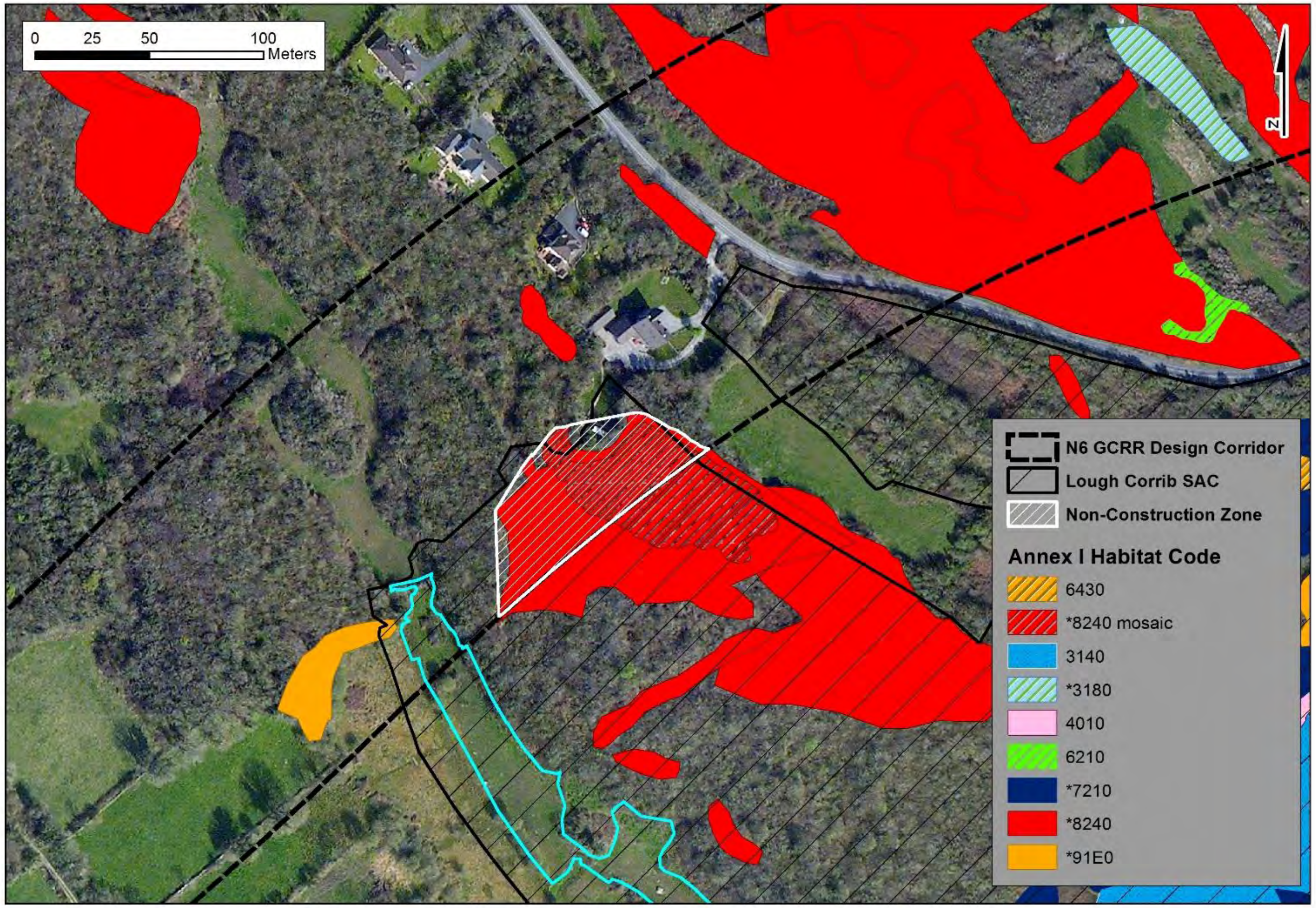
Agrostis stolonifera, Marsh thistle *Cirsium palustre* and Purple loosestrife *Lythrum salicaria*. This habitat did not correspond with any Annex I habitat types.

Figure 9: ***Description of habitat areas within Lough Corrib SAC at risk of habitat loss as a result of the N6 GCRR – Area 8 (highlighted cyan area)***



These habitat areas highlighted in cyan above corresponded with the Fossitt (2000) category Oak-Ash-Hazel Woodland (WN2) and the *Corylus avellana* – *Oxalis acetosella* (Hazel – Wood-sorrel) vegetation community (WN2_2e). Typical species included Ash, Hazel, Ivy, Blackthorn, Pedunculate oak *Quercus robur*, Holly *Ilex aquifolium*, Sycamore *Acer pseudoplatanus* and Honeysuckle *Lonicera periclymenum*. These woodlands lacked the thin soils cover and cover of exposed limestone rock beneath the woodland canopy (i.e. minimal soil depth over at least 50% of the habitat) to qualify as the wooded variant of the priority Annex I habitat type Limestone pavements [*8240].

