Our Case Number: ABP-305271-19

Your Reference: Eirgrid Plc

An Bord Pleanála

[redacted]MRTPI
C/O Eirgrid
The Oval
160 Shelbourne Road
Ballsbridge
Dublin 4
D04 FW28

Date: 11 May 2020

Re: 400kV Cross-Shannon Cable Project.
Between Moneypoint 400kV substation, Co. Clare and Kilpaddoge 220kV station, Co. Kerry.

A Chara,

Please be advised that following consultations under section 182E of the Planning and Development Act, 2000, as amended, the Board hereby serves notice that it is of the opinion that the proposed development falls within the scope of section 182A of the Planning and Development Act, 2000 as amended and would accordingly be strategic infrastructure.

Please also be informed that the Board considers that the pre-application consultation process in respect of this proposed development is now closed.

The following is a list of prescribed bodies who should be notified if a subsequent application is made:

Minister for the Environment, Heritage and Local Government
Minister for Communications, Marine and Natural Resources
Minister for Agriculture and Food
Planning authorities in which the development is situated (Clare County Council & Kerry County Council)
Environmental Protection Agency
Fáilte Ireland
An Taisce
The Heritage Council
The Southern Regional Assembly
Health and Safety Authority (Seveso)
Inland Fisheries Ireland
Commission for Energy Regulation
Irish Water
Waterways Ireland
Office of Public

Teil	**Tel**	(01) 858 8100
Glao Áitiúil	**LoCall**	1890 275 175
Facs	**Fax**	(01) 872 2684
Láithreán Gréasáin	**Website**	www.pleanala.ie
Ríomhphost	**Email**	bord@pleanala.ie

64 Sráid Maoilbhríde
Baile Átha Cliath 1
D01 V902

64 Marlborough Street
Dublin 1
D01 V902

If you have any queries in relation to the matter please contact the undersigned officer of the Board.

Please quote the above mentioned An Bord Pleanála reference number in any correspondence or telephone contact with the Board.

Yours faithfully,

[redacted]

[redacted]
Executive Officer
Direct Line: [redacted]

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Record of 2nd Meeting
ABP-305271-19

Case Reference / Description	ABP-305271-19 400kV Cross-Shannon Cable Project between Moneypoint 400kV substation, Co. Clare and Kilpaddoge 220kV station, Co. Kerry.		
Case Type	Pre-application consultation		
1st / 2nd / 3rd Meeting	2nd		
Date	13/03/20	**Start Time**	11 a.m.
Location	Cathal Brugha Room	**End Time**	11.40 a.m.
Chairperson	[redacted]	**Executive Officer**	[redacted]

Attendees		
Representing An Bord Pleanála		
Staff Member	**Email Address**	**Phone**
[redacted], Assistant Director of Planning		
[redacted] Senior Planning Inspector		
[redacted], Senior Administrative Officer		
[redacted], Executive Officer		

Representing the Prospective Applicant		
[redacted], Senior Planner		

The meeting commenced at 11 a.m.

Introduction:

The Board referred to its previous meeting with the prospective applicant held on the 25th October, 2019 and the record of this. The Board enquired if the prospective applicant had any comments to make on the record. The prospective applicant replied that it had no comments to make.

Presentation by the prospective applicant:

- The prospective applicant recapped on the main elements of the proposed development and the overall need for the project. The proposed Cross-Shannon Cable Project involves the laying of a new 400kV cable, principally submarine, across the Shannon Estuary between the electricity substations at Moneypoint, County Clare and Kilpaddoge, County Kerry. The prospective applicant stated that there are no major changes to this since the time of its previous meeting with the Board and reiterated that the project is principally proposed to facilitate getting the surplus volume of renewable energy (especially wind) in the south-west region onto the 400kV network and onward to demand centres across the country. Noting this, the Board's representatives advised that the need and rationale for the proposal should be clearly outlined in the documentation accompanying the proposed planning application.

  The prospective applicant set out the location for the proposed development which traverses the Shannon Estuary from south to north. The proposed development will comprise of a 400kV underground cable

connection, two underground transition joint bays (where the submarine cable makes landfall), a 400kV AIS bay with electrical equipment and associated and ancillary development. With respect to the consents to be sought for the project generally, the prospective applicant said that the SID planning application would be lodged with the Board prior to any application for a foreshore licence. It noted for the record that there are still some outstanding matters to be resolved apropos construction accesses and that engagements with relevant landowners are on-going in this respect. In response to the Board's query on the matter, the prospective applicant said that all construction access tracks to be utilised, and any associated works, will be contained within the red line application boundary.

- The prospective applicant referred to the existing Moneypoint GIS substation and set out the nature and extent of the new 400kV cable route to link into this substation. A cross section of the typical trench on land to facilitate the new 400kV cable route was provided and the prospective applicant also provided detail on the typical landfall transition joint bays.
- The prospective applicant referred to the existing Kilpaddoge GIS substation and the AIS bay within this facility. It also noted for the record the fact that there is on-going construction work occurring in the vicinity of this location. With regard to this, the Board's representatives reminded the prospective applicant to be cognisant of extant permissions and existing development in the consideration of in-combination effects in the NIS.
- The prospective applicant reiterated its opinion that, given its nature and function, the proposed development would constitute strategic infrastructure development. With regard to this opinion on the SID status, the prospective applicant pointed out that the proposed development is for the purposes of electricity transmission as defined under the Act, will form part of the 400kV transmission network, will contribute substantially to the fulfilment of objectives in the National Planning Framework, will be of strategic economic or social importance with regard to the Climate Action Plan and will occur in the functional area of more than one local authority.

- With respect to EIA, the prospective applicant re-stated its consideration that the proposed development is not of a type that falls within Annex I and Annex II of the Environmental Impact Assessment Directive and relevant Irish legislation. It does not currently propose to lodge an environmental impact assessment report with the planning application and said that an Planning and Environmental Report addressing relevant matters would be submitted with the forthcoming planning application.
- With regard to the matter of Appropriate Assessment, the prospective applicant noted the fact that the Shannon Estuary is a Natura 2000 site. It said that it is its intention to submit a Natura Impact statement with the planning application.
- The prospective applicant sought further advice from the Board's representatives in relation to the plans and particulars which the Board will require for the purposes of considering the planning application and the likely timeframe and sequencing which will apply to the application process. It also requested advice on the matters of the public notices and consultations with relevant prescribed bodies. The Board's representatives suggested that, in addition to standard plans and particulars, the planning application might include details of the cable route with particular regard as to how it traverses the estuary and cross sections for same. The Board also advised that a robust NIS should accompany the planning application. In response to the Board's query on the matter, the prospective applicant confirmed that Moneypoint is a Seveso Site. The Board advised the prospective application to engage with the Health and Safety Authority and also noted that it would be one of the prescribed bodies which will have to be formally notified of the planning application. It advised the prospective applicant that a full list of all relevant prescribed bodies will accompany its letter determining the SID status of the proposed development.
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Foreshore Licence Application is also on-going with the Department of Housing, Planning and Local Government.

Application procedures:

The Board provided the prospective applicant with advice on the making of a formal planning application to it as follows:

- An application can only be lodged after formal notice has been received by the prospective applicant from the Board.
- The application must be made by way of full completion of an application form to the Board.
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Conclusion:

The record of the instant meeting will issue in the meantime and the prospective applicant may submit any comments it has on this in writing. Following receipt of this record, the prospective applicant may then write to the Board to request formal closure of the pre-application consultation process.

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[redacted]

Assistant Director of Planning

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Staff Member	**Email Address**	**Phone**
[redacted], Assistant Director of Planning		
[redacted] Senior Planning Inspector		
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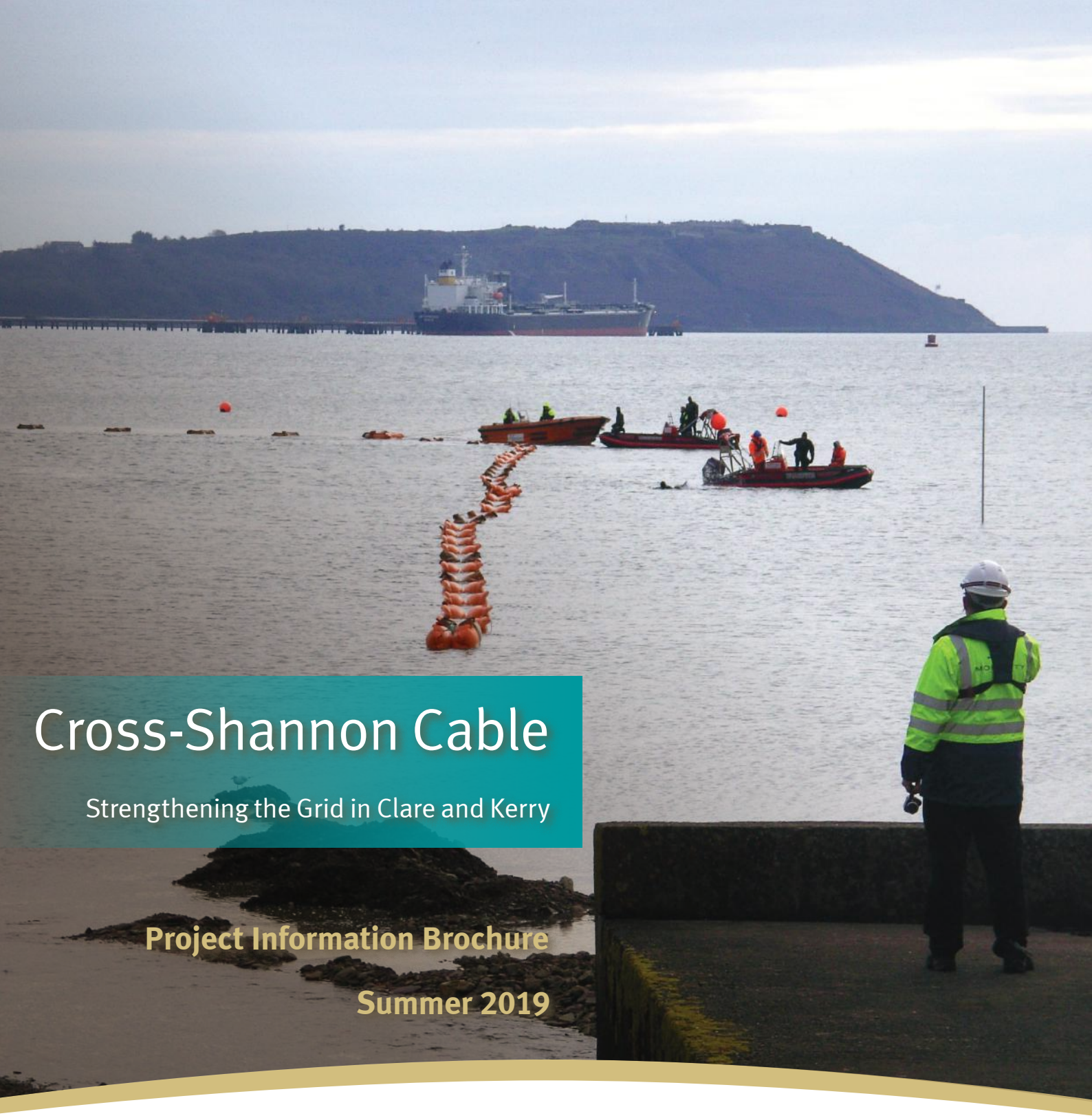
[redacted]

Assistant Director of Planning



Cross-Shannon Cable

Strengthening the Grid in Clare and Kerry

Project Information Brochure

Summer 2019

EIRGRID

The current. The future.

Who are EirGrid - and what do we do?

EirGrid is responsible for a safe, secure and reliable supply of electricity – now and in the future.

We develop, manage and operate the electricity transmission grid. This brings power from where it is generated to where it is needed throughout Ireland. We use the grid to supply power to industry and businesses that use large amounts of electricity. The grid also powers the distribution network. This supplies the electricity you use every day in your homes, businesses, schools, hospitals and farms.

What is the Cross-Shannon Cable Project?

The Cross-Shannon Cable Project involves the laying of a new 400kV cable across the Shannon Estuary between electricity substations at Moneypoint, County Clare and Kilpaddoge, County Kerry.

Why do we need this project?

A high level of renewable energy, particularly wind, is generated in the south and west of Ireland. It is important when wind is high, and a surplus of energy is created, that any additional power is moved to wherever it is needed across the country. The Cross-Shannon Cable Project will ensure that any excess power generated in the south west is despatched around the country as efficiently as possible.

Step 1
How do we identfy the future needs of the electricity grid?

Step 2
What technologies can meet these needs?

Step 3
What's the best option and what area may be affected?

Step 4
Where exactly should we build?

Step 5
The planning process

Step 6
Construction energisation and benefit sharing

EirGrid has a six-step public consultation process for large projects. The Cross-Shannon Cable is at Step 4 of the process

Where exactly should we build?

Step 4
At a glance

What's happening?

Between the summer of 2018 and the spring of 2019 we completed a detailed underwater survey in the Shannon Estuary. We also surveyed the lands around Moneypoint electricity generating station and Kilpaddoge substation.

These surveys have allowed us to identify feasible route options and a best performing option for the Cross-Shannon Cable project.

We now wish to consult with landowners, local communities, organisations and elected representatives to seek views on the best performing option.

How long will this take?

Work has been ongoing on this step for a number of months. This phase of public consultation will take six weeks.

What can you influence?

You can influence where the Cross-Shannon cable route will be located.

How can you get involved

Stakeholders and communities are invited to feedback on this project by Monday 29 July.

You can submit feedback by:

- Email, phone or in writing
- Attending one of the Public Information Meetings: -

17 June from 1pm – 8pm in: The Lanterns Hotel, Coast Road, Tarbert, County Kerry

18 June from 1pm – 8pm in: Knockerra Hall, Killimer, County Clare.

If you would like further information on this project, or have any questions, please drop in to speak with a member of the EirGrid team.

Details of this meeting will be advertised in advance in the local media, and on social media.

You can also contact our community liaison officer, at the contact details listed on the back cover of this brochure.

Project Timeline & Next Steps

Supporting documentation

To learn more about our assessments and the proposed route, visit our website at http://www.eirgridgroup.com/the-grid/projects/cross-shannon-cable/related-documents/

There you will find a report on surveys, assessments that were considered in identifying the best performing option.

The feedback received from the consultation phase will be incorporated into our decision making process on this route. This will be published on the EirGrid website.

Future plans

Once the consultation on Step 4 has been completed, the route of the Cross-Shannon Cable will be finalised to allow the project to progress to Step 5, 'The Planning Process'. The new underwater cable across the River Shannon will connect to the substation at Moneypoint station in County Clare. The connection in County Kerry requires an extension to the existing Kilpaddoge substation on ESB lands. This extension will include a second substation building and outdoor electrical equipment. The substation building will use Gas Insulated Switchgear (GIS) technology and outdoor equipment similar to what is used at the existing substation.

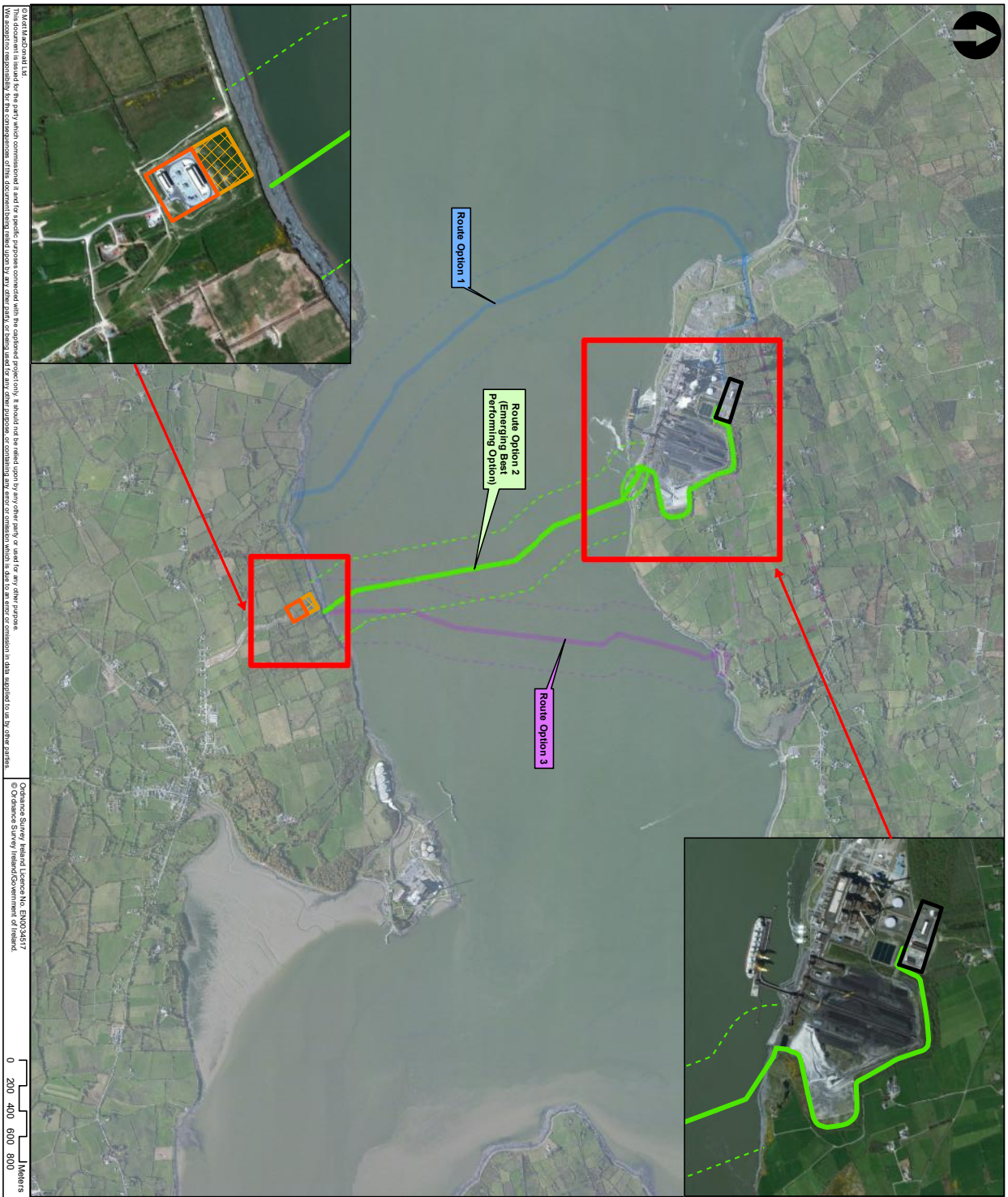
EirGrid will prepare a foreshore licence application and planning application during the autumn of 2019. The planning application is likely to be made directly to An Bord Pleanála and the foreshore licence application will be made to the Department of Housing, Planning and Local Government. Both applications will be advertised in the local media and the documentation will be available for public inspection and submissions.