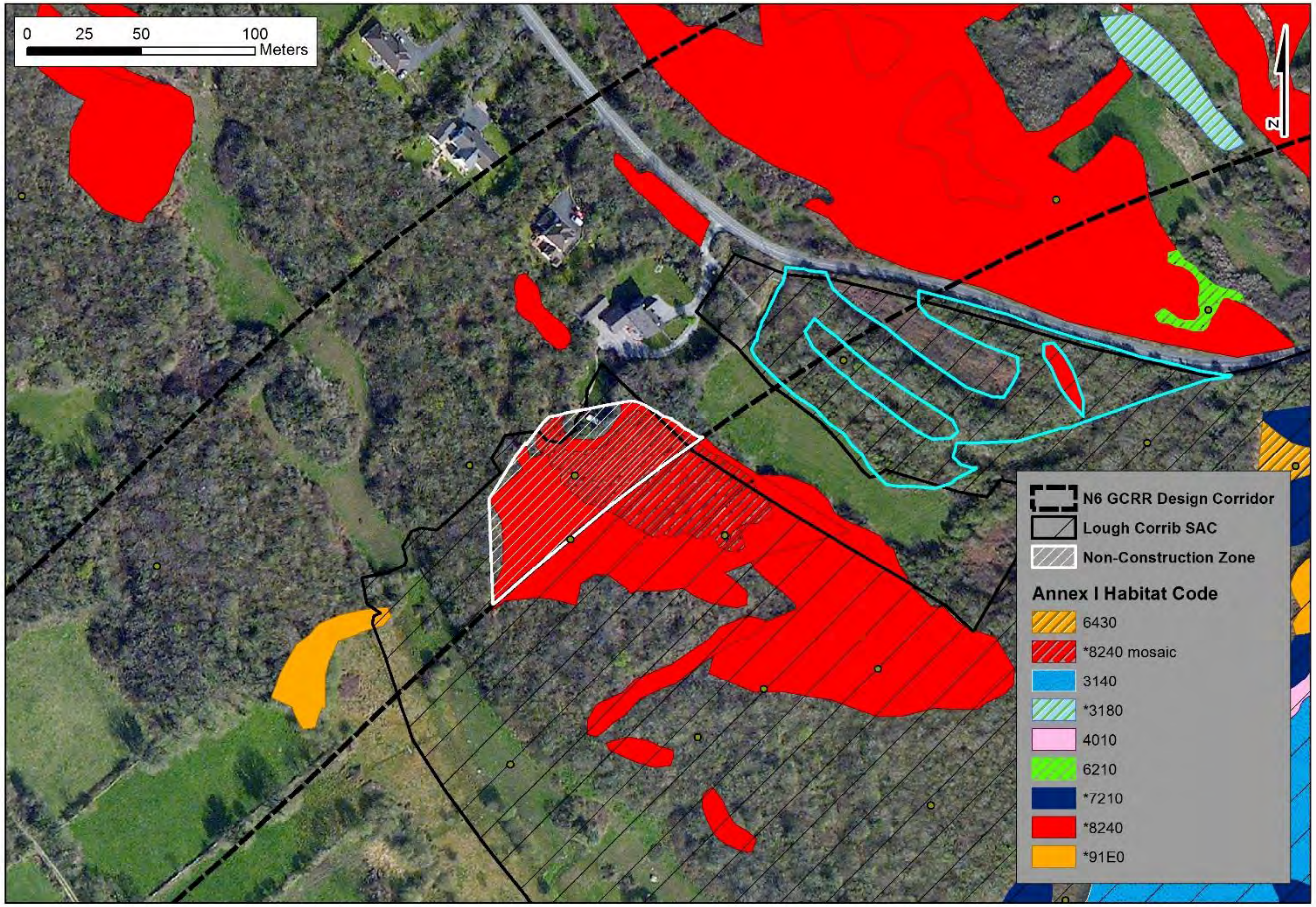
Figure 10: ***Description of habitat areas within Lough Corrib SAC at risk of habitat loss as a result of the N6 GCRR – Area 9 (highlighted cyan area)***



These habitat areas highlighted in cyan above corresponded with the Fossitt (2000) category Dry calcareous and neutral grassland (GS1) and the *Holcus lanatus* – *Lolium perenne* grassland vegetation community (GS1_2c). The sward was dominated by Yorkshire fog with other typical species

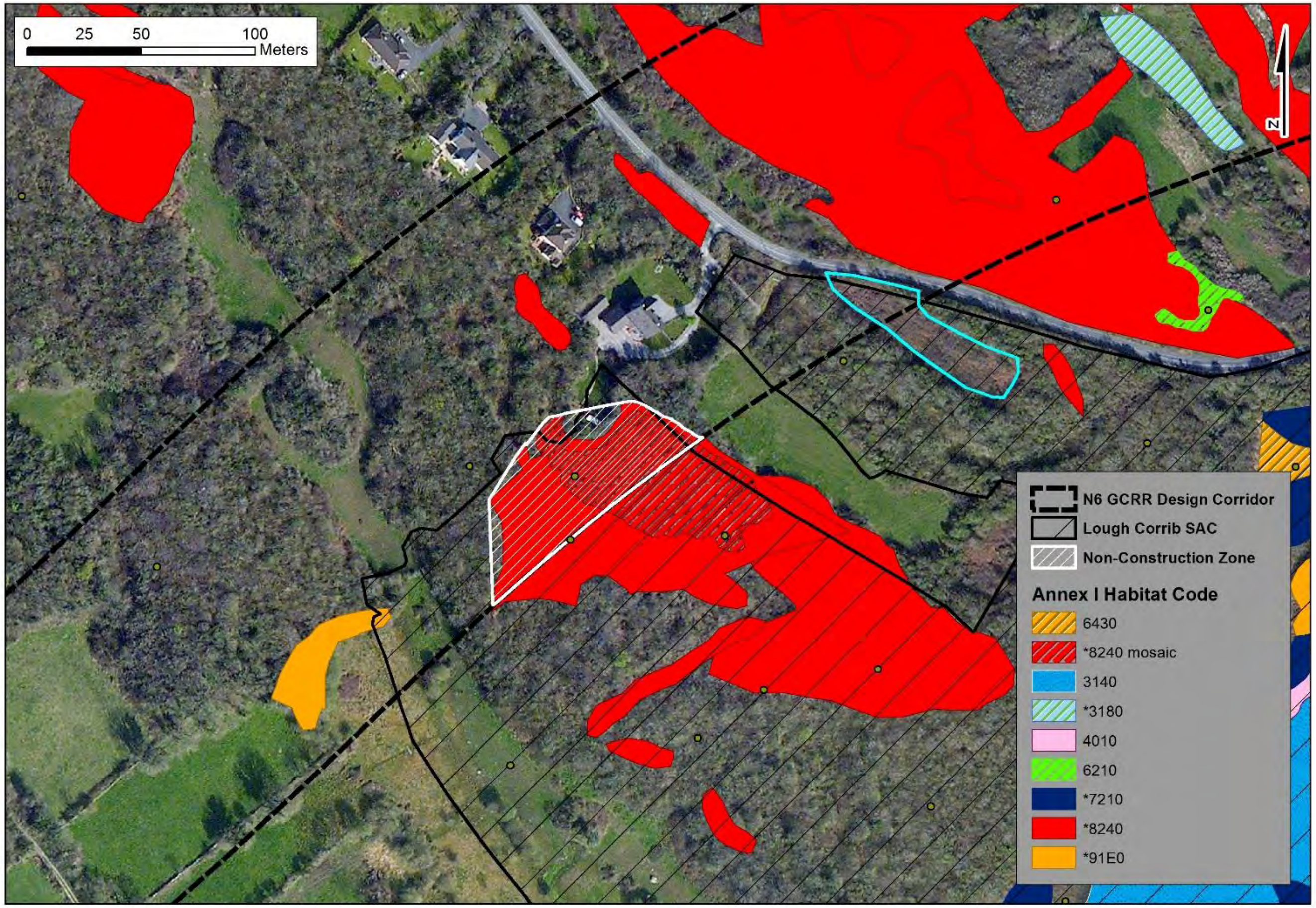
such as Creeping bent, White clover, Creeping buttercup *Ranunculus repens*, and Ribwort plantain present. This habitat does not correspond with any Annex I grassland habitat types.

Figure 11: Description of habitat areas within Lough Corrib SAC at risk of habitat loss as a result of the N6 GCRR – Area 10 (highlighted cyan area)