Construction of the Cross-Shannon Cable Project is expected to begin in 2021 and operational in 2023.

Example of the proposed Substation at Kilpaddoge

The Proposed Option

Route Option 2 coloured in green, linking the existing substations at Kilpaddoge, County Kerry and Moneypoint, County Clare



Location Map

Key to Symbols

- Moneypoint Substation
- Kilpaddoge Substation
- Kilpaddoge Proposed Substation Extension

Notes

Services Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Rev	Date	Drawn	Description	Chkd	Appd
02	31/05/19	[redacted]	Final Issue	[redacted]	-
01	23/04/19	[redacted]	Final Issue	[redacted]	-

MOTT MACDONALD
South Block
Rockfield, Dundrum
Dublin 16
D16 R6V0
Ireland
T +353 (0)1 291 6700
W www.mottmac.ie

Client

EIRGRID

Title

Cross Shannon 400 kV
Cable / Step 4 Report
Emerging Best Performing Option

Designed		Eng Check	
Drawn	[redacted]	Coordination	
GIS Check	[redacted]	Approved	[redacted]
Scale at A3	1:28,000	Status	PRE
		Rev	P2
		Security	STD

Drawing Number
379408-MMD-XX-GIS-Y-108

0 200 400 600 800 Meters

Public Consultation

Contact Details for the Cross-Shannon Cable Project

[redacted]
Community Liaison Officer
[redacted]
EirGrid Customer Relations
+353 (0)1 237 0472

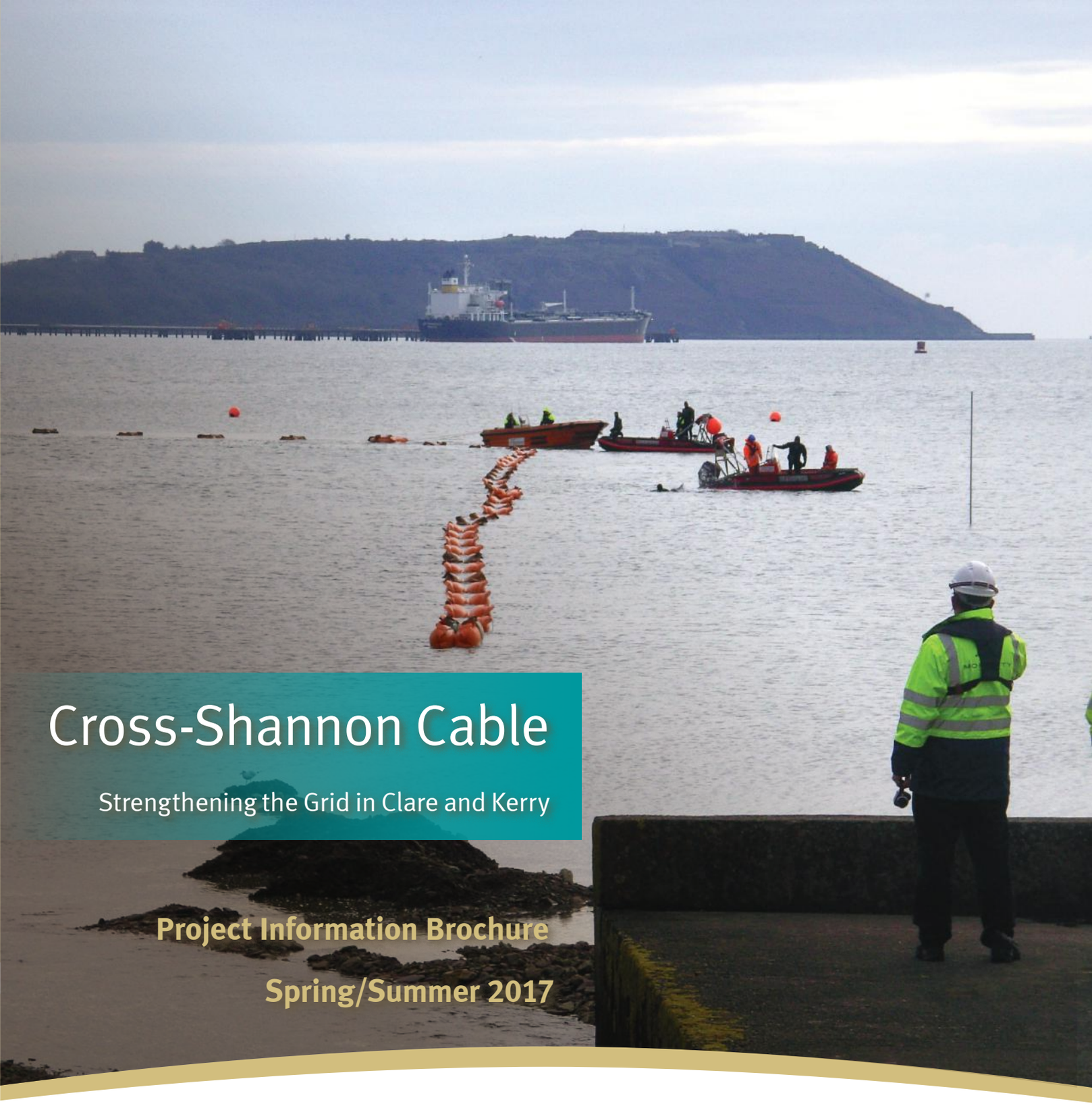
Email
[redacted]
info@eirgrid.com

Web
www.eirgrid.com/the-grid/projects/cross-shannon-cable

Address
Project Manager
Cross-Shannon Cable Project
EirGrid plc
The Oval
160 Shelbourne Road
Ballsbridge
Dublin D04 FW28
Ireland

EIRGRID

PLEASE RECYCLE



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Spring/Summer 2017

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What is the Cross-Shannon Cable project?

The Cross Shannon-Cable Project involves the laying of a new 400kV cable across the Shannon Estuary (in the river bed) between the electricity substations at Moneypoint, County Clare and Kilpaddoge, County Kerry.

Why do we need this project?

There are high levels of renewable electricity generation, mainly wind power, being connected to the electricity grid in the south and west of Ireland. At times of high wind, power is expected to flow from the south and west to the east of Ireland. The Cross-Shannon Cable Project will enable this power to connect to the existing cross-Ireland 400 kV overhead line which connects at Moneypoint.

What is the background to the Cross-Shannon Cable Project?

In 2014, the Government announced the establishment of an Independent Expert Panel to conduct an independent review of overhead and underground options for the Grid West Project and Grid Link Project in the south of the country.

In 2015 we developed a number of alternative options to meet the need of the Grid Link Project, in line with the terms of reference, as set by the expert panel.

In our analysis we identified a solution, referred to as the "regional solution". This option meets the need of the project, and minimises the development of new, large-scale infrastructure.

The "regional option" uses a technology known as series compensation. This allows more power to flow through existing lines, and does not require the significant new transmission lines.

To complete this solution, an underwater cable across the Shannon estuary is needed, in addition to a set of reinforcements elsewhere on the system.

Are Electricity Cables Crossing the Shannon a new Technology?

No, electricity transmission cables have been laid previously in the Shannon Estuary, including the Prospect-Tarbert 220 kV cable that was laid in 1977, and the Moneypoint -Kilpaddoge 220 kV cable that was laid in 2015.

Study Area Map

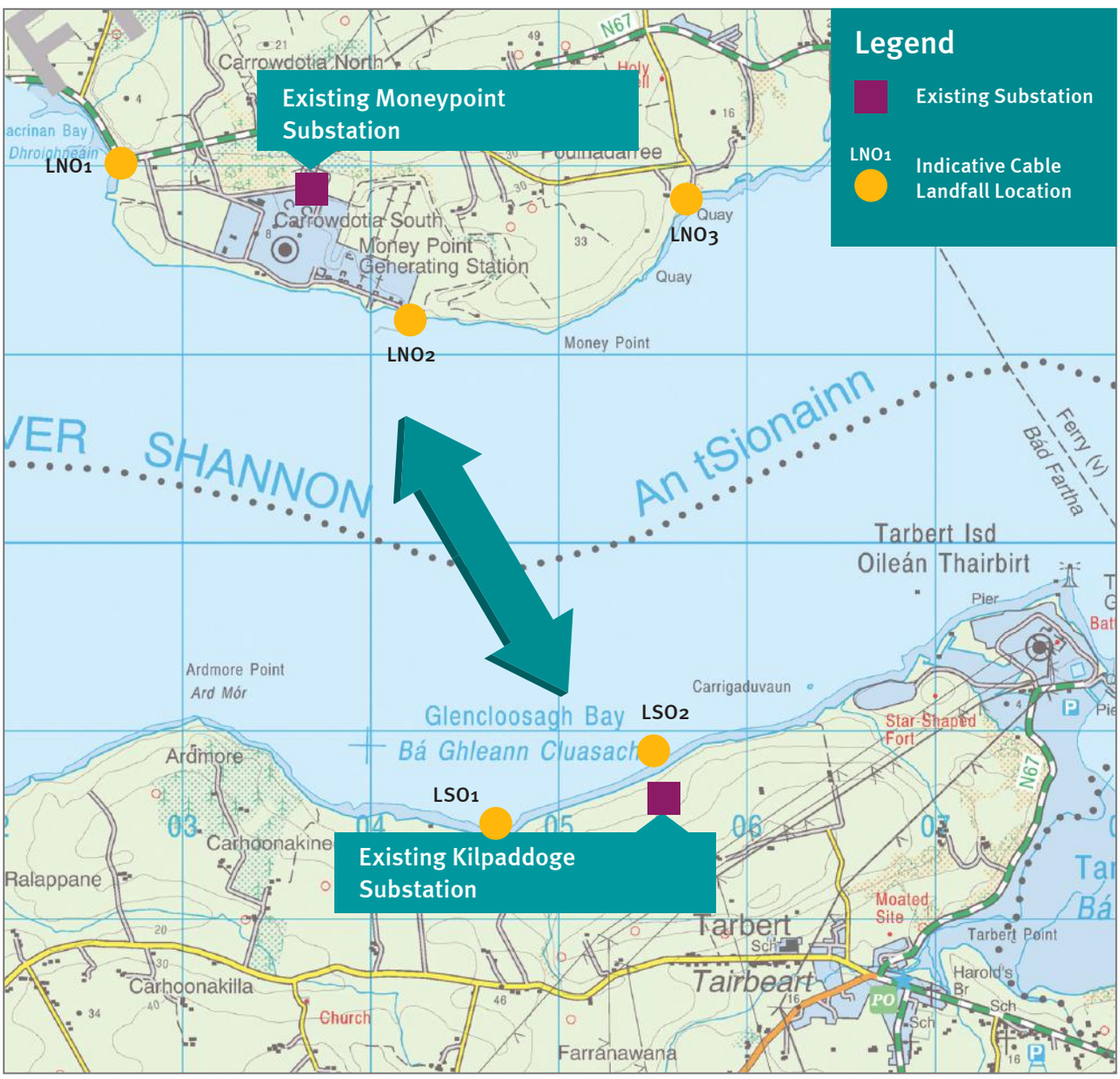

Figure 1: Map showing existing substations at Moneypoint and Kilpaddoge

Project Timeline & Next Steps

What's happening on the project now?

We are currently completing a range of technical, environmental and social studies to assist in the identification of feasible options for the routing of the cables. These surveys will occur both on land but also in the Shannon Estuary itself. Some of these surveys may require particular consents, such as a Foreshore Licence, and notices associated with them will be put on public display.

We welcome your feedback on the Cross Shannon Cable project and invite you to contact us.

Future plans

During 2017 we are planning to identify feasible options and specific locations for the Cross-Shannon Cable Project. EirGrid will consult with landowners, local communities, organisations and individuals when these specific options have been identified. This is to provide us with further information and provide input into deciding what is the best option for the project.

During 2018 we plan on submitting an application for permission for the installation of the cables and construction of associated infrastructure at the substations at Kilpaddoge and Moneypoint.

In 2020 we plan to construct the Cross-Shannon Cable Project and in 2021 we plan to make it operational.

Public Consultation

Tell us what you think

Your feedback is central to how we move forward with the Cross Shannon Cable project.

As part of our consultation we are seeking your input on issues we need to consider when selecting feasible route options for the cable installation.

We hope to hear from you.

Contact Details for Cross-Shannon Cable Project

Phone
Freephone number

Email
crossshannoncable@eirgrid.com

Web
www.eirgridprojects.com/projects/crossshannoncable

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EIRGRID

MOTT MACDONALD

EIRGRID

Step 4 Report

Development Options Report Cross Shannon 400 kV Cable

15 October 2019

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Step 4 Report

Development Options Report Cross Shannon 400 kV Cable

15 October 2019

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1 Project Overview

1.1 Introduction

Mott MacDonald Ireland has been appointed by EirGrid plc as lead consultant for the Cross Shannon 400 kV Cable project (Capital Project Reference CP0970). The Project is being developed in accordance with EirGrid's Framework for Grid Development. This report documents the assessment undertaken as part of Step 4 of the Framework.

1.2 Who is EirGrid

EirGrid plc (EirGrid) is the state owned independent Transmission System Operator (TSO) and developer of Ireland's national high voltage electricity grid (also called the "Transmission System"). The *European Communities (Internal Market in Electricity) Regulations 2000* (statutory instrument number 445 of 2000) sets out the role and responsibilities of the TSO; in particular, Article 8(1) (a) gives EirGrid, as TSO, the exclusive function:

"*To operate and ensure the maintenance of and, if necessary, develop a safe, secure, reliable, economical, and efficient electricity transmission system, and to explore and develop opportunities for interconnection of its system with other systems, in all cases with a view to ensuring that all reasonable demands for electricity are met having due regard for the environment".*

In this capacity EirGrid is planning a significant upgrade to the transmission network between Kilpaddoge (near Tarbert in County Kerry) and Moneypoint (near Killimer in County Clare).

1.3 Project Need

High levels of renewable generation are currently being integrated into the transmission and distribution systems in the south and west of Ireland. At times of high wind generation output, it is expected that wind generation will displace conventional (e.g. thermal power station) generation on the system in order of economic merit, while respecting operational constraints. As a consequence of this, at times of high wind, large bulk power flows are expected to flow from the west and south-west towards the large load centres on the east coast. A system reinforcement is required to facilitate these projected power flows, as well as to resolve other network issues including voltage collapse, large phase angles and thermal issues. As part of a regional solution to meet this need EirGrid are proposing the Moneypoint-Kilpaddoge 400 kV circuit. This will involve the installation and operation of an additional cable crossing of the Shannon estuary between the existing transmission substation on the site of the existing electricity generation station at ESB Moneypoint (north side of the Shannon estuary, near Killimer in County Clare) and a new 400/220 kV transformer at the transmission substation at Kilpaddoge (south side of the Shannon estuary near Tarbert in County Kerry).

1.4 Consent Requirements

The connection of the proposed 400 kV cable installation, at the Moneypoint substation, will be into a spare bay at the existing 400 kV GIS (gas-insulated switchgear) substation. The connection of the cable installation at the existing Kilpaddoge 220/110 kV substation will require the installation of a new 400/220 kV transformer and associated ancillary infrastructure (for example high voltage equipment, hard standing surfaces to facilitate access and a new perimeter boundary fence). The proposed 400 kV cable installation between both substations will consist of both land-

cable and submarine cable. Having regard to the future statutory approval process (planning) for the project, as the nature of the project is 'electricity transmission' it is anticipated that the proposed development will require statutory approval from An Bord Pleanála pursuant to an application made under Section 182A of the Planning and Development Act, 2000 as amended. In addition, as the development is located within the foreshore it is anticipated that it will be required to secure a foreshore licence from the Department of Housing, Planning and Local Government in accordance with the Foreshore Acts, 1933 as amended.

1.5 Health and Safety

1.5.1 General

EirGrid regard the protection of health, safety and welfare of its staff and the general public as a core company value. The Irish Transmission and Distribution Systems are designed, constructed and operated in accordance with all national and EU Safety Regulation and in accordance with best international practice. Extensive studies have been undertaken on the health risks associated with high voltage circuits. Guideline Reference levels for exposure to electro-magnetic fields (EMF) have been set by the International Commission on Non-Ionising Radiation Protection (ICNIRP) who advise the World Health Organisation (WHO) on non-ionising radiation matters. EirGrid will adhere to international and national standards and guidelines in the development of the Cross Shannon 400 kV Cable project.

1.5.2 Project Supervisor for the Design Process (PSDP)

At the start of the design of the Cross Shannon 400 kV Project EirGrid appointed Mott MacDonald Ireland to act as the Project Supervisor for the Design Process (PSDP). By law, the PSDP is required to co-ordinate the activities of designers involved in the project to ensure that they design works that can be constructed, used, maintained and demolished safely. Designers involved in the project will design out risk where possible in their designs. Designers will record the decisions they make to mitigate risks in their design. These risk assessments identify those risks that could not be mitigated so that the people responsible for constructing, using, maintaining and demolishing the works can be informed of those risks.

Each PSDP will prepare a Preliminary Safety and Health Plan for the respective Contractor which will include in the background information issued to the Tenderers when the construction project goes to tender. This is to inform the tendering Contractors of the risks present on the site that are associated with the construction of the works.

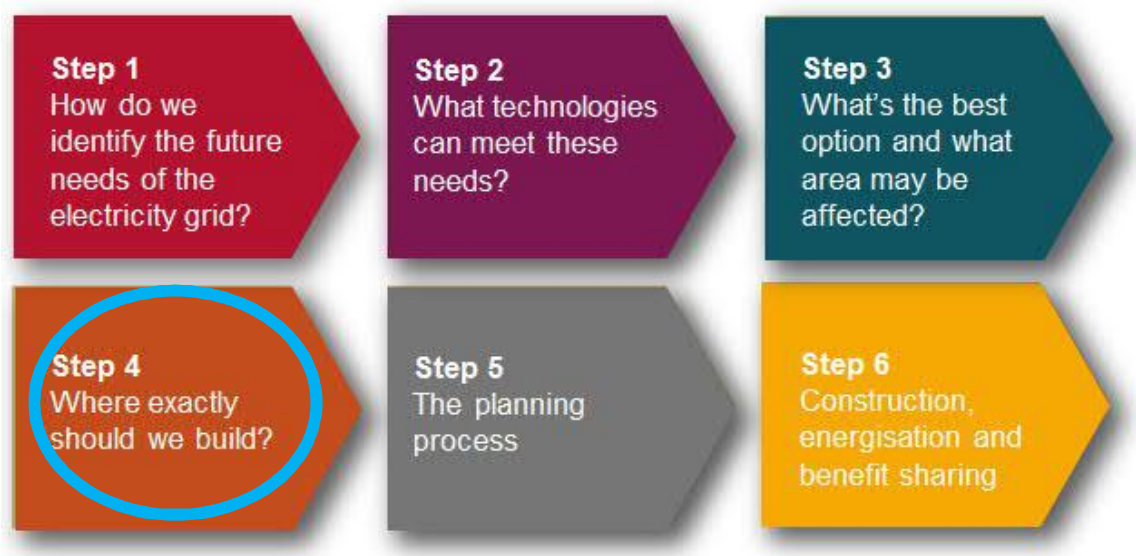
On completion of the works the PSDP will compile the Safety File. The Safety File will be a comprehensive record of the completed scheme and will serve as a reference point for the future operation and maintenance of the works and any future upgrading works.

2 Methodology and EirGrid Framework for Grid Development

2.1 EirGrid Framework for Grid Development

EirGrid follow a six step approach when developing and implementing the best performing solution option to any identified transmission network problem. This six step approach is described in the document 'Have Your Say' published on EirGrid's website[1]. The six steps are shown on a high-level in Figure 1.1 below. Each step has a distinct purpose with defined deliverables.

Figure 2.1: High Level Project Development Process



Source: EirGrid

2.2 Where Are We Now

The system reinforcement required to meet this need was termed the 'Grid Link' project. A number of options were considered by EirGrid including;

- A high voltage alternating current (HVAC) 400 kV overhead line between Knockraha, County Cork and Dunstown in County Kildare;
- A high voltage direct current (HVDC) circuit between Knockraha and Dunstown; and
- A regional solution including series compensation of the two existing 400 kV circuits between Moneypoint and the east coast at Woodland and Dunstown.

In September 2015, EirGrid submitted a report on the Grid Link project to the Government appointed Independent Expert Panel (IEP). This report included an analysis of each of the options from technical, environmental and economic perspectives. Subsequent to the publication of this

[1] www.eirgridgroup.ie

report EirGrid has made a decision to progress the 'regional solution' to meet the needs of the Grid Link project. The 'regional solution' consists of the following individual components;

- Moneypoint Kilpaddoge 400 kV Circuit;
- Series Compensation Oldstreet 400 kV Station;
- Series Compensation Moneypoint 400 kV Station;
- Series Compensation Dunstown 400 kV Station;
- Wexford 110 kV Station Upgrade;
- Great Island-Wexford 110 kV OHL Uprate; and
- Great Island-Kilkenny 110 kV OHL Uprate.

The Moneypoint Kilpaddoge 400 kV Circuit involves the installation of an addition cross Shannon Cable at 400 kV between the existing substations at Moneypoint in County Clare and Kippaddoge in County Kerry. This component of the 'regional solution' is called the *Cross Shannon Cable Project*.

The project is currently at Step 4 which is typically where routing of circuits and siting of transmission stations is carried out. At the end of Step 4 a best performing solution option will be identified which will form the basis of the subsequent statutory approval (planning) process. This decision will take into account both EirGrid's needs and stakeholder views.

As the routing and siting of transmission infrastructure will create multiple options and variations the identification of the emerging Best Performing Option is carried out using a multi-criteria assessment based on five criteria.

2.3 Methodology

2.3.1 General

The Step 4 assessment is primarily a desktop study, supported by consultation and a windscreen visits of the project study area. The study was further supported by landowner and public engagement. Where access was sought from, and granted by landowners, Mott MacDonald and EirGrid staff undertook preliminary walkover surveys of lands. The assessment consisted of the following principal steps:

- Stakeholder Consultation;
- Landowner and Community Engagement;
- Information Gathering (including completion of marine geotechnical, environmental and cultural heritage surveys);
- Data Mapping;
- Evaluation of Feasible Options;
- Walkover Surveys; and
- Identification of the Emerging Best Performing Option (BPO).

Each of these steps were undertaken to ensure that the most accurate and up to date constraints drawings for the project study area were compiled, prepared and reported. The tasks undertaken to complete each of the principle steps are detailed below.

In addition, the requirements of the following key documentation was considered during the preparation of the constraints and evaluation assessment;

- EirGrid Framework for Grid Development;

- EirGrid Ecology Guidelines for Electricity Transmission Projects; and
- EirGrid Cultural Heritage Guidelines.

2.3.2 Stakeholder Consultation

Communications with statutory and environmental consultees is an important element of the Step 4 process. This consultation was primarily to source information at this stage. The principal statutory and environmental consultees utilised to source data during this phase of the project are as follows:

- National Parks and Wildlife Service;
- National Monuments Service;
- Clare County Council;
- Kerry County Council;
- Environmental Protection Agency;
- Geological Survey Ireland;
- Inland Fisheries Ireland;
- Utilities providers (Bord Gais, ESB, Irish Water, Telecommunications services); and
- Biodiversity Ireland.

2.3.3 Landowner and Community Engagement

A key aspect to the project development is engagement with the local community and those which may potentially host any infrastructure (landowners). EirGrid seek to provide the local community and landowners with project information in a timely manner, to advise of how the project is planned to progress and of the expected timelines.

EirGrid Community Liaison Officers (CLOs) and Agricultural Liaison Officers (ALOs) carry out this role and have been out on the ground visiting the landowners and residents in the project study area since early May 2017. Further details on the engagement and consultation is provided in Section 6 of this report.

In addition to providing project information, EirGrid welcomed all feedback. The feedback is considered in the overall project development process.

2.3.4 Information Gathering

A preliminary list of potentially relevant constraints data required for the purposes of the assessment was collated based on the principles outlined above. The relevant datasets required were determined by the project team in co-ordination with the environmental and technical specialists. It was considered that these identified datasets were critical to the development of the constraints drawings. The list of potentially relevant constraints datasets were further modified on the basis of consultation undertaken with the Statutory and Environmental Consultees.

A hierarchical step by step approach was used to the sourcing of data, based on the ease of the availability of data.

1. Identify if dataset is required;
2. If dataset is required, download from websites of data suppliers;

3. If dataset is not available to download, request from data supplier;
4. If dataset is not available from data supplier, digitise data.

Where possible, all data was sourced in GIS format, compatible with ArcGIS v 10.6.1 software. Where digital data was not available in this format, it was accessed in available formats and translated to the format compatible with ArcGIS v 10.6.1. In all cases, where data was digitised, it was done so using ArcGIS 10.2 software.

2.3.5 Data Mapping

A number of constraints drawing were prepared using ArcGIS v 10.6.1 GIS software. A number of subject specific constraints drawings were prepared to allow multiple data layers to be displayed concurrently. The drawings were prepared by experienced GIS technical specialists to ensure that all relevant data is displayed clearly and concisely with legends indicating all the data contained on each constraint drawing. Each drawing was prepared on standard A3 landscape map layout sheets. For this assessment an overall environmental constraints drawing was then collated to illustrate the key environmental sensitivities within the project study area. Each constraint map contains standard background mapping layers to allow viewers to identify locations of constraints. A copy of the maps are provided in *Appendix A Drawings* of this report.

2.3.6 Project Study Area

The main study area for the project is illustrated in drawing reference 229379408-MMD-XX-GIS-Y-101 (Discovery Series) and 229379408-MMD-XX-GIS-Y-102 (Aerial Photography) included in *Appendix A Drawings*. The study area is approximately 65km^2, encompassing lands adjacent to existing ESB Moneypoint electricity generation station and the existing Kilpaddoge 220/110 kV electricity substation. The study area is in the functional areas of both Clare County Council and Kerry County Council. The focus of the study area was informed by a number of factors, but specifically based on the fact that the connection point for each end of the cable installation are at the existing 400/220/110 kV and 220/110 kV substations at Moneypoint and Kilpaddoge respectively. Due to the fact that the nearest land-route for a cable connection between both substations would involve a distance of between 100 and 140 kilometres (direct line or exclusively in the public road, incorporating a crossing using the N18 Limerick Tunnel) and that an overhead line would involve a crossing of an approximately 3 kilometres across the River Shannon Estuary these were not considered to be reasonable alternatives or appropriate or sustainable solutions to be considered further. In addition, the River Shannon is a nationally important national shipping channel and a site of European ecological conservation importance designated under the Birds and Habitats Directive further supporting this contention.

2.3.7 Structure of this Report

The remaining sections of this report are structured as follows;

Table 2.1: Structure of this Report

Section	Description
Section 3	Strategic Planning Context
Section 4	Planning and Environment Considerations
Section 5	Design Considerations
Section 6	Consultation and Engagement
Section 7	Identification of Feasible Options
Section 8	Criteria for identification of the Best Performing Options
Section 9	Options Evaluation
Section 10	Description of Best Performing Option

3 Strategic Planning Context

3.1 Introduction

This section of the report assesses the proposed Cross Shannon 400 kV Cable project in the context of relevant national, regional and local planning policies and objectives. Through the identification of key spatial, economic and social policies, subsequent analysis will demonstrate how the Cross Shannon 400 kV Project is consistent with, and will contribute towards, the achievement of planning policies and objectives.

3.2 National Planning Policy Context

3.2.1 Project Ireland 2040 - National Planning Framework (2018)

Ireland 2040 - National Planning Framework, hereafter referred to as the NPF, published by the Government in February 2018, is a 20-year planning framework designed to guide public and private investment, to create and promote opportunities for Irish citizens, and to protect and enhance Ireland's built and natural environment.

The NPF notes that the population of Ireland is projected to increase by approximately 1 million people by 2040 which will result in a population of roughly 5.7m. This growth will place further demand on both the built and natural environment as well as the social and economic fabric of the country. The aim of the NPF is to achieve an approximately 50:50 distribution of growth between the Eastern and Midland region and the Southern (where the proposed Cross Shannon Cable project is intended to be located) and Northern and Western regions, with 75% of the growth to be outside of Dublin and its suburbs.

The **National Strategic Outcome 8** (*Transition to Sustainable Energy*), notes that in creating Ireland's future energy landscape, new energy systems and transmission grids will be necessary to enable a more distributed energy generation system which connects established and emerging energy sources to the major sources of demand. To facilitate this, NPF acknowledges the need to:

'*Reinforce the distribution and transmission network to facilitate planned growth and distribution of a more renewables focused source of energy across the major demand centres*.'

The implementation of new Cross Shannon 400 kV Cable Project will strengthen energy provision within the Mid-East Region, especially in the context of ensuring grid capacity to meet growing demand. This will assist in delivering a secure and sustainable electricity system which will in turn improve the performance of local and regional enterprises in terms of '*innovation, export potential and productivity, supporting technology-led start-ups and by attracting further investment to the regions'* as described in **National Strategic Outcome 6** (*A Strong Economy Supported by Enterprise, Innovation and Skills*). As such, the available support provided by the Cross Shannon 400 kV Project will comply with the strategic outcomes envisioned by the NPF's National Energy Policy and National Strategic Outcomes.

3.2.2 National Development Plan 2018-2027 (2018)

The National Development Plan 2018-2027, hereafter referred to as the NDP, sets out the investment priorities at national, regional and local planning levels which will facilitate the implementation of the NPF. In the context of the energy sector, the ultimate objective of the NDP is to assist in ensuring a '*long-term, sustainable and competitive energy future for Ireland*'. The

NDP notes that State Owned Enterprises (SOEs), such as EirGrid, are predicted to invest over €13 billion in energy related investments within the lifetime of this Plan; specifically, works will focus on regulated energy network infrastructure to provide smart reliable electricity networks to support security of electricity supply, SMART metering and enable increased renewable generation. Targeted investment within network infrastructure ensures that Ireland's power grid is:

- Maintained to the highest international safety standards;
- Fit for purpose in the medium to longer-term in order to meet projected demand levels; and
- Has the infrastructural capacity to integrate the required levels of renewable energy.

Similar to the precedent set out in the NPF, the NDP states that investments within grid infrastructure, including improvements to transmission networks, are an important enabler of economic growth and as such, the energy sector will play critical role to play in meeting priority infrastructural needs at both national and local levels. The implementation of the proposed Cross Shannon 400 kV Cable Project by EirGrid represents the type and nature of investment described within the NDP required to achieve the NPF's strategic outcomes.

3.2.3 Government White Paper – Ireland's Transition to a Low Carbon Energy Future 2015-2030

The Government White Paper entitled *Ireland's Transition to a Low Carbon Energy Future 2015-2030* sets out a framework to guide Ireland's energy policy development. The White Paper, acknowledges the need for the 'development and renewal' of energy networks to meet economic and social goals. Enhanced energy infrastructure, i.e. the Cross Shannon 400 kV Project, will therefore be critical for economic development, regional development and the secure provision of energy and other services for the proper functioning of the markets.

3.3 Regional Planning Policy Context

3.3.1 Draft Regional Spatial and Economic Strategy for the Southern Region

The Mid-West Regional Authority (including County Clare) and the South-West Regional Authority (including County Kerry) were dissolved in 2014 and its functions and responsibilities have been transferred to the Southern Regional Assembly, however, the Mid-West Regional Authority and the South-West Regional Authority Planning Guidelines 2010-2022 will continue to have effect until a Regional Spatial and Economic Strategy (RSES) is prepared and adopted by the Southern Regional Assembly. Public consultation on the Southern RSES Material Amendments were closed on the 11th of October 2019.

The draft RSES includes a Draft Limerick Shannon Metropolitan Area Strategic Plan and identifies Listowel and Newcastle West as drivers in a North Kerry/West Limerick context connected with the Shannon Estuary (including its strategic assets such as Cahercon and Moneypoint) and Shannon Foynes Port.

The surplus of energy in the region is addressed including the 'Regional Solution' increasing transfer capacity from the south and southwest to the Eastern and Midland Region signifying the strategic role of the region's energy assets in national energy generation and transmission.

The draft RSES supports a safe, secure and reliable transmission and distribution of electricity and the successful implementation of the "Ireland's Grid Development Strategy "Your Grid, Your Tomorrow", prepared by EirGrid.