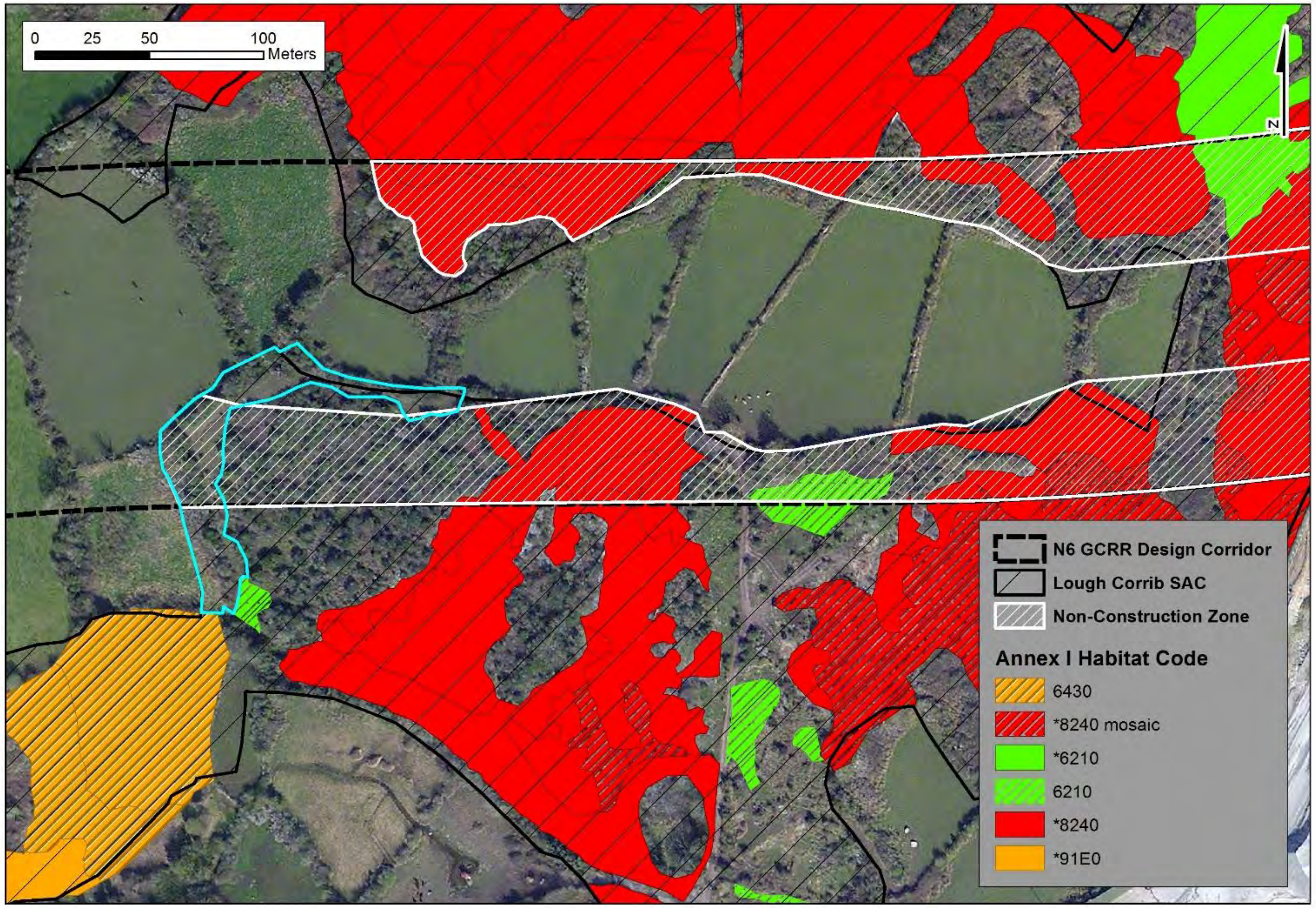
These habitat areas highlighted in cyan above corresponded with the Fossitt (2000) category Oak-Ash-Hazel Woodland (WN2) and the *Corylus avellana – Oxalis acetosella* (Hazel – Wood-sorrel) vegetation community (WN2_2e). Typical species included Hazel, Ash, Ivy, Blackthorn, Pedunculate oak *Quercus robur*, Holly *Ilex aquifolium*, Sycamore *Acer pseudoplatanus* and Honeysuckle *Lonicera periclymenum*. These woodlands lacked the thin soils cover and cover of exposed limestone rock beneath the woodland canopy (i.e. minimal soil depth over at least 50% of the habitat) to qualify as the wooded variant of the priority Annex I habitat type Limestone pavements [*8240].

Figure 12: Description of habitat areas within Lough Corrib SAC at risk of habitat loss as a result of the N6 GCRR – Area 11 (highlighted cyan area)



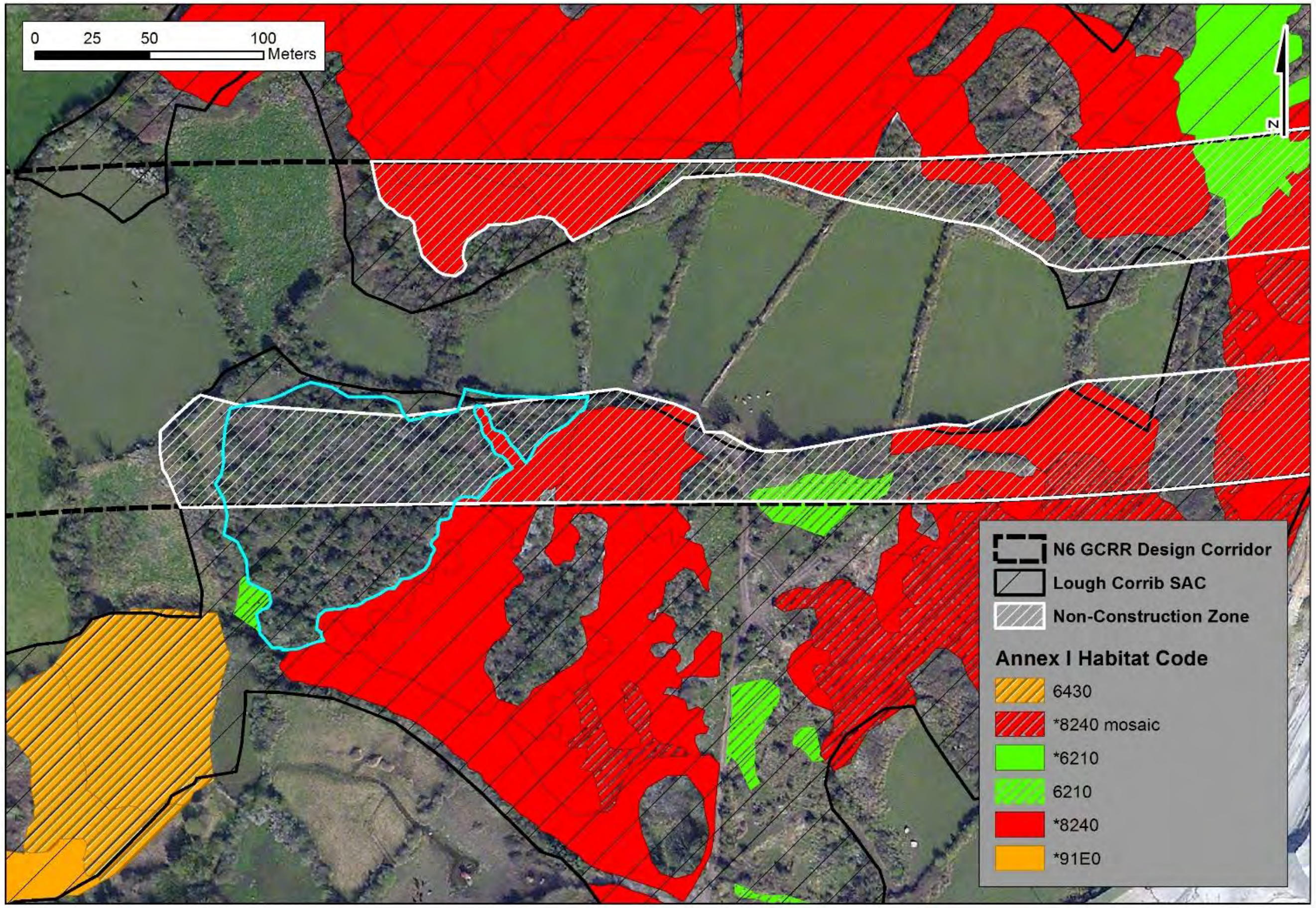
This habitat area corresponded with the Fossitt (2000) category Scrub (WS1) and was dominated by Blackthorn. Other typical species included Bramble, Ivy and Bracken *Pteridium aquilinum*. This habitat does not correspond with any Annex I woodland habitat types.