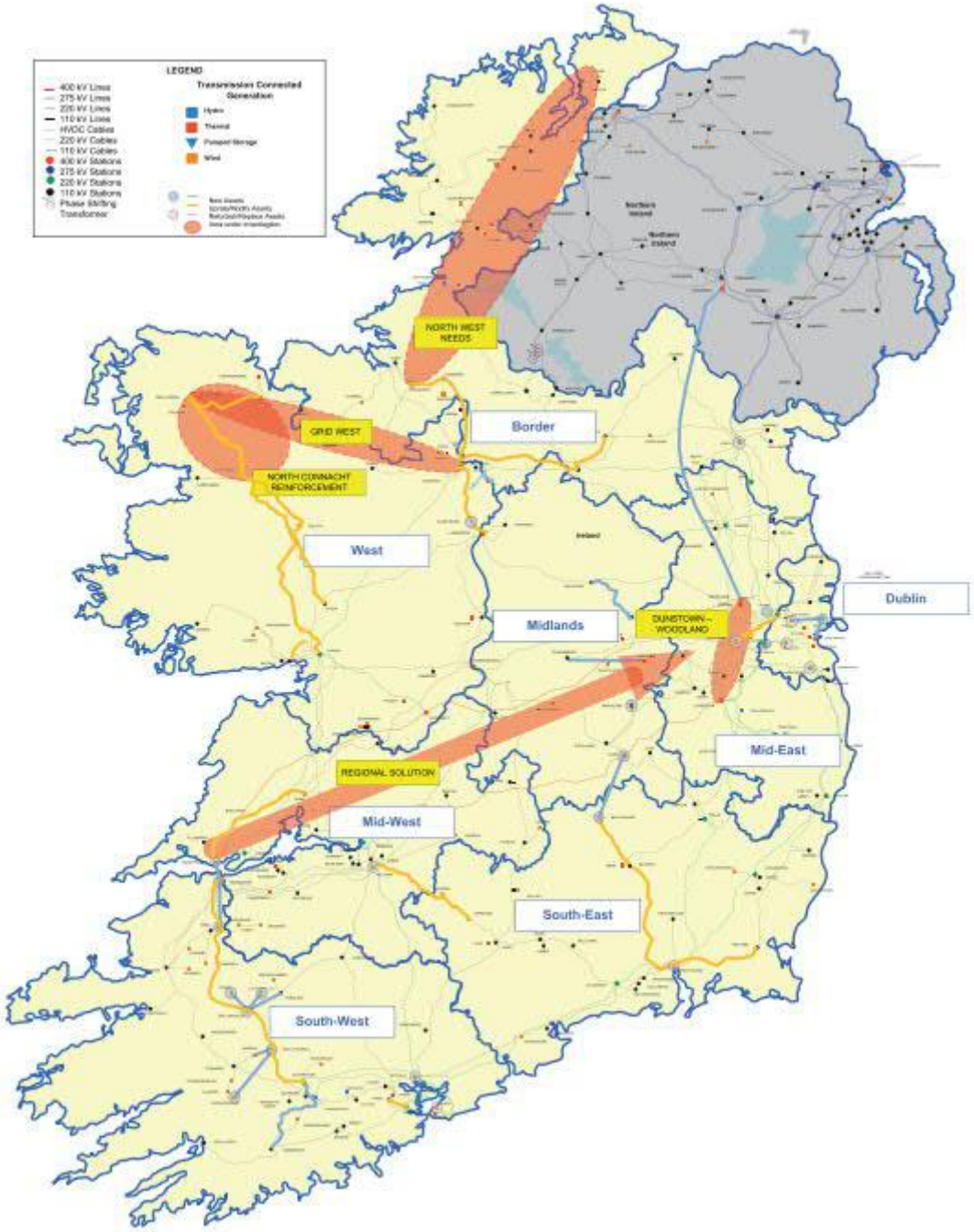
The following objectives are outlined in the Draft RSES

- RPO 214 Electricity Infrastructure
  - *It is an objective to support the development of a safe, secure and reliable supply of electricity and to support and facilitate the development of enhanced electricity networks and facilitate new transmission infrastructure projects that might be brought forward in the lifetime of this plan under EirGrid's (2017) Grid Development Strategy (subject to appropriate environmental assessment and the planning process) to serve the existing and future needs of the region and strengthen all-island energy infrastructure and interconnection capacity.*

- RPO 211 New Energy Infrastructure

It is an objective to support the sustainable reinforcement and provision of new energy infrastructure by EirGrid, ESB Networks and other key energy agencies (subject to appropriate environmental assessment and the planning process) to ensure the energy needs of future population and economic expansion within designated growth areas and across the Region can be delivered in a sustainable and timely manner and that capacity is available at local and regional scale to meet future needs.

Figure 3.1: EirGrid's Grid Development Strategy: Your Grid, Your Tomorrow, Strategic Projects



Source: https://www.southernassembly.ie/uploads/general-files/Draft_RSES_2018_-_WEB.pdf

3.3.2 Regional Planning Guidelines for Mid-West Region 2010-2022

The Regional Planning Guidelines for the Mid-West Region give regional effect to national planning policy, including the National Development Plan and the National Spatial Strategy. The Mid-Western Region includes County Clare.

Chapter 6 of the Regional Planning Guidelines for the Mid-West Region states that;

- *These Guidelines favour expediting connections and incorporate modifications proposed by EirGrid in respect of speedier connections to the National Grid by way of a positive bias toward the development of grid infrastructure.*

The guidelines advise that:-

- *Development Plans should facilitate the provision of energy networks in principle, provided it can be demonstrated that:*
  - *the development is required in order to facilitate the provision or retention of significant economic or social infrastructure;*
  - *the route proposed has been identified with due consideration for social, environmental and cultural impacts;*
  - *the design is such that it will achieve the least environmental impact, consistent with not incurring excessive cost, and;*
  - *where impacts are inevitable, sufficient mitigation will be implemented, and any mitigation will ensure compliance with European Environmental Directives.*
- *In considering facilities of this nature that traverse a number of counties or that traverse one county in order to serve another, Planning Authorities should consider the proposal in light of the criteria outlined above. They should also treat the proposal as if it were required to service a development within the Planning Authority's own area of jurisdiction.*

These guidelines will be replaced by the Regional Spatial and Economic Strategy for Southern Region following completion of the draft stage and adoption of the strategy by the Assembly

3.3.3 Regional Planning Guidelines for the South-West Region 2010-2022

The Regional Planning Guidelines for the South-West Region give regional effect to national planning policy, including the National Development Plan and the National Spatial Strategy. The Mid-Western Region includes County Kerry.

The guidelines acknowledge the following in the statement for the region:

- *Promote security of energy supply and develop renewable energy in the region in a sustainable manner.*
- *Deliver an integrated and cost effective transportation and infrastructure system (including Broadband) throughout the region in a sustainable manner.*

A modern electricity distribution grid serving the region

Chapter 5 of the Regional Planning Guidelines for the South-West Region states that;

- *It is an objective to facilitate the sustainable development of additional electricity generation capacity throughout the region and to support the sustainable expansion of the network. National grid expansion is important in terms of ensuring adequacy of regional connectivity as well as facilitating the development and connectivity of sustainable renewable energy resources.*
- *Future regional electricity demands may not be necessarily supplied from within the region and could be even imported from abroad. This will require improvements to be made to the national electricity grid and EirGrid, which is the Transmission System Operator (TSO), has put in place a strategy until 2025 (Grid 25) which is intended to future proof the nation's electricity transmission infrastructure. The electricity transmission network forms that backbone of our power supply and it is critical that is developed in a sustainable manner to*

ensure that the region has the necessary infrastructure to attract business and accommodate economic growth and the future development of our local economy. EirGrid's role is to ensure that there is adequate network capacity to carry power from new generation stations and to ensure a reliable supply to meet growing demand for electricity. In order to facilitate the development of the transmission grid, local authorities must consider the development of the grid in all development proposals to ensure that the grid is not compromised in any way by the proposals.

These guidelines will be replaced by the Regional Spatial and Economic Strategy for Southern Region following completion of the draft stage and adoption of the strategy by the Assembly.

3.3.4 Strategic Integrated Framework Plan for the Shannon Estuary (2013-2020)

The Strategic Integrated Framework Plan for the Shannon Estuary (2013-2020) (SIFP) for the Shannon Estuary is an inter-jurisdictional land and marine based framework plan to guide the future development and management of the Shannon Estuary. It was commissioned by Clare County Council, Kerry County Council, Limerick City and County Councils, Shannon Development and the Shannon Foynes Port Company. The project is being overseen by a multi-agency steering group comprised of a number of local authorities and other key stakeholders including EirGrid with an interest in the Estuary.

The SIFP identifies Moneypoint Power Plant and Tarbert Power Plant as having created a strategic energy hub within the Shannon Estuary, identifying the area of Moneypoint Power Plant in County Clare and the area between Ballylongford and Tarbert Power Plant in County Kerry as Strategic Development Locations (SDLs).

The Development Objectives outlined in the SIFP include:

- SIFP MRI 1.2.2 Moneypoint Strategic Energy Location
  - *To safeguard the role and function of ESB Moneypoint as a key strategic driver of economic growth in the Region, encouraging its sustainable growth, operational expansion and diversification in accordance with national and regional energy objectives*.
- SIFP ERG 1.2: Safeguarding the role & function of energy sites
  - *To safeguard the role and function of the strategic energy infrastructure existing within and adjacent to the Shannon Estuary, and encourage the further sustainable development of energy, enterprise and industry within these identified strategic energy locations, subject to the requirements of the Habitats & Birds Directive, Water Framework Directive, and all other relevant EU Directives.*
- SIFP ERG 1.3: Facilitating energy development
  - *To facilitate the further development of the energy infrastructure at identified strategic energy sites and encourage appropriate diversification projects subject to compliance with sustainable planning, and the requirements of the Habitats & Birds Directive, Water Framework Directive and all other relevant EC Directives.*
- SIFP ERGI 1.5: Electricity Network
  - *To support and facilitate the sustainable development, upgrade and expansion of the electricity network, transmission, storage and distribution infrastructure ensuring that all such developments comply with the requirements of the Habitats & Birds Directives, Water Framework Directive, and all other EC Directives.*

The Plan notes "*There is a growing network of wind powered electricity generators in both Cork and Kerry and significant potential exists for additional electricity generation by sustainable wind, wave and tidal energy sources. However many of these sources of renewable energy are not served by existing electricity transmission routes. Significant reinforcement of the electricity grid would be required to cater for the new power flows from renewable generation*".

The Plan also notes there are a number of pockets of deep water in the Shannon Estuary area, and it has identified Areas of Opportunity for Tidal Energy. One opportunity area is located just off the coast at the Moneypoint strategic energy site. The existing 220 kV cables infrastructure is noted to occur within the Area of Opportunity area. The existing 220 kV cables, spans from Moneypoint electricity generation station on the northern shoreline of the Shannon Estuary, to the southern shoreline where the cables make landfall approximately 600m west of the Kilpaddoge substation.

3.4 County Development Planning Policy Context

3.4.1 Clare County Development Plan 2017 - 2023

The *Clare County Development Plan 2017 – 2023* (CDP) includes the following objective in terms energy security;

- To promote and facilitate the achievement of secure and efficient energy supply, storage and distribution for County Clare

The CDP states that *'Clare County Council will continue to work closely with EirGrid to facilitate the on-going development of the grid infrastructure in line with national, regional and local requirements.* Energy transmission objectives have been provided within the CDP to support this:

In terms of objectives related to electricity networks (CDP8.38), the CDP states that it is an objective of Clare County Council to:

A *To facilitate improvements in energy infrastructure and encourage the expansion of the infrastructure within the County;*

B *To facilitate future alternative renewable energy developments and associated utility infrastructure throughout the County;*

C *To collaborate with EirGrid to facilitate the delivery of quality connection, transmission and market services to electricity generators, suppliers and customers utilising the high voltage electricity system in County Clare;*

D *To collaborate with EirGrid over the lifetime of the Plan to ensure that the County's minimum target of 966MW renewable energy generation is achieved and can be accommodated on the electricity network in County Clare;*

E *To have regard to environmental and visual considerations in the assessment of developments of this nature.*

Specific reference is made to the Cross Shannon 400 kV Cable project as follows:

EirGrid is currently progressing a number of projects to accommodate various energy generators and reinforce the National Grid. In County Clare the project will involve works at Moneypoint in order to allow increased use of the capability of the existing 400 kV overhead lines and the

proposed construction of a new submarine 400 kV cable to connect Moneypoint to North Kerry on the southern side of the Shannon Estuary.

The overall collection of policies and objectives contained within the CCDP establish a clear precedence for developing a sustainable and secure energy transmission system to facilitate emerging industrial sectors and continued investment within the growing Clare and national economy.

3.4.2 Kerry County Development Plan 2015 – 2021

The *Kerry County Development Plan 2015 – 2021* (CDP) includes the following objective in terms energy and power;

- **EP-1:** *Support and facilitate the sustainable provision of a reliable energy supply in the County, with emphasis on increasing energy supplies derived from renewable resources whilst seeking to protect and maintain biodiversity, archaeological and built heritage, the landscape and residential amenity.*
- **EP-3:** *Facilitate sustainable energy infrastructure provision, so as to provide for the further physical and economic development of the County.*
- **EP-4:** *Support and facilitate the sustainable development of enhanced electricity and gas supplies, and associated networks, to serve the existing and future needs of the County.*
- **EP-7:** *To support the sustainable expansion of the network. National grid expansion is important in terms of ensuring adequacy of regional connectivity as well as facilitating the development and connectivity of sustainable renewable energy resources.*
- **EP-8:** *Ensure that the siting of electricity power lines is managed in terms of the physical and visual impact of these lines on both the natural and built environment, the conservation value of Natura 2000 sites and especially in sensitive landscape areas. When considering the siting of powerlines in these areas the main technical alternatives considered should be set out, with particular emphasis on the undergrounding of lines, and the identification of alternative routes at appropriate locations. It should be demonstrated that the development will not have significant, permanent, adverse effects on the environment including sensitive landscape areas and the ecological integrity of Natura 2000 sites.*
- **EP-9:** *Support the sustainable implementation of EirGrid's Grid 25 Investment Programme, subject to landscape, residential, amenity and environmental considerations.*

With specific reference to the Shannon Integrated Framework Plan, it is an objective of Kerry County Council to:

- *Promote and facilitate the sustainable development of these lands for marine related industry, utilising the presence of deep water, existing infrastructure, natural resources, and waterside location to harness the potential of this strategic location. Alternative proposals for general industrial development, compatible or complimentary with marine related industry and / or those creating a synergism with existing or permitted uses and / or those contributing to the sustainable development of a strategic energy hub at this location will also be encouraged. Development will be subject to compliance with the objectives of this Plan, particularly as they relate to the protection of the environment and will also be subject to compliance with the Environmental Reports prepared in support of the SIFP, where appropriate.*

3.5 Conclusions

In summary it is clear that there is a strong national, regional and county (Clare and Kerry) planning framework supporting the development of the proposed Cross Shannon 400 kV Cable project.

4 Planning and Environmental Considerations

4.1 Introduction

The proposed Cross Shannon 400 kV Cable project has the potential to impact the receiving environment including the local population. This section has been prepared in order to present the key characteristics and features of the project study area for the Cross Shannon 400 kV Project, which are relevant for the identification of feasible transmission route options and for determining appropriate locations for a new substation location.

A constraint can be identified as "*any physical, technical, legal, environmental, topographical or other consideration that may potentially affect, limit, restrict or confine the proposed development within the study area"*

A high-level desk top study has been undertaken to identify relevant land-use planning policy and known technical and environmental constraints relevant to the project study area under consideration. The identified constraints have been mapped and are considered in identifying preliminary options and site location. The project study area has been characterised separately under the following key themes;

- Socio Economic and Land Use;
- Natural heritage;
- Landscape and Visual;
- Archaeology, Architectural and Cultural Heritage;
- Water and Flood Risk;
- Soils and Geology;
- Marine Aspects; and
- Noise.

A summary of each of the themes is presented below.

4.2 Socio Economic and Land Use

This section provides a consideration of population, settlement patterns and land use within the study area. An understanding of these spatial and land use constraints within the study area will allow feasible route options and site locations for the substation and high voltage transmission infrastructure to be fully considered. The key constraints are discussed in detail under the following broad headings;

- Population and Economic Profile;
- Land Use Patterns;
- Traffic and Transport; and
- Tourism and Recreation.

4.2.1 Resources

The material sources consulted as part of this desktop study are as follows;

- Strategic Integrated Framework Plan for the Shannon Estuary (2013);
- Clare County Council Development Plan 2017-2023;
- Kerry County Council Development Plan 2015-2021;
- A review of planning applications granted within last 5 years within the study area and functional areas of Clare and Kerry County Councils;
- An examination of Central Statistics Office (CSO) 2016 census data;
- A review of EPA Corine 2012 land use dataset;
- Utility providers for the information on any existing or proposed services within the project study area;
- OS mapping was consulted on for the location of all key infrastructure including road, rail within the study area; and
- A review of Fáilte Ireland website in relation to tourism as well as websites on local tourism organisations and enterprises within the study area.

4.2.2 Existing Constraints

4.2.2.1 Population and Economic Profile

The project study area extends over two land-based administrative areas within counties Clare and Kerry which are separated by the Lower Shannon Estuary. From a foreshore development perspective, the consenting authority for the Lower Shannon Estuary is the Department of Housing, Planning and Local Government.