Figure 13: Description of habitat areas within Lough Corrib SAC at risk of habitat loss as a result of the N6 GCRR – Area 12 (highlighted cyan area)



This habitat area highlighted in cyan above comprised a mosaic of the Fossitt (2000) categories Treelines (WL2) and Scrub (WS1) with some Dry meadows and grassy verges (GS2), and Spoil and Bare Ground (ED2) habitats associated with it. Typical species of the treeline/scrub were Ash, Blackthorn and Bramble. This habitat does not correspond with any Annex I habitat types.

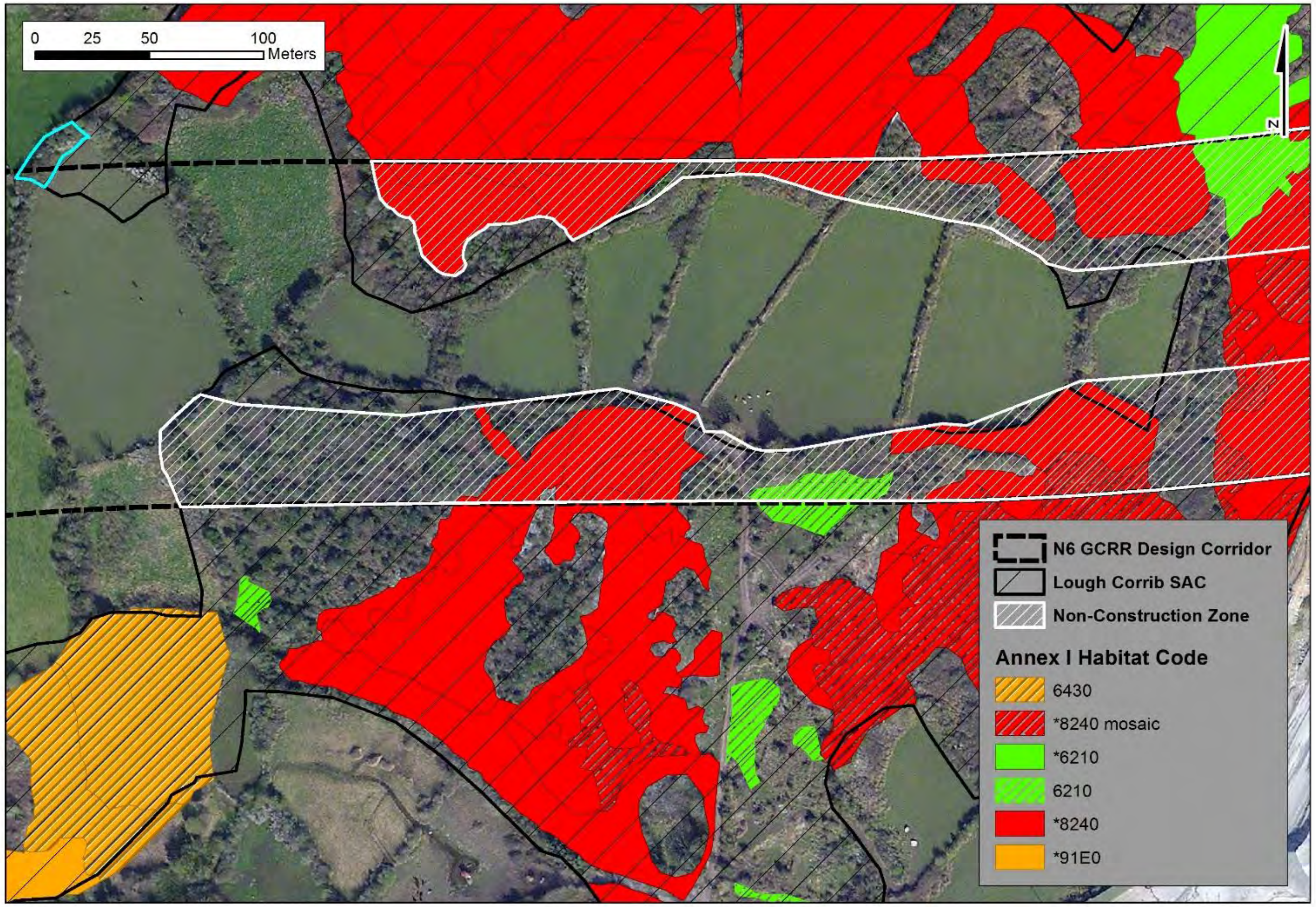
Figure 14: Description of habitat areas within Lough Corrib SAC at risk of habitat loss as a result of the N6 GCRR – Area 13 (highlighted cyan area)