The terrestrial extents of the study area are characterised by a blend of towns/villages including Killimer in County Clare and Tarbert in County Kerry, significant industrial (electricity generation) sites at Moneypoint (County Clare) and Tarbert (County Kerry), agricultural lands, residential dwellings and community facilities (tourism and recreation).

Shannon Estuary is the largest estuary in Ireland and is located between Loop Head in County Clare and Limerick City. The estuary has accommodated industrial development in the past and currently continues to do so including major industries such as Shannon Foynes Port (commenced 1846), Limerick Docks (commenced 1750 to 1840), Shannon International Airport (commenced 1942), ESB Moneypoint (commissioned 1985), SSE Tarbert Power Station (commissioned 1969), the National Oil Reserves Agency Fuel Storage at Tarbert and Aughinish Alumina (commenced 1983). The Strategic Integrated Framework Plan for the Shannon Estuary (SIFP) recognises that the electricity generation stations at Moneypoint and Tarbert have *'created a strategic energy hub within the Shannon Estuary, facilitating the growth of strategic grid infrastructure and other synergistic industries such as renewable energy and combined heat and power'.*

Within the study area the most significant employer is the Electricity Supply Board (Moneypoint electricity generation station). To the east of the study area is Tarbert island where the SSE electricity generation station is located. Kilpaddoge Energy Limited have secured planning permission from Kerry County Council for the development of an electricity generation station. In February 2019, Glencloosagh Energy Limited submitted a planning application (planning register reference: 19115) to construct battery storage units and associated equipment in the townland of Kilpaddoge as an alternative to the permitted and under construction Kilpaddoge Peaking Plant (planning register reference 13138, as extended by 139138). The Shannon Estuary within the project area functions as a commercial shipping channel and is Ireland's premier deepwater resource. Approximately 1,000 ships per year use the shipping channel carrying in excess of 12

million tonnes of cargo (approximately 20% of goods tonnage handled at national ports in Ireland) to six main facilities - the largest of which is Shannon Foynes Port. However equally it should be noted that the Shannon Estuary itself provides significant natural capital for the tourism, fisheries and aquaculture industries. Whilst fishing traditionally was an important industry for coastal communities in the region increasing environmental controls and restrictions on the amount and type of commercial fishing has resulted in a degree of decline of this activity in the estuary. The estuary is an important area for commercial aquaculture, the majority of current licensed activities focus on the cultivation of shellfish (in particular Pacific oysters) centred in locations outside of the project area in/near Rinvella, Carrigaholt, Poulnasherry Bay, Ballylongford Bay, Bunnaclugga Bay and adjacent to Aughinish Island. The only licensed site within the project area is held by Atlantic Shellfish Limited. The SIFP recognises the constraints on aquaculture development in the estuary associated with natural constraints (physical environment-high currents, sediment load) and potential industrial pollution.

Within the project area, a significant portion of the lands are used for agricultural enterprise. In addition, it should be noted that there a range of utilities installed and maintained by services providers in the project area including water services, telecommunications and electricity infrastructure.

County Clare

The study area incorporates the ESB electricity generation station at Moneypoint, in the townland of Carrowdotia South, within the Electoral Division (ED) of Kilrush Rural and the area directly east, within the ED of Killimer.

The immediate area surrounding Moneypoint Power plant is rural agriculture, with one-off housing. The nearest areas of settlement to Moneypoint Power Plant are Kilrush Town and Cappa village to the West and Killimer to the East.

According to the CSO, the total population of County Clare in the 2016 census was 118,817, of which Males numbered 58,785 and Females were 60,032. The total housing stock was 55,779, of which vacant households (excluding holiday homes) numbered 6,104. The total population in this ED was 726, of which Males numbered 380 and Females were 346. The total housing stock was 319, of which vacant households (excluding holiday homes) numbered 47.

The total population in Killimer ED was 480, of which Males numbered 248 and Females were 232. The total housing stock was 228, of which vacant households (excluding holiday homes) numbered 40.

County Kerry

According to the CSO, the total population of County Kerry in the 2016 census was 147,707, of which Males numbered 73,055 and Females were 74,652. The total population in Tarbert ED was 761, of which Males numbered 391 and Females were 370. The total housing stock was 411, of which vacant households (excluding holiday homes) numbered 84.

4.2.2.2 Agriculture and Aquaculture Industry

Another important employer in the study area is the agriculture and aquaculture industries. With the exception of the lands associated with electricity generation and transmission infrastructure the project study area is predominately open countryside, agricultural land and estuarine in nature. EirGrid has a Code of Practice with the Irish Farmers Association (IFA)/ESB for Survey, Construction and Maintenance of OHL in relation to the rights of landowners in place. As part of

the grid development process EirGrid will seek to engage with all landowners that are potentially directly impacted by the project.

Information sourced from the Department of Agriculture concerning aquaculture interests in the study area are depicted on drawing reference 379408-MMD-XX-00-GIS-Y-105 (Aquaculture/Fishery Interests) in *Appendix A Drawings.*

There are a range of designated aquaculture sites within or adjacent to the study area. These include the *West Shannon Ballylongford Designated Shellfish Waters* and the *West Shannon Poulnasherry Designated Shellfish Waters*. In addition, site reference T08/0004BOFO is located within the study area and relates to an Oyster Fishery Order issued in 1961 to SO Limited. There are a number of licensed aquaculture sites in the study area including T08/086 and T06/223. During the marine survey phase of the project the Department of Agriculture identified that there were two licence applications in process for oyster cultivation (application referenceT08/94) and mussels/seaweed (application reference Site T06/394B). A licence has been issued in respect of application reference T08/94 and the application in respect of T06/394B is still in process at the time of writing of this report.

4.2.2.3 Land Use Patterns

A detailed review of national and regional land use policies and development of core strategies, as set out in each local authority is provided in Section 3 of this report. The general location within which the proposed landfall and associated underground cable infrastructure on the northern shoreline of the Shannon Estuary is located in north County Kerry in the townlands of Coolnanoonagh and Kilpaddoge adjacent to Tarbert. The Kerry County Development Plan 2015 – 2021 makes specific reference to the zoning of the 'Tarbert/Ballylongford Land Bank', for marine-related industry, compatible or complimentary industries and enterprises which require deep water access. The immediate area surrounding the existing Kilpaddoge 220/110 kV substation within this landbank can be categorised as predominantly rural or on the fringes of ribbon development associated with Tarbert, however, a number of planning applications have been submitted for industrial type and energy related developments in the general location which are addressed further below.

The general location within which the proposed landfall and associated underground cable infrastructure on the northern shoreline of the Shannon Estuary is located in south County Clare. The land-use in the area is dominated by ESB electricity generation station at Moneypoint, agricultural pasturelands and one-off housing. The nearest areas of settlement within the study area is Killimer to the east.

The site of the existing Moneypoint electricity generation station is designated a SEVESO Upper Tier Site due to the presence of hazardous substances stored and used therein. The Clare County Development Plan 2017 – 2023 identifies Moneypoint Power Plant, and the immediate surroundings, as a Strategic Development Location (SDL) B, within an Area of Deep Sea Water.

Moneypoint SDL comprises approximately 280 hectares, 227 hectares of which is occupied by the Moneypoint Power Generation station. The general area surround the electricity generation station is also identified as a rural area under strong urban pressure.

As noted in Section 3.3, the SIFP identifies an Area of Opportunity for tidal energy within Shannon Estuary. There is opportunity area is located just off the coast at the Moneypoint strategic energy site. There are no known or planned projects are recorded within the identified Area of Opportunity.

As demonstrated in Section 3.4, the project is sympathetic to the overall development strategy set out in the Clare and Kerry County Development Plans in relation to the sustainable development of their respective counties. It is therefore considered that the project would satisfy both Planning Authorities (Local Authorities) tests for proper and sustainable development both in the context of broader county objectives and associated benefits of an augmented transmission network, as well as the specific land zoning for the lands under consideration for the construction of the proposed Cross Shannon 400 kV Cable project.

4.2.2.4 Planning Applications

A desktop search was undertaken of each Planning Authority's online planning enquiry system to review valid (granted) planning applications or currently live planning applications within the general Moneypoint and Kilpaddoge areas within the last 5 years. The only planning applications granted within close proximity are listed in the table hereunder;

Table 4.1: Planning Decisions within the last Five Years (Moneypoint)

Planning Authority	Reference Number	Applicant	Location	Description of The Development	Decision Made
Clare County Council	19746	The Electricity Supply Board	Moneypoint	A 1.8 ha site with a 300 to 400 mva syncronous condenser – including a generator and flywheel building and associated works	Decision due 20/11/2019
Clare County Council	18520	The Electricity Supply Board	Carrowdotia South	A c.7.5 MW capacity battery storage facility	21 August 2018
Clare County Council	17809	ESB Power Generation and Wholesale Market	Carrowdotia South	Two water storage tanks above ground level and an underground pump chamber	20 October 2017
Clare County Council	161011	EirGrid plc	Moneypoint	The refurbishment of the existing Moneypoint - Oldstreet 400 kV overhead line	21 February 2017
Clare County Council	16616	EirGrid plc	Carrowdotia South,	To extend the Appropriate Period of Planning Permission P11-457 for the development of electrical transmission infrastructure and associated works	August 2016
Clare County Council	14373	ESB Power Generation & Wholesale	Carrowdotia North, and South	development which will consist of works to the existing	14 August 2014

Planning Authority	Reference Number	Applicant	Location	Description of The Development	Decision Made
		Markets Division		32 HA ash repository site located within the Moneypoint generation station complex. A 20 year planning permission is requested.	
Clare County Council	14190	EirGrid plc	Carrowdotia South	A new indoor Gas Insulated Switchgear (GIS) 400 kV substation building (3463m2), 17m high, Two new 400/220 kV transformers with associated Switchgear, Three new 30m high lightning masts, and associated drainage and site works	04/06/2014

Source:(https://clarecoco.maps.arcgis.com/apps/webappviewer/index.html?id=7b81e3372c17498589994ec61006e846&find=17809, accessed 01 October 2019

Table 4.2: Planning History (Kilpaddoge)

Planning Authority	Reference Number	Applicant	Location	Description Of The Development	Decision Made
Kerry County Council	19115	Glencloosagh Energy Limited	Kilpaddoge	Battery Storage Units And Associated Equipment As An Alternative To The Permitted And Under Construction Kilpaddoge Peaking Plant (Ref: 13138, As Extended By 139138	FI request
Kerry County Council	18878	Shannon Clean Tech Ltd.	Kilpaddoge	Battery Energy Storage System Comprising 26 Units Adjacent To Kilpaddoge 220 Kv Substation	Clarification Request 29 March 2019
Kerry County Council	18392	Sse Renewables (Ireland) Ltd.	Tarbert Island	Battery Storage Unit Comprising 50 Units Within Tarbert Power Plant	18 February 2019 (Notification Of Grant)
Kerry County Council	171082	Andrew And Michelle Woods	Kilpaddoge	A Single Storey Porch Extension	12 December 2017

Planning Authority	Reference Number	Applicant	Location	Description Of The Development	Decision Made
				To Front, Extension To Rear, Including Demolition Of Conservatory And Alterations To Window Opes To Rear,	

Source:(http://kerry.maps.arcgis.com/apps/webappviewer/index.html?id=60710831bedf4d988572eb0ed41e618a , accessed 01 Oct 2019)

4.2.2.5 Community and Residential Facilities

A search of health care facilities and community and education facilities within the project study area was carried out from the Health Service Executive (HSE) and Department of Education websites.

Within, or in close proximity to, the project area there are a number of community facilities as set out in the table below. Tarbert Development Association perform an active role in the community and engage in a range of community development and social activities (www. http://www.kerrytourism.tarbert.ie/tarbert-development-association/). Kilrush Chamber of Commerce perform a similar function on the Clare side of the study area (http://www.westclare.com/).

Table 4.3: Stakeholders (Social and Community)

Community Organisations
Tarbert Development Association
Tarbert Community Care
Kilrush Lifeboat Station
Social/Sporting Organisations
Ballylongford Boat Club
Killimer GAA Club
Tarbert GAA Club
Religious Organisations
Tarbert Church Parish Office (Roman Catholic)
St. Brendan's Church Tarbert (Church of Ireland)
St. Imy,'s, Killimer and Knockera Parish (Roman Catholic)
Schools
Burrane National School (Killimer, County Clare)
Tarbert National School (Tarbert, County Kerry)
Tarbert Comprehensive School (Tarbert, County Kerry)
Community Facilities/Services
Tarbert Post Office
Kilrush Fire Station
Tarbert Garda Station
Kilrush Garda Station
Health Services
Ballylongford Health Centre (HSE)
Tarbert (various services including GP, pharmacy, Heatlh Centre (HSE)

Kilrush (various services including GP, dental, pharmacy, nursing homes)(HSE)
Killimer Community Hall
Shannondoc, Kilrush Treatment Centre

The social and community aspects of the project are likely to arise from indirect impacts. Such indirect impacts would be the temporary increase in marine traffic associated with the construction phase of the proposed development or the introduction of temporary traffic restrictions on the L1010 local road and N67 national secondary road to accommodate cable installation works. Of particular note is the location of the Tarbert Comprehensive School which is located on the L1010 road between the entrance to Kilpaddoge 220/110 kV substation and Tarbert.

4.2.2.6 Existing Utilities

Existing utilities information has been sourced through the relevant local authorities in the areas. For utilities inside ESB property, information has been provided directly by ESB.

There are no significant underground utilities installed in the N67 national secondary road. There are however, telecommunication and watermains running in this road within the study area. The watermain in the N67 splits and diverts off in the local road south east towards the coast.

There are also several HV overhead lines crossing the N67 road that converge at and connect to Moneypoint Substation.

Crossing the Shannon Estuary within the study area are the existing 220 kV Moneypoint-Kilpaddoge submarine cable installation and the 220 kV Prospect-Tarbert submarine cable installation.

Within the Moneypoint Electricity Generation Station, there are several types of underground utilities. Small power, telecommunications and water run throughout the power station, however, these do not pose a significant challenge to the cable installation. The main constraints within the power station are the existing HV cable circuits as well as the cable system associated with the on-site wind turbines.

Kilpaddoge is an existing operational 220 kV and 110 kV substation. The main utilities identified within the study area at Kilpaddoge consist of underground HV cable installations entering the substation from the north and south.

4.2.2.7 Moneypoint Electricity Generation Station and Industrial Emissions Directive

The ESB electricity generation station at Moneypoint is classified as a ‘higher tier’ establishment under the European Communities (Control of Major Accident Hazards Involving Dangerous Substances) Regulations, 2013, S.I. 571 of 2013 (Seveso III or COMAH Regulations). The Health and Safety Authority (HSA) has been designated as the central competent authority for the enforcement of the SEVESO III Directive and has established generic consultation distances for these facilities. Default consultation distances are noted within the Planning and Development Regulations,2001, as amended. For example, where pressurised flammable substances (including petroleum gas) are stored in bulk above ground, a distance of 600m from the establishment perimeter are noted within the Regulations. It is understood that the implications of each of the options for Major Accidents/Hazards on-site is outside the scope of this study. It should be noted in this context that the development is not of a type or nature which is subject to the Seveso III Directive.

The operations and environmental emissions from the electricity generation station are currently regulated by the Environmental Protection Agency under the existing Industrial Emissions Directive licence (register reference number P0605-04).

4.2.2.8 Traffic and Transport

Significant regional transportation routes in the study area include the N67 and N69 national secondary roads and the Shannon Estuary itself. The N67 national secondary road links Galway and Tarbert in County Kerry (with the final link between Killimer in County Clare and Tarbert in County Kerry being via the ferry across the River Shannon). The ferry is a significant local transport asset operated by Shannon Ferry Group Limited. The N69 national secondary road links Limerick and Tralee.

The Shannon Estuary within the project area functions as a commercial shipping channel and is Ireland's premier deepwater resource. Approximately 1,000 ships per year use the shipping channel carrying in excess of 12 million tonnes of cargo (approximately 20% of goods tonnage handled at national ports in Ireland) to six main facilities - the largest of which is Shannon Foynes Port[2].

4.2.2.9 Tourism, Recreation and Amenities

The Shannon Estuary is considered to be a strategic tourism asset. Sea angling and marine ecotourism are identified with the SIFP as *'thriving tourism industries within the Estuary and the West Clare Peninsula, with potential to grow further within the lifetime of the SIFP'.*

The Wild Atlantic Way is a defined tourist route along the western coast of Ireland over a distance of 1,400 km between Donegal and West Cork. A section of the Wild Atlantic Way passes through the northern extent of the project area along the N67 national secondary route connecting Kilrush and Killimer in County Clare. The Wild Atlantic Way connects to the N67 at Tarbert in County Kerry via passenger/vehicle ferry connection between Killimer and Tarbert (http://www.shannonferries.com/). Of particular relevance to the project area, the strategy for Marine Tourism & Leisure as contained within the SIFP identifies Kilrush as a service town with well developed marina facilities. SIFP identifies that tourism has the potential to contribute significantly to the economic success of Kilrush and its hinterland. Sea angling and observational marine tourism are recognised to be of growing importance in the estuary and Inland Fisheries Ireland are working to maximise the potential for sea angling and charter boat operations for angling tourism in the estuary.