This habitat area corresponded with the Fossitt (2000) category Oak-Ash-Hazel Woodland (WN2) and the *Corylus avellana* – *Oxalis acetosella* (Hazel – Wood-sorrel) vegetation community (WN2_2e). Typical species included Ash, Hazel, Hawthorn and bramble. This woodland lacked the

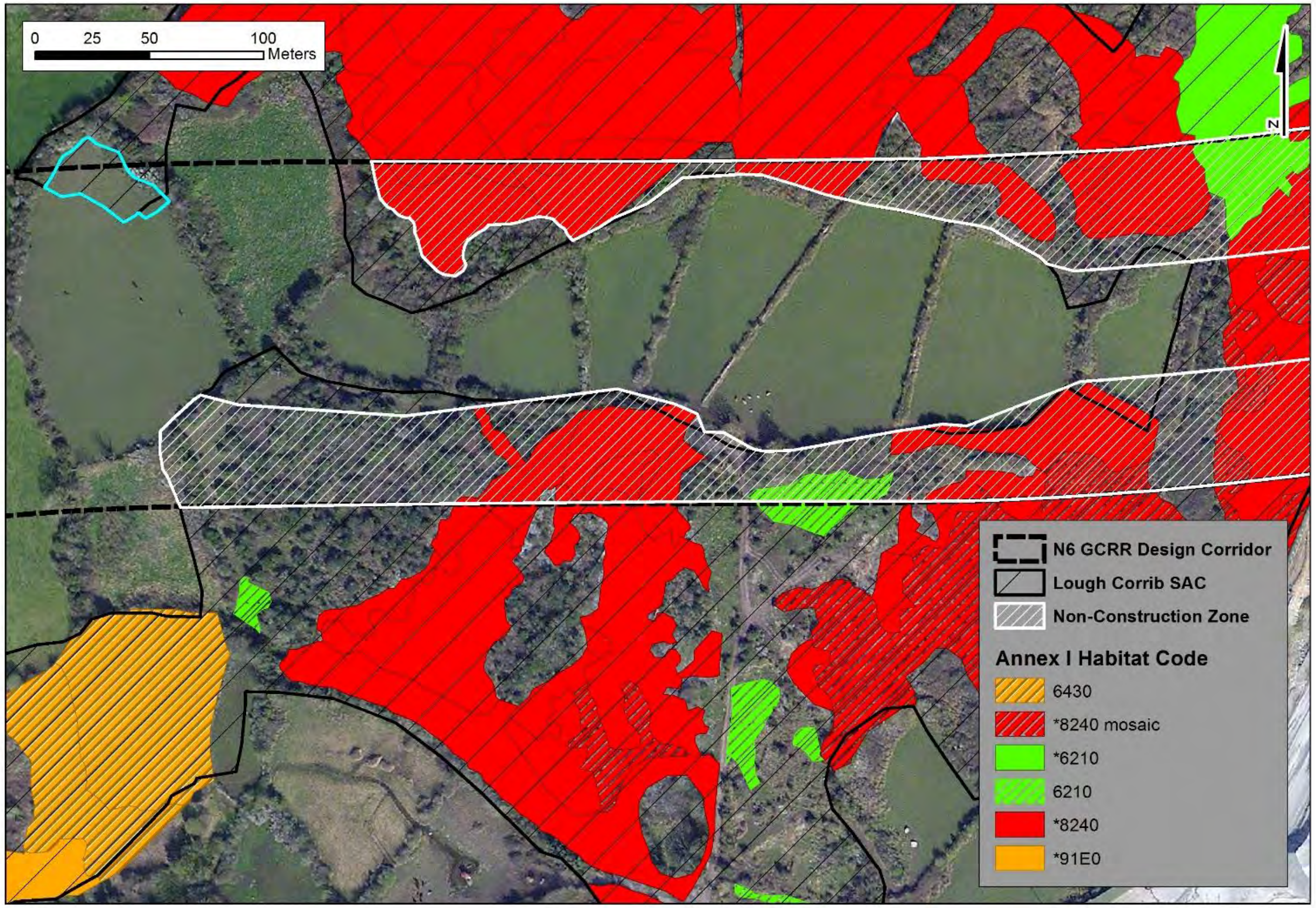
thin soil cover and cover of exposed limestone rock beneath the woodland canopy (i.e. minimal soil depth over at least 50% of the habitat) to qualify as the wooded variant of the priority Annex I habitat type Limestone pavements [*8240].