Table 4.4: Stakeholders (Environment and Tourism)

Government Agencies
National Parks and Wildlife Service -Department of Culture, Heritage and the Gaeltacht
National Monuments Service - -Department of Culture, Heritage and the Gaeltacht
Underwater Archaeology Unit --Department of Culture, Heritage and the Gaeltacht
Coastal Zone Management Division (Department Housing, Planning, Community and Local Government)
Inland Fisheries Ireland
Marine Institute

[2] All AIS tracked vessel movements within the project area for periods 2015-2018 were provided by the port company

Bord Iascaigh Mhara
Sea Fisheries Protection Authority
Statutory Environmental Organisations
An Taisce
Other Environmental Organisations
BirdWatch Ireland
Shannon Whale and Dolphin Foundation
Planning/Environment Authorities
Clare County Council
Kerry County Council
Local Tourism/Environmental Groups
Killimer Tidy Village
Tarbert Bridewell Museum

Source: Mott MacDonald

4.2.3 Key Constraints

The key constraints associated with the proposed project within the project study area in terms of impact on socio economic and land use are summarised below.

Table 4.5: Key Constraints related to socio economic and landuse

What is the Constraint
Settlement Patterns: Proximity to residential and sensitive receptors may present challenges for route selection. Where possible cable infrastructure will be located within lands owned by the public or the ESB. The project development will have consideration of the zoning objectives set out in the County Development plan and local area plan.
Traffic and Transport: The installation of cable infrastructure in the N67 regional road may result in temporary traffic disturbance arising from the implement of traffic management measures/lane closure. Cable installation in local roads may also result in local road closures. Cable installation in the Shannon Estuary will need to be planned in a manner to reduce the potential for marine traffic disturbance.
Agriculture and Aquaculture Activities:. There is potential for agricultural lands and aquaculture interests to be locally affected by the proposed cable installation and associated transmission infrastructure. The route selection of the cable installation will need to be cognisant of the existing land uses.
Tourism, recreation and amenities: The installation of the proposed cable and associated infrastructure has the potential to impact known amenity sites and tourism activities. There are no recorded high amenity areas located within the project study area. However, the project may temporarily disrupt the use and enjoyment of facilities which could result in adverse impacts to the area's recreational amenity with potential economic drawbacks.
Traffic and Transport: The installation of cable infrastructure in the N67 regional road may result in temporary traffic disturbance arising from the implement of traffic management measures/lane closure. Cable installation in local roads may also result in local road closures. Cable installation in the Shannon Estuary will need to be planned in a manner to reduce the potential for marine traffic disturbance.

4.3 Biodiversity/Natural Heritage (Terrestrial)

A desktop assessment was undertaken to identify areas of ecological significance within the project study area which may form constraints to the Cross Shannon 400 kV Project. These ecological constraints will be considered further when identifying the project options.

Sites and areas of ecological significance within the project study area have been identified and included on the constraints drawing reference 229379408-MMD-XX-00-GIS-N-106 (Designated Sites) and 227379408-MMD-XX-00-GIS-N-107 (Ecological Features) included in *Appendix A Drawings.* Both international and national sites have been considered and discussed under the following heading:

- Designated Sites of International Importance; and

- Designated Sites of National Importance.

The desktop assessment was supplemented by windscreen surveys and where access was provided walkover surveys were carried out. In addition, other features likely to be of local ecological significance (non-designated) within the project study area are also considered as part of this constraints assessment. These areas include areas which support or are likely to support species protected under the Wildlife Act 1976 as amended and/ or under Annex IV of the Habitats Directive. Other features are considered as areas which contain Annex I type habitat, albeit outside of the boundary of a Special Area of Conservation. It is important that the conservation objectives of protected sites are considered throughout the project process..

4.3.1 Resources

Several ecological datasets and mapping data were consulted with for the purpose of this assessment. Datasets were obtained from government departments and national authorities including the following:

- Department of Arts, Heritage and Gaeltacht (DAHG);
- Department of Environment, Community and Local Community;
- Department of Agriculture, Food and the Marine; and
- Environmental Protection Agency (EPA).

The following sources were also utilised to inform the desktop assessment:

- EirGrid, 2012. Ecology Guidelines for Electricity Transmission Projects, A Standard Approach to Ecological Impact Assessment of High Voltage Transmission Projects.
- Existing relevant mapping and databases i.e. species and habitat distribution etc. (sourced from the Environmental Protection Agency (EPA), the National Biodiversity Data Centre (NBDC) and the National Parks and Wildlife Services (NPWS);
- Published and unpublished NPWS reports on protected habitats and species including Irish Wildlife Manual reports, Species Action Plans and Conservation Management Plans;
- Conservation Status Assessment Reports (CSARs), Backing Documents and Maps prepared in accordance with Article 17 of the Habitats Directive;
- Published data from BirdWatch Ireland; and
- Published documents and mapping from Inland Fisheries Ireland.

4.3.2 Existing Constraints

4.3.2.1 Designated Sites of International Importance

Sites identified as sites of international importance within the project study area including the following;

- Special Areas of Conservation (SACs) are areas with habitats protected by the designation under the Habitats Directive (92/43/EEC), as amended. The directive was transcribed into Irish law by the European Communities (Natural Habitats) Regulations, 2011-2015;
- Special Protection Areas (SPAs) are sites designated for the protection of habitats used by bird species. These areas are designated under the Birds Directive (2009/147/EC), the codified version of 79/4089/EEC as amended).

Both Directives are transposed in Ireland as the European Union (Birds and Natural Habitats) Regulations 2011 to 2015.

Lower River Shannon SAC (002165)

The lower River Shannon SAC bisects the study site and the boundary encompasses the coastal waters and shoreline within the study area. The Lower River Shannon SAC is designated for 21 features of interest. These are outlined in Table 4.6 below.

Table 4.6: Lower River Shannon SAC Qualifying Interests

Qualifying Interests (*indicates priority Habitat	
Annex I Habitats	**Annex II Species**
Sandbanks which are slightly covered by sea water all the time [1110]	*Margaritifera margaritifera* (freshwater pearl mussel) [1029]
Estuaries [1130]	*Petromyzon marinus* (sea lamprey) [1095]
Mudflats and sandflats not covered by seawater at low tide [1140]	*Lampetra planeri* (brook lamprey) [1096]
Coastal lagoons [1150]	*Lampetra fluviatilis* (river lamprey) [1099]
Large shallow inlets and bays [1160]	*Salmo salar* (salmon) [1106]
Reefs [1170]	*Tursiops truncatus* (common bottlenose dolphin) [1349]
Perennial vegetation of stony banks [1220]	*Lutra lutra* (otter) [1355]
Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]	
Salicornia and other annuals colonising mud and sand [1310]	
Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330]	
Mediterranean salt meadows (*Juncetalia maritimi*) [1410]	
Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]	
Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) [6410]	
Alluvial forests with *Alnus glutinosa* and Fraxinus excelsior (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0]	

Site specific conservation objectives have been produced for the Lower River Shannon SAC. The conservation objectives outline a set of targets and attributes for each of the qualifying interests for which the SAC is designated. These aim to define the favourable conservation condition for the designated habitats and species within the site.

River Shannon and River Fergus Estuaries SPA (004077)

The River Shannon and River Fergus Estuaries SPA also bisects the study site, with the boundary encompassing the coastal waters and shoreline within the study area. The River Shannon and River Fergus Estuaries SPA is designated for 22 qualifying interests. These are outlined in Table 4.7 below

Table 4.7: River Shannon and River Fergus Estuaries SPA Qualifying Interests

Species name	Population Type
Cormorant (*Phalacrocorax carbo*) [A017]	Breeding and wintering
Whooper Swan (*Cygnus cygnus*) [A038]	Wintering
Light-bellied Brent Goose (*Branta bernicla hrota*) [A046]	Wintering
Shelduck (*Tadorna tadorna*) [A048]	Wintering
Wigeon (*Anas penelope*) [A050]	Wintering
Teal (*Anas crecca*) [A052]	Wintering
Pintail (*Anas acuta*) [A054]	Wintering

Species name	Population Type
Shoveler (*Anas clypeata*) [A056]	Wintering
Scaup (*Aythya marila*) [A062]	Wintering
Ringed Plover (*Charadrius hiaticula*) [A137]	Wintering
Golden Plover (*Pluvialis apricaria*) [A140]	Wintering
Grey Plover (*Pluvialis squatarola*) [A141]	Wintering
Lapwing (*Vanellus vanellus*) [A142]	Wintering
Knot (*Calidris canutus*) [A143]	Wintering
Dunlin (*Calidris alpina*) [A149]	Wintering
Black-tailed Godwit (*Limosa limosa*) [A156]	Wintering
Bar-tailed Godwit (*Limosa lapponica*) [A157]	Wintering
Curlew (*Numenius arquata*) [A160]	Wintering
Redshank (*Tringa totanus*) [A162]	Wintering
Greenshank (*Tringa nebularia*) [A164]	Wintering
Black-headed Gull (*Chroicocephalus ridibundus*) [A179]	Wintering
Wetlands [A999]	Not applicable

Site specific conservation objectives have been produced for the River Shannon and River Fergus Estuaries SPA. The conservation objectives outline a set of targets and attributes for each of the qualifying interests for which the SPA is designated. These aim to define the favourable conservation condition for the designated species within the site.

4.3.2.2 Designated Site of National Importance

At a national level, the basic unit of conservation is the Natural Heritage Area (NHA). NHAs are designated to protect habitats, flora, fauna and geological sites of national importance. The legislative framework for NHAs is provided by the Wildlife Act, 1976 and the Wildlife (Amendment) Act, 2000. The Geological Survey of Ireland (GSI) have also compiled a list of geological/geomorphological sites in need of protection through NHA designation. In addition, there are over 600 proposed NHA (pNHA), which were published in 1995, but have not since been statutorily designated. These sites are of significance for wildlife and habitats. Prior to statutory designation, pNHA are subject to limited protection, however for the purposes of this project pNHA are considered as having the same extent of legal protection.

4.3.2.3 Natural Heritage Areas

There are no NHAs within the study area. The closest NHA, Bunnaruddee Bog NHA, is located approximately 6km to the south of the study area. The site consists of a raised bog, which has developed on a floodplain of the Galey River.

4.3.2.4 Proposed Natural Heritage Areas

There are no pNHAs within the study area. The closest pNHAs are Tarbert Bay pNHA and Ballylongford Bay pNHA. These sites are located approximately 900m to the east and 2km west of the study area respectively.

The boundaries for these two pNHAs overlap with that of the River Shannon and Fergus Estuaries SPA. Both sites are noted as being important for waterfowl associated with the River Shannon and Fergus Estuaries SPA in their respective site synopses.

4.3.2.5 Flora

Habitats and flora which occurs within the study area were also considered as part of the constraints assessment. Habitats of International, National, County and Local Importance were all considered.

4.3.2.6 Annex I Habitats

The EU Directive on the Conservation of Habitats, Flora and Fauna (92/43/EEC), commonly known as "the Habitats Directive", was adopted in 1992, came into force in 1994 and was initially transposed into Irish law in 1997 (NPWS, 2013)[3]. The main aim of the Habitats Directive is to contribute towards the conservation of biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species listed on the Annexes to the Directive at a favourable conservation status. Annex I Habitats are defined as habitat types whose conservation requires the designation of SAC (NPWS, 2013).

The potential for Annex I habitats associated with the Lower River Shannon SAC to occur within the study area is discussed below in Table 4.8.

Table 4.8: Annex I habitats location in relation to the study area

Annex I Habitats	Potential for occurrence within the site boundary
Sandbanks which are slightly covered by sea water all the time [1110]	This habitat has been derived from admiralty maps and mapped as part of the conservation objectives for the Lower River Shannon SAC (NPWS 2012). The habitat is not associated with the study area. The two areas which have been mapped are located in the mouth of the estuary, approximately 20km from the study area.
Estuaries [1130]	Estuaries have been mapped as part of the conservation objectives for the Lower River Shannon SAC (NPWS 2012). This habitat occurs throughout the study area.
Mudflats and sandflats not covered by seawater at low tide [1140]	Mudflats and sandflats have been mapped as part of the conservation objectives for the SAC (NPWS 2012). This habitat has not been recorded within the study area. The habitat is associated with bays along the fringes of the SAC. The closest mapped extent is located approximately 1.6km to the east of the study area.
Coastal lagoons [1150]	Coastal lagoons have been mapped as part of the Inventory of Irish Coastal Lagoons (Oliver 2007). The habitat has not been recorded within the study area. The closest mapped extent is located approximately 5.5km from the study area.
Large shallow inlets and bays [1160]	Large Shallow Inlets and Bays have been mapped as part of the conservation objectives for the Lwoer River Shannon SAC (NPWS 2012). The habitat is associated with the western end of the SAC. And extends as far east as Ballynote East. The closest extent of this habitat to the study area is approximately 2.6km to the east of the study area.
Reefs [1170]	Reef habitat has been mapped as part of the conservation objectives for the Lower River Shannon SAC (NPWS 2012). The habitat is mapped as occurring throughout the study area along the coastal fringes, and through the centre of the coastal area.
Perennial vegetation of stony banks [1220]	A number of records for Perennial vegetation of stony banks have been mapped as part of the National Shingle Beach Survey (Moore & Wilson 1999). No records for the habitat are located within the study area.

[3] NPWS (2013). The Status of Protected EU Habitats and Species in Ireland. Overview Volume 1. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland. Editor: Deirdre Lynn

Annex I Habitats	Potential for occurrence within the site boundary
	The closest record to the study area is located approximately 300m to the north east of the study area.
Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]	Vegetated sea cliffs have been mapped as part of the national survey and assessment of the conservation status of the Irish Sea cliffs (Barron *et al.* 2011). No records for the habitat occur within the study area. The closest mapped extent of the habitat is located approximately 13km to the west of the study area.
Salicornia and other annuals colonising mud and sand [1310]	Salicornia and other annuals colonising mud and sand have been mapped as part of the Saltmarsh Monitoring Project (McCorry & Ryle 2009). No records for this habitat are located within the study area. The closest mapped extent of the habitat is located approximately 3km to the east of the study area.
Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330]	Atlantic salt meadows have been mapped as part of the Saltmarsh Monitoring Project (McCorry & Ryle 2009). No records for this habitat are located within the study area. The closest mapped extent of the habitat is an area marked as “potential Atlantic slat meadows” which is located approximately 300m to the east of the study area.
Mediterranean salt meadows (*Juncetalia maritimi*) [1410]	Mediterranean salt meadows have been mapped as part of the Saltmarsh Monitoring Project (McCorry & Ryle 2009). No records for this habitat are located within the study area. The closest mapped extent of the habitat is located approximately 3km to the east of the study area.
Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]	This habitat has not been mapped within the SAC and is generally poorly defined in Ireland. No river waterbodies have been mapped within the study area. The only watercourses which have been identified as part of the desktop study are small scale drainage ditches which are unlikely to support this habitat.
Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) [6410]	The habitat has been mapped in Ireland as part of the Irish Semi Natural Grassland Survey (O’Neill *et al*. (2013). There are no records of Molinia meadows from the surveys within the study area. The closest record to the study area is approximately 15km to the south east.
Alluvial forests with *Alnus glutinosa* and Fraxinus excelsior (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0]	This habitat has been mapped as part of the conservation objectives for the Lower River Shannon SAC (002165). There are no records for this habitat within the study area. The closest mapped extent of this habitat is located approximately 35km to the east of the study area.

Annex I Habitats can also be found outside of designated SAC sites, however there are no records of any other Annex I habitats within the study area.

The potential for these habitats to be affected by the project will be dependent upon connectivity between the development and the habitat. This will be determined at the next stage of the project development.

4.3.2.7 General Conditions in the River Shannon

A marine geophysical and geotechnical investigation was undertaken within the study area during the summer of 2018 and the winter of 2018/2019. In terms of the ecological assessment the main focus of interest is the habitat type of the top *ca* 50 cms of the sea bed as it is this lens of sediment into which marine invertebrates can maximally penetrate; very few benthic infaunal organisms can live deeper in the sediment than that. Where hard substrates occur on the surface *e.g.* bed rock, epifaunal taxa such as sponges, hard corals, bryozoans and tunicates are amongst the main groups that colonise such habitat types. Within the survey area a variety of conditions were

encountered including dark grey fine to medium sands with patches of gravelly clay, yellow brown medium to coarse sand, dark grey fine to medium sands and gravelly clays, grey clay and gravelly clay and bedrock.

4.3.2.8 General Sub-Tidal Biology in the River Shannon

It is noteworthy that the geophysical and geotechnical surveys did not record any subtidal reef habitat where the NPWS mapping anticipated its occurrence [NPWS Conservation Objective mapping for Lower River Shannon cSAC (IE002165)]. The following communities were identified in the survey area-: subtidal sand with *Nucula nucleus* community complex and faunal turf dominated reef community, subtidal sand with *Nepthys spp* community complex, fucoid dominated intertidal reef community complex and *Laminaria* dominated community complex.