Figure 15: Description of habitat areas within Lough Corrib SAC at risk of habitat loss as a result of the N6 GCRR – Area 14 (highlighted cyan area)



This habitat area highlighted in cyan above corresponded with the Fossitt (2000) category Treelines (WL2). Typical species included Blackthorn, Hazel and Bramble. This habitat does not correspond with any Annex I habitat types.

Figure 16: Description of habitat areas within Lough Corrib SAC at risk of habitat loss as a result of the N6 GCRR – Area 15 (highlighted cyan area)



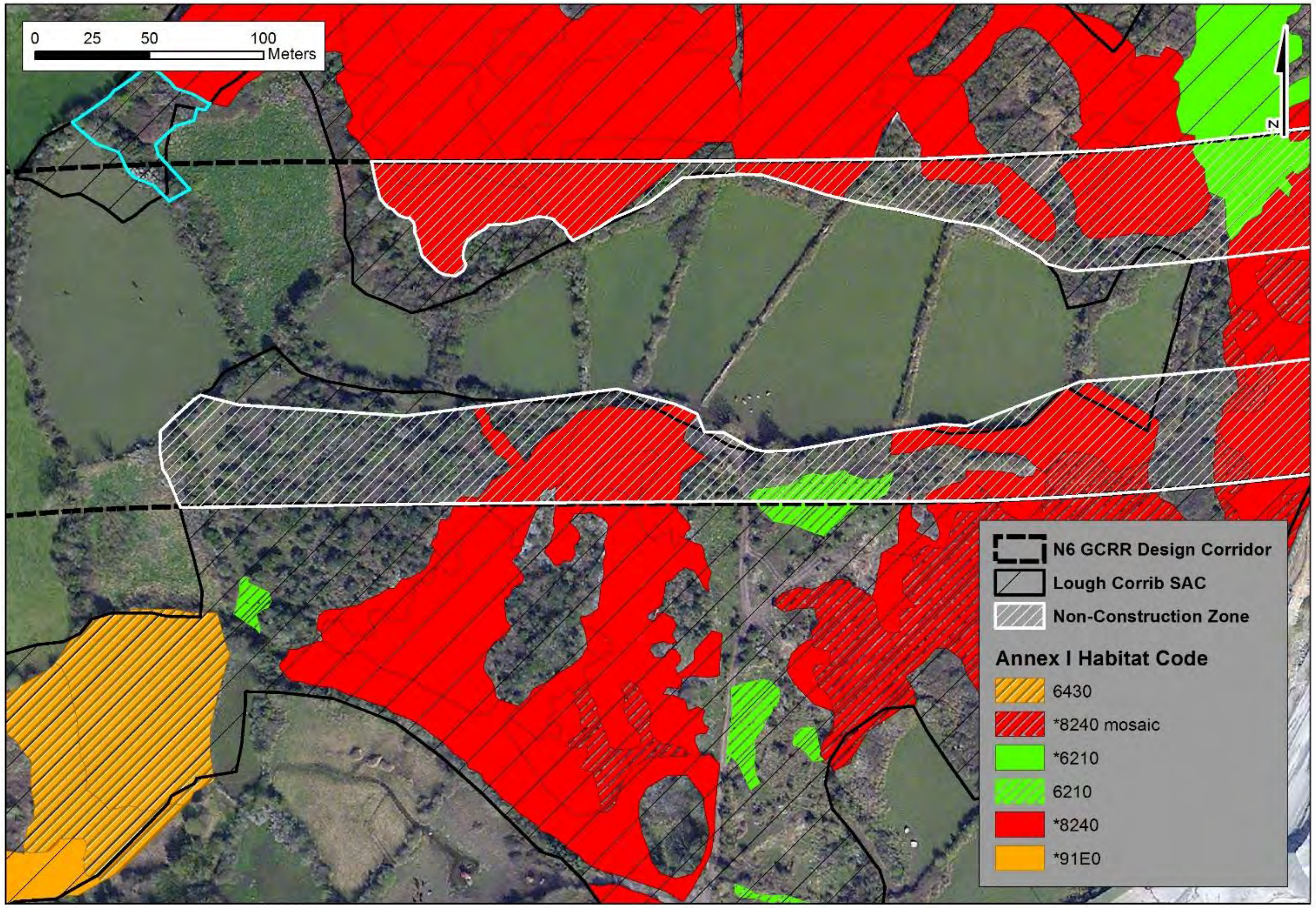
This habitat area corresponded with the Fossitt (2000) category Dry calcareous and neutral grassland (GS1) and the *Cynosurus cristatus – Trifolium pratense* (Crested dog's-tail and Red clover) grassland vegetation community (GS1_3d).

This habitat type does not correspond to the (priority) Annex I habitat type *Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometea) (* important orchid sites)* [6210/*6210] on the basis that it does not support the required species composition for this habitat type. None of the requisite High Quality Positive Indicator Species for were present and only two of the requisite seven Positive Indicator Species were present. Table 4 below is a record of the plant species recorded in the grassland fields in this location—indicator species for the Annex I habitat type are highlighted in **bold** font.