4.3.2.9 Inter-Tidal Biology in the River Shannon

The intertidal habitat in front of the existing Kilpaddoge 110/220 kV substation comprises of rocks, stones and gravel and some exposed bed rock. *Pelvetia canaliculata*, *Ascophyllum nodosum* and *Fucus vesiculosus* is present on the upper shore as are littorinids and barnacles. The intertidal habitat to west of the existing ESB Moneypoint electricity generation station also comprises of stones, gravel and some bed rock along with a similar suite of algae and invertebrates as observed on the inter-tidal habitat in from the existing Kilpaddoge 110/220 kV substation. The intertidal habitat at cove to the immediate east of the existing jetty as the ESB Moneypoint electricity generation station comprises bedrock with fucoids, littorinids and barnacles. The intertidal habitat at the cove to the east of the existing ESB Moneypoint electricity generation station comprises of stones and gravel with green algae and fucoids. In the general environs of this cove a small section of reed bed and salt marsh and noted.

4.3.2.10 Bird Usage

To assess the value of the study area to waterbirds reference was made to a survey undertaken by Keville McCarthy O'Sullivan on behalf of Clare County Council in 2017/2018 (Waterfowl numbers, usage and distribution on the River Shannon and the River Fergus Estuaries 2017-2018 Volume 1: Final Report, MKOS, 2019). The survey covered 85% of the River Shannon and River Fergus Estuaries SPA and all the tidal habitat within Areas of Opportunity, and adjacent to Strategic Development Locations, identified within the Strategic Integrated Framework Plan for the Shannon Estuary (including the general study area for this project). This survey is the most comprehensive waterbird survey of the River Shannon and Fergus Estuaries that has ever been undertaken, with year-round coverage of around 85% of the SPA. The only previous reasonably comprehensive survey was the WSP in 2010/11, which covered around 70% of the SPA and was limited to the October-February period.

The MKOS report was reviewed to determine the level of importance of the study area proposed for the Cross Shannon 400 kV cable. The relevant survey sites in the report are numbers ONO23 and ONO24 on the Clare coast and ONO 10 and ONO11 on the Kerry coast. The shoreline at the Moneypoint site never dries out and with the additional level of disturbance both at sea and on land, it is clear that the area is of little significance for water birds. There is some intertidal habitat both upstream and downstream of the generation station with the predominant substrate being gravel and stones and this type of substrate is used by only a small number of waterbirds e.g. Turnstone and Purple Sandpiper. There is an extent of muddy shoreline at low water at Killimer and this provides a feeding and roosting habitat for water birds. The habitat type at the existing Kilpaddoge 110/220 kV Substation is also stones with gravel and as noted above, this habitat is of limited use to many waterbird species. There is some terrestrial habitat at both sites on which some water bird species could forage and roost. Such species include Whimbrel, Lapwing and

gull species. The following bird species are the Species of Conservation Interest (SCI) for the Shannon and Fergus SPA: Cormorant (*Phalacrocorax carbo*), Whooper Swan (*Cygnus cygnus*), Light-bellied Brent Goose (*Branta bernicla hrota*), Shelduck (Tadorna tadorna), Wigeon (*Anas penelope),* Teal (*Anas crecca*), Pintail (*Anas acuta*), Shoveler (*Anas clypeata*), Scaup (*Aythya marila*), Ringed Plover (*Charadrius hiaticula*), Golden Plover (*Pluvialis apricaria),* Grey Plover (*Pluvialis squatarola*), Lapwing (*Vanellus vanellus*), Knot (*Calidris canutus*), Dunlin (*Calidris alpina*), Black-tailed Godwit (*Limosa limosa*), Bar-tailed Godwit (*Limosa lapponica*), Curlew (*Numenius arquata*), Redshank (*Tringa totanus*), Greenshank (*Tringa nebularia*) and Black-headed Gull (*Chroicocephalus ridibundus*).

With the exception of Cormorant, Whooper Swan and Black-headed Gull, the remainder of these 21 SCIs feed on mudflats or dabble at low water on similar substrates. Of the remaining three species, Cormorants feed on fish in the water, Whooper Swans feed either on freshwater vegetation or on grasses on land and Black-headed Gulls are omnivorous scavengers and are not restricted to the intertidal habitat.

The data indicates that the general area where the cable installation and associated infrastructure is proposed is not listed as an important site for total numbers of birds and also scored low to medium in terms of mean species richness and mean total numbers per count. The same area was also shown to be of limited use as bird flocking and roosting sites. The reasons for the area not being an important area for water birds is mostly likely due to the lack of suitable substrate. Another factor for the Clare side of the study area could also be due to the proximity to the existing Moneypoint electricity generation station.

4.3.2.11 Terrestrial Habitats of Local Importance

The terrestrial extent of the study area is dominated by improved agricultural grassland and existing development. The grassland is generally bordered by a mixture of hedgerows, mature treelines and drainage ditches. These linear habitats provide important ecological corridors for a range of protected species such as badgers and species of bats. The removal of hedgerows and treelines should be minimised where possible. Where removal is required appropriate measures to minimise impact should be implemented.

Two mature stands of woodland within the study area, to the north of Moneypoint have been mapped as part of a provisional inventory of ancient and long-established woodland (Perrin *&* Daly 2010) The survey mapped the stands as “potential ancient woodland”. A survey by Perrin *et al.* (2008) determined that the woodland is modified broadleaf woodland and gave the stands a conservation rating of “poor”. The survey also noted that the rare grass *Milium effusum* was recorded on the site. The woodland extends into a linear strip which likely contains areas of scrub. Despite the modified nature of the woodland, mature woodland is scarce in the wider landscape. In addition, the woodland likely provides important habitat for an array of species. As such, disturbance of this area of woodland should be avoided.

Other habitat within the project study area includes scrub, and amenity grassland. These habitats are likely to be some importance for wildlife within the area and are likely to provide some importance in maintaining habitat links.

4.3.2.12 Flora Protection Order Species

The presence of protected or rare species within the project area will be determined through completion of botanical surveys within the optimal survey period. Where the species are confirmed present, appropriate mitigation measures will be implemented to ensure the plant species are not disturbed.

Bryophytes

The Flora (Protection) Order, 2015 (S.I. No. 356 of 2015) gives legal protection to 65 species of bryophytes in the Republic of Ireland (25 liverworts and 40 mosses). The National Parks and Wildlife Service have grouped records of protected bryophytes into “taxon sites”. A Taxon Site is defined by the NPWs as “an assemblage of all the records for a particular taxon at a particular place (as there may have been several sightings of a taxon at roughly the same place, made by different people, and on different occasions over the years)”. There are no taxon sites located within the study area.

Known records of protected or rare species occurring within the study area was supplied by the national biodiversity data centre. There are no records of any

Flowering Plants

The National Biodiversity Data Centre collates records from a variety of sources. No records of any Flora Protection Order species were found within, or intersecting with, the study area.

Invasive Species

A number of invasive species have previously been identified within the study area. These include Fallow deer (*Dama dama*), Sika deer (*Cervus nippon*), and Spanish bluebell (*Hyacinthoides hispanica*).

The development of measures as part of the project will aim to avoid works in the vicinity of invasive species in order to prevent the spread and/or translocation of same. Where avoidance is not feasible invasive species management plans will be necessary.

4.3.2.13 Fauna

Mammals, insects, and amphibians

The National Biodiversity Data Centre (NBDC) records for protected species listed within the project study area was obtained study area. Species listed within the study area include species protected under both the Habitat Directive and the Wildlife Act (2000). An example of species previously recorded within the study area include common frog (*Rana temporaria*), marsh fritillary butterfly (*Euphydryas aurina*), bottle nosed dolphin (*Tursiops truncates*), common dolphin (*Delphinus delphis*), grey seal (*Halichoerus grypus*), badger *(Meles meles),* soprano pipistrelle bat (*Pipistrellus pygmaeus*), and whiskered bat (*Myotis mystacinus*).

Previous surveys of the site as part of an Environmental Impact Statement for a previous windfarm development at Moneypoint Electricity Generation Station have identified a number of potential bat roosts within the survey area. Surveys to inform the Environmental Impact Statement have also recorded otter spraints, and badger scat within the study area.

Other ecological receptors which are likely to occur within the project study area may include, but are not limited to:

- Bats and their roosting sites (various);
- Protected non-volant mammals and their resting sites (i.e. badgers, otters, red squirrel, pine marten etc.);
- Protected reptile and amphibian species;
- Protected invertebrate species
- Protected and rare flora species; and
- Breeding bird sites of significant conservation concern.

It is important that the project aims to avoid impacting or disturbing protected species and their resting sites. Where disturbance cannot be avoided appropriate mitigation may be required to ensure that the population(s) of protected species is not affected. Any such disturbance must be under license from NPWS.

Birds

As previously noted, the centre of the study area forms part of the River Shannon and Fergus Estuaries SPA which is designated for 21 species of waterbirds. Where works occur in proximity to the SPA there is a risk of disturbance to these birds.

A review of the NBDC records for protected bird species indicates that a number of protected bird species have previously been recorded within the study area. Examples of species previously recorded included bar-tailed godwit (*Limosa lapponica*), corn crake (*Crex crex*), dunlin (*Calidris alpina*), great northern diver (*Gavia immer*), hen harrier (*Circus cyaneus*), little egret (*Egretta garzetta*), Meditteranean gull *(Larus melanocephalus*), merlin *(Falco columbarius*), peregrine falcon (*Falco peregrinus*), red throated diver (*Gavia stallata*), ruff (*Philomachus pugnax*), sandwich tern (*Sterna sandvicensis*), and whooper swan (*Cygnus cygnus*).

As part of the Site-Specific Conservation Objectives data supplied by the NPWS for the SPA, locations of Waterbird Survey Programme count subsites have been mapped. The Waterbird Survey Programme surveyed key coastal wetland sites which have been designated as Special Protection Areas. There are no count subsites within the survey area. Under the survey programme roost locations were also identified within the SPA. No such roosting locations were recorded within the survey area.

The Irish Wetland Bird Survey (I-WeBS) is a scheme undertaken by Bird Watch Ireland which monitors wintering birds at various site and subsite across Ireland. The monitoring site “Ardmore Pt-Tarbert Race” is located within the study area.

No important wintering bird sites were recorded located within the project study area. There is potential however that wintering bird species may commute through the project study area to reach suitable wintering sites located to north and south of the study area.

Fisheries

The EPA mapping of river waterbodies in Ireland does not show any significant fresh water watercourses within the study area. Data is available from the IFI fish survey map on the transitional water which makes up the centre of the survey area. Records from the fish survey map included European eel *(Anguilla anguilla*), smelt (*Osmerus esperlanus*), and cod (*Gadus morhua*).

The key constraints associated with the Cross Shannon 400 kV Project within the project study area in terms of impact on natural heritage are summarised in Table 4.9 below.

Table 4.9: Summary of Key Biodiversity Flora and Fauna Related Constraints

What is the constraint
Damage / Loss of protected Habitat / protected species: There is potential for the direct loss or damage to protected habitats and species within the project study area due to the development. The proposed works will require crossing of the Lower River Shannon Estuary SAC/ River Shannon and River Fergus Estuary SPA. This will include works within the SAC boundary, there is therefore a risk of impacts to SAC and SPA and the designated habitat and species associated with these designated sites. Targeted field surveys of protected habitats and areas which support protected species within the proposed works area will highlight areas to avoid where possible and eliminate potential impacts or recommend appropriate mitigation.
Fragmentation and degradation of Habitats: There is potential for the degradation of habitats and connectivity between habitats due to the provision of the project. This includes potential loss or damage to hedgerows and tree lines which are important wildlife corridors for numerous species, particularly bats and mammals. There is potential

What is the constraint
for the project to obstruct or impair mammal movements during the construction stage. The identification of ecological corridors and important habitats will ensure the movement of species between identified sites are not impaired by the project.
Disturbance: Potential impacts during the construction phase include the displacement of species from roosting / resting / breeding and foraging areas. Avoidance of important ecological features will be prioritised where possible. In the event where works located within or in proximity to designated sites and ecological features appropriate mitigation measures will be implemented to minimise disturbance.
Water quality impacts: There is potential for water quality impacts due to the release of polluted emissions into the Lower River Shannon SAC and the River Shannon and Fergus Estuary SPA. This has the potential to result in damage to sensitive habitats associated with the SAC and SPA.

A detailed review of the potential ecological constraints and ecological sensitivities is outlined above. This constraint assessment is based on desktop review and whilst every effort has been made to identify all ecological constraints it is considered that other local detailed ecological constraints may be identified as the project progresses through completion of field surveys as part of the design development and environmental impact assessment processes for the best performing solution. It is important that the conservation objectives of protected sites are considered throughout the project process.

4.4 Landscape and Visual

County Clare

The ESB Moneypoint electricity generation station and associated transmission infrastructure dominates the landscape in the study area in County Clare.

The Clare County Development Plan 2017 – 2023 designates Moneypoint Power Plant as a Working Landscape (under the heading 'Living Landscapes'). The areas of Kilrush and Killimer area categorised as Heritage Landscape. The surrounding areas are categorised as Settled Landscapes and Landscape Character Type: Farmed Rolling Hills. The N67, to the west of Moneypoint Power Plant, is identified as a scenic route.

Working Landscapes are defined in the CDP as those areas within Settled Landscapes that contain pockets of concentrated development or a unique natural resource.

The CDP identifies two such landscapes in the County; The Western Corridor - Ennis to Limerick Working Landscape and The Shannon Estuary Working Landscape. The Shannon Estuary Working Landscape includes all shores and waters between Moneypoint to Ballynacragga Point excluding Clonderalaw Bay.

CDP 13.4 outlines the Development Plan objectives in relation to Shannon Estuary Working Landscape; as follows:

- *A: To permit development in these areas that will sustain economic activity of regional and national significance – especially through the protection of resources to sustain largescale energy projects, logistics, large-scale manufacturing and associated infrastructure. All such developments shall be required to conform to relevant management and conservation objectives for designated and protected habitats and species within the estuary;*
- *B: That selection of appropriate sites in the first instance within this landscape, together with consideration of the details of siting and design, are directed towards reducing visual impact and that residual visual impacts are minimised;*
- *C: That particular regard should be given to avoiding intrusions on scenic routes and on ridges or shorelines. Developments in these areas will be required to demonstrate: i That sites have been selected to avoid visually prominent locations wherever feasible; ii That site layouts avail*

of existing topography and vegetation to reduce visibility from scenic routes, walking trails, public amenities and roads; iii That design for buildings and structures reduce visual impact through careful choice of form, finish and colours and that any site works seek to reduce visual impact of the development.

- *Applicants for planning permission in these areas will be expected to familiarise themselves with the requirements in relation to the protection of water resources and should be aware of the likely need to prepare and submit a Natura Impact Statement should the Council determine that an appropriate assessment is required in accordance with the requirements of Article 6 of the Habitats Directive in tandem with the preparation of designs.*

To the east of the 'working landscape' associated with the ESB Moneypoint electricity generation station there is an area of 'heritage landscape' stretching from Killimer to Cahercon, surrounding Clonderlaw Bay.

There are a number of Trees for Preservation within the boundary of the existing Moneypoint electricity generation station and to the west/south west of Killimer. It is a written objective of Clare County Council in the County Development Plan;

- *To preserve and conserve individual or groups of trees identified in Volume 2 of this Plan as 'Trees for Preservation' which will enhance the character and appearance of an area*

County Kerry

The study area on the south side of the River Shannon Estuary setting is predominantly rural and dominated by an area zoned for industry (Kerry County Development Plan 2015 – 2021). The only above ground works to facilitate the connection of the proposed Cross Shannon 400 kV Cable will be located within the existing ESB landholding at the Kilpaddoge 220/110 kV substation, most likely on the eastern side of the existing substation (in the un-development lands immediately west of the Kilpaddoge Energy Limited site.

4.4.1 Existing Constraints

4.4.1.1 Scenic Routes and Views

County Clare

There is a section of scenic route (N67) between Kilrush and the ESB Moneypoint electricity generation station which is part of the Wild Atlantic Way tourist route. It should also be noted that the ferry route between Killimer in County Clare and Tarbert in County Kerry is also part of the Wild Atlantic Way.

County Kerry

There is no scenic route defined in the study area within County Kerry, however it is noted that the Wild Atlantic Way tourist route continues from the ferry terminal at Tarbert along the N67 road prior to joining the R651 regional road and travelling in a south-westerly direction outside of the study area towards Ballylongford in County Kerry.

There are protected views and prospects towards Ballylongford Bay and Tarbert Bay on the edges of the study area.

4.4.1.2 Sensitive Visual Receptors

Due to the nature of the project being predominantly a submarine or below ground cable it is considered that there is no potential for significant visual impact associated with its installation.

There are however particular elements which have the potential to have overground aspects to same. On the County Clare side the connection will be within the existing Moneypoint substation and as such no additional above ground infrastructure is envisaged, however depending on the selection of the location of the landfall on the northern shorelines of the Shannon Estuary there may be a requirement for some civil infrastructure (slipway/jointing bay) to accommodate the installation of the cables in the inter-tidal/ tidal area At the County Kerry side at the connection point adjacent to the existing Kilpaddoge substation there will be a requirement to construct some additional hardstanding surfaces and extending the existing palisade fenceline. In addition, similar to the northern shoreline of the estuary, there may be a requirement for some civil infrastructure (slipway/jointing bay) to accommodate the installation of the cables in the inter-tidal/supra tidal area.

It is considered that the most sensitive aspects of the project will be the selection of the landfalls and the development of the infrastructure associated with same, particularly due to the stated objective in the County Clare Development Plan to avoiding intrusions on scenic routes and shorelines. In addition, particularly attention needs to be paid to the protection of stands of trees adjacent to the ESB electricity generation station and Killimer when routing underground cables on land.