Table 4: Species list for the Habitat area shown on Figure 15

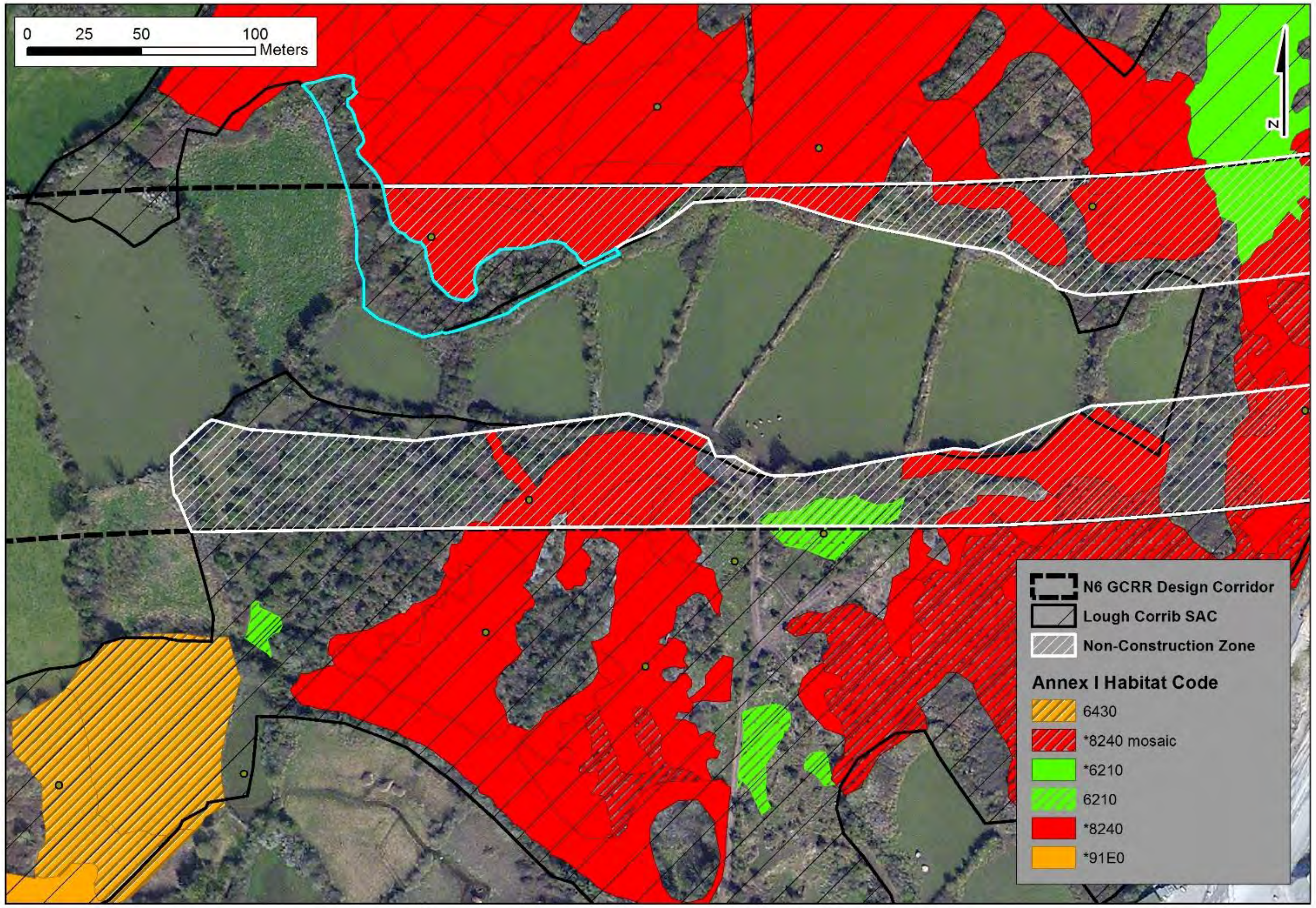
Species	Species
Agrostis stolonifera	***Lotus corniculatus***
Crepis capillaris	*Lolium perenne*
Senecio jacobaea	*Plantago lanceolata*
Centaurea nigra	*Prunella vulgaris*
Cerastium fontanum	*Ranunculus acris*
Cirsium arvense	*Ranunculus repens*
Cynosurus cristatus	*Taraxacum officinale* agg.
Dactylis glomerata	*Trifolium pratense*
Festuca rubra	*Potentilla anserina*
Daucus carota	*Trifolium repens*
Holcus lanatus	*Linum catharticum*

Figure 17: Description of habitat areas within Lough Corrib SAC at risk of habitat loss as a result of the N6 GCRR – Area 16 (highlighted cyan area)



This habitat area highlighted in cyan above corresponded with the Fossitt (2000) category Scrub (WS1). Typical species included Blackthorn, Hawthorn and Ash. This habitat does not correspond with any Annex I woodland habitat types.

Figure 18:* *Description of habitat areas within Lough Corrib SAC at risk of habitat loss as a result of the N6 GCRR – Area 17 (highlighted cyan area)



This habitat area corresponded with the Fossitt (2000) category Oak-Ash-Hazel Woodland (WN2) and the *Corylus avellana – Oxalis acetosella* (Hazel – Wood-sorrel) vegetation community (WN2_2e). Typical species included Hazel, Hawthorn, Ivy and Bramble. This woodland lacked the

thin soil cover and cover of exposed limestone rock beneath the woodland canopy (i.e. minimal soil depth over at least 50% of the habitat) to qualify as the wooded variant of the priority Annex I habitat type Limestone pavements [*8240].