Key constraints

The key constraints associated with the development of major transmission infrastructure within the project study area in terms of potential to impact on landscape are summarised in Table 4.10 below.

Table 4.10: Summary of Key Landscape and Visual Related Constraints

What is the constraint
Proximity to Scenic routes or Viewpoints or landscape sensitivity or value etc. The selection and design of the proposed landfalls on the northern and southern shorelines could result in impacts on the landscape. Careful selection of the landfall location and design, in addition to selecting cable routes which avoid impacts on protected stands of trees will be fully considered throughout the project delivery process.

The County Development Plans for Clare and Kerry County Council were reviewed in order to identify relevant features to the landscape and visual constraints and their local polices with regards to transmission projects. The landscape significant features which have been afforded particular attention within each local authority were mapped on accompanying constraints map. At this stage where possible, sensitive landscape and complex terrain will be avoided or during next stage of the project development, if this is not possible, they will be fully considered at a more site-specific scale.

4.5 Archaeology, Architectural and Cultural Heritage

The Archaeological Diving Company (ADCO) completed an assessment of features of archaeological, architectural or cultural heritage significance which could be impacted by the proposed Cross Shannon 400 kV Cable project. The assessment has been carried out having regard to the methodologies contained in the EirGrid 'Cultural Heritage Guidelines for Electricity Transmission Projects' (EirGrid 2015) and the 'The Code of Practice between the Minister of EHLG (now CHG) & EirGrid in relation to Archaeological Heritage' (2009).

The Code of Practice outlines the principles and measures to be applied to ensure the protection of Ireland's archaeological heritage whilst developing and upgrading the existing transmission system. It is generally guided by the following principles:

- Every effort will be made to avoid direct impacts on archaeology;
- Mitigatory planning will take place at the earliest opportunity as it minimises the impact on the archaeological heritage;
- EirGrid and the Minister of Arts Heritage and the Gaeltacht (now referred to as Culture, Heritage and the Gaeltacht) will co-operate to ensure, as far as possible, that appropriate archaeological investigation is carried out during the period from route identification to the commencement of construction;
- If avoidance cannot be achieved, EirGrid will finance a balanced and cost-effective approach to archaeological investigation, excavation and mitigation as an integral element of the transmission system development programme.

In accordance with EirGrid's Cultural Heritage Guidelines (EirGrid, October 2015), the objective for the cultural heritage constraints study is to provide a high-level understanding of the key likely significant constraints within the project study area. It is a tool to ensure that cultural heritage assets are considered alongside all other environmental constraints at the earliest possible stage of the transmission system planning process and that consideration is given to all alternatives. This assessment provides an archaeological and historical background to the area and will highlight the designated archaeological sites and sites of architectural heritage significance within the defined constraints area. It aims to establish as far as the records allow the archaeological and cultural/built heritage potential of the project study area and to highlight if there are any implications for the development of the substation and associated connections.

The information contained within the constraint study will be used to assist the decision-making process and inform the design and planning of the scheme.

4.5.1 Resources

A desktop review of the following information took place to inform the cultural heritage assessment:

- UNESCO World Heritage Sites (WHS) and Tentative World Heritage Sites and those monuments on the tentative list;
- National Monuments in State care, as listed by the National Monuments Service (NMS) of the Department of Culture, Heritage and the Gaeltacht (DCHG);
- Sites with Preservation Orders;
- Sites listed in the Register of Historic Monuments;
- Record of Monuments and Places (RMP) and the Sites and Monuments Record (SMR) from the Archaeological Survey of Ireland;
- Record of Protected Structures (RPS);
- National Inventory of Architectural Heritage (NIAH) Building Survey (NIAH ratings are international, national, regional, local and record, and those of regional and above are recommended for inclusion in the RPS);
- National Inventory of Architectural Heritage (NIAH) Garden Survey (paper survey only);
- Cartographical Sources, OSi Historic Mapping Archive, including early editions of the Ordnance Survey including historical mapping (such as Down Survey 1656 Map);
- The Irish archaeological excavations catalogue i.e. Excavations bulletin and Excavations Database;
- Historic Shipwreck Inventory;

- A review and interpretation of aerial imagery (Google earth 2001–2017, Digital Globe 2017, Bing 2017) to be used in combination with historic mapping to map potential cultural heritage assets; and
- A review of existing guidelines and best practice approaches.

A desktop assessment and site walkover/inter-tidal survey was undertaken to identify areas of cultural heritage significance within the project study area which may form constraints to the Cross Shannon 400 kV Project. These cultural heritage constraints will be considered further when identifying the project options.

Sites and areas of archaeological, architectural and cultural heritage significance within the project study area have been identified and included on the constraints drawing 229100457-MMD-XX-00-GIS-N-111 (Cultural Heritage sites).

The Shannon Estuary is the largest inlet located along the Irish coastline and constitutes an exposed inter-tidal zone around 200km in length (combined length of both sides of the river). The estuary is part of a dynamic landscape that includes raised bogland, freshwater fens, salt marshes and intertidal mudflats. Research conducted in the 1990s highlighted the archaeological importance of the Shannon estuary since earliest times. The inter-tidal environment provides for an extremely rich archaeological holding content and archaeological/palaeoenvironmental evidence of Mesolithic, Neolithic, Bronze Age and post-medieval date has been recovered. Large sections of the estuary provide suitable environmental conditions for the preservation of archaeological material along its intertidal zone, where deep deposits of estuarine mud provide an anaerobic environment within which archaeological material is preserved. Areas of submerged Neolithic forest have been identified, buried deep within the estuarine clays. The distribution of known medieval and early modern/nineteenth-century fortifications along the estuary was well known, but the new work highlighted the as-yet undocumented foreshore areas with relict fish weirs and old piers as features that can retain significant and early phases of use.

4.5.2 Existing Constraints

4.5.2.1 Cartographic Information

The OS First Edition (1842) 6-inch to the mile map depicts a gently curving intertidal foreshore composed of shingle with occasional areas of bedrock outcropping along the upper foreshore. The intertidal zone is shown extending in a south-westwardly direction to the Low Water Mark (LWM) for a distance of c. 50m, although in places the foreshore is shown to extend further, with up to c. 80m of exposure. A finger of exposed shingle, measuring up to c. 60m width, is also shown extending from the LWM in a westerly direction for a distance of c. 400m (Map Item 1). A sub-rectangular spit/islet of bedrock is depicted a short distance to the south (c. 170m), located c. 58m southwest of the LWM (Map Item 2). This cartographic feature measures c. 166m in length x c. 62m in width and is annotated ‘Visible at Low Water’.

A roadway, the present-day N67 (Killimer road), runs immediately adjacent to the upper foreshore for a distance of c. 640m before continuing westwards at an increasing distance from the shoreline. A number of small rectangular dwellings are dotted along the north side of the roadway. A second road conjoins with the former, at a point approximately one quarter of the way around Ballymacrinan Bay (travelling east-west); travelling northwards through the townlands of Ballymacrinan and Dysert. Small holdings are also located along this roadway, positioned on either side of the road.

The wider landscape depicted on the OS 25-inch to the mile map (1888-1913) is largely similar to that shown on the earlier map series. However, a number of alternations/additions to previous

cartographic features are evident. Foreshore topography remains largely unchanged, comprising a shingle beach with an intertidal extent that ranges between c. 45m and c. 86m. There is a sizeable reduction in the size of a shingle finger that extends from the LWM (Map Item 7) and an alteration in the size/shape of a nearby bedrock spur/islet now annotated 'Carrigogore' and shown to be a shingle deposit rather than exposed bedrock. Clearly the tidal-dynamic along this stretch of the bay has changed over time, resulting in the removal of material from the former and the deposition of material at the latter. In addition, shelving bedrock is now depicted at the southeast extent of the bay area, comprising the full extent of the intertidal area at that location. It is reasonable to assume that the shingle deposits originally covering this area of foreshore bedrock were removed and re-deposited elsewhere during the intervening period between the two map editions. A short distance (c. 27m) to the northeast of this area of bedrock, there is now a foreshore structure recorded; annotated 'Salmon Weir'). The fishtrap is orientated roughly east-west and measures 83m in length; extending 38m across the intertidal foreshore and 45m across the sub-tidal zone. No other structures are depicted on the OS 25-inch map for the area under assessment. The three earthworks, as shown on the First Edition Map (Map Items 3-5), are also included on this map edition although they are now depicted in slightly greater detail – Map Item 4 now forms a clearly defined ringfort. In addition, the possible quarry feature (Map Item 6) is now confirmed as such, annotated as 'Quarry (Disused)'. It has two rock extraction areas with trackways leading between the two areas, and three associated building structures (Map Item

4.5.2.2 National Monuments and Record of Monuments and Places (RMP) Sites

The Record of Monuments and Places (RMP) is a list of archaeological sites based on the Sites and Monuments Record (SMR) files, maintained by the National Monuments Service at the DCHG.5 SMR entries include detailed descriptions of archaeological sites based on site visits and historic studies and associated mapping where available. The SMR focuses on sites that are pre-1700AD in date, and so includes the ringforts and associated features recorded on the OS maps. However later buildings, including the fishtraps and historic house and foreshore buildings are not typically included in the archive, yet all structures that are more than 100 years old are considered as archaeological sites today. Thirty-nine (39) RMP sites are listed in the vicinity of the foreshore areas within the study area where the cable installation is under consideration (1.5km radius), although only one (CL067-030; Earthwork) is located in close proximity to one of the landfall assessment areas (N1). At a remove from the shoreline, but within 1.5km radius of the coastline, is a series of other archaeological sites that provide clear evidence of the early medieval settlement of the townlands located on either side of the estuary. A number of souterrains and a ringfort in Kilpaddoge townland, Co. Kerry, attest to this occupation. The picture is mirrored on the north side of the estuary with ringforts and associated structures located in the townlands of Carrowdotia North and Carrowdotia South.

4.5.2.3 National Inventory of Architectural Heritage

The National Inventory of Architectural Heritage (NIAH) is a county-by-county database that identifies, records, and evaluates the post-1700 architectural heritage of Ireland as an aid to the protection and conservation of the nations' built heritage.6 The NIAH surveys provide the basis for the recommendations of the Minister for the DCHG to the planning authorities for the inclusion of particular structures in their Record of Protected Structures (RPS). There are no entries listed in the NIAH for the townlands under assessment.

4.5.2.4 Topographical Archive

The topographical files held at the National Museum of Ireland record objects that have been reported to the Museum or form part of its national collections. The records have been catalogued

according to county and townland. There are currently no entries in the Topographic Archive relating to the area under assessment.

4.5.2.5 Historic Shipwreck Inventory

The Historic Shipwreck Inventory at the DCHG is a national archive that seeks to include all shipwreck events recorded in Ireland since records began to be made systematically since c. 1750 AD. It does not claim to represent a systematic record of wrecking prior to this date. The Inventory is made up principally of recorded incidents of wrecking. The locations of these wrecking incidents are not absolute and refer to the nearest headland or other known topographic feature. There are far fewer known locations of shipwreck, where wreckage has been identified on the seabed from sources such as marine geophysical survey, diver-truthing, fishermen's records or combinations of these and related sources.

In relation to the present survey area, the headlands considered for the assessment include Moneypoint, Money Point, Burrane Point, Clonderalaw Bay, Kilkerin Point, Bolands Rocks and Colman's Point on the Clare side, and Ballydonohue Point, Tarbert, Carrigaduaun, and Ardmore Point on the Limerick/Kerry side. The Inventory records only ten wrecking events, and none of these have been confirmed in terms of specific coordinates for actual wreckage surviving in situ. It should also be noted that despite comprehensive marine geophysical survey between Tarbert and Moneypoint conducted in 2008 for a previous cable lay and also in 2018 associated with the proposed Cross Shannon 400 kV submarine cable there were no observations made of shipwreck material. There are significantly more events of historic wrecking recorded downriver at Scattery Island and upriver at Foynes. Tarbert is a tricky anchorage and suffers from a strong ebb-tide. This may explain the absence of shipwrecking incidents noted in the Tarbert and Moneypoint area

4.5.2.6 Excavations Bulletin

The excavations bulletin provides an annual published and online summary of accounts of archaeological excavations undertaken throughout Ireland.10 Summaries may also be submitted for inter-tidal survey, underwater assessments, and the archaeological monitoring of marine/ riverine dredging works. Archaeological monitoring for the previous cable-lay between Tarbert and Moneypoint did observe two series of timber posts or stakes in the nearshore sands off Kilpaddoge, Co. Kerry. Four stakes were considered to be associated with a previously unrecorded nineteenth-century salmon weir, and three other stakes may have been associated with a weir and part of a rope fragment recovered from dredge spoil associated with this second set of stakes was dated to the Bronze Age, at 1815+/- 55CAL BC.

4.5.2.7 Intertidal Inspection

Eight features of archaeological/historical interest were encountered as part of the intertidal inspection. The majority are related to the nineteenth-century exploitation of the estuary while a section of submerged woodland and peat-saltmarsh (adjacent to the inter-tidal area east of the existing ESB Moneypoint electricity generation station) is likely to date back to prehistory, and a souterrain (on the intertidal area associated with the southern-shoreline west of the existing Kilpaddoge 220 kV substation) on the southern shore would date to the Early Medieval period (c. 500-110 AD). There was no indication of the wooden posts/stakes identified during archaeological monitoring work completed during the 220 kV cable installation project.

4.5.2.8 Marine Geophysical Survey

As part of the assessment undertaken to date a marine geophysical survey was undertaken under archaeological licence held by ADCO. The survey vessel was Dulra na Mara and the survey was conducted from Kilrush Marina between 27/07/2018 and 24/08/2018. There are no clearly defined

features associated with shipwreck, and while most of the anomalies identified may be considered to be either natural items such as rocks or modern debris, the data does highlight two areas that could be of further interest. Side scan sonar anomaly ss18 in the southern sector of the survey area, off Carhoonakineely townland in Glencoosagh Bay is a stone alignment that lies close to a former fishtrap and may be related to it. Secondly, the magnetometer data highlights the inshore area at the north side of the survey area in the vicinity of landfalls N2 and N3 as a busy sea area that can be expected with the presence of the former quarry sites and quays to the east of the existing ESB Moneypoint electricity generation station. In neither instance was it considered that the findings from the geophysical data would significantly influence the selection of the proposed cable installation and associated transmission infrastructure however it does highlight the need for the project development process to be mindful of the archaeological risk associated with the Shannon estuary.

4.5.3 Key Constraints

The key constraints associated with the development of major transmission infrastructure within the project study area in terms of potential to impact on Cultural Heritage are summarised in Table 4.11 below.

Table 4.11: Summary of Key Cultural Heritage related Constraints

What is the constraint
Protecting existing cultural heritage assets Research conducted in the 1990s highlighted the archaeological importance of the Shannon estuary since earliest times. The inter-tidal environment provides for an extremely rich archaeological holding content and archaeological/palaeoenvironmental evidence of Mesolithic, Neolithic, Bronze Age and post-medieval date has been recovered. A range of intertidal, marine and historic mapped features as well as marine survey anomalies exist within the study area which need to be avoided wherever possible.
Encountering new archaeological finds The installation of the proposed cable has the potential to encounter previously unrecorded features of significant cultural heritage interest. Large sections of the estuary provide suitable environmental conditions for the preservation of archaeological material along its intertidal zone, where deep deposits of estuarine mud provide an anaerobic environment within which archaeological material is preserved. Areas of submerged Neolithic forest have been identified, buried deep within the estuarine clays. The distribution of known medieval and early modern/nineteenth-century fortifications along the estuary was well known, but the foreshore areas can retain features such as with relict fish weirs and old piers that can retain significant and early phases of use. The identification of the constraints within the project study area will allow feasible route options and site locations for cable and associated transmission infrastructure to be considered

It was concluded that the archaeological potential within the study area based on existing data highlights the shorelines as locations that retain simple quays and former fish traps. As demonstrated during the archaeological monitoring of the previous cable lay, the potential to observe new material during construction remains high. The inshore environment retains expanses of soft sediment and features such as buried fishtraps remain invisible to marine geophysical prospection.

4.6 Water Resources and Flood Risk

A desktop review was carried out to identify the main constraints within the project study area relating to water resource and flood risk. This section identifies the areas that should be avoided, where possible, in order to minimise water related effects.

4.6.1 Resources

Key datasets utilised for the purposed of this section were sourced from the following organisations:

- EPA (Water Framework Ireland Map viewer) databases for information on surface water features within and adjacent to the project study area and designated sites within and adjacent to the study area;
- Office of Public Works (OPW) Flood Risk Maps. (www.floodinfo.ie); and
- Office of Public Works Irish Coastal Protection Strategy Study (https://www.opw.ie/en/floodriskmanagement/floodanderosionmapping/icpss/wp234asw/).

4.6.2 Existing Constraints

4.6.2.1 Water Resources

The main surface water body within the study are is the Lower Shannon Estuary. The Lower Shannon Estuary transitional waterbody has been identified as having a 'Moderate' Water Framework Directive (WFD) Status (2010-2015) by the Environmental Protection Agency (EPA) and thus is 'At Risk'.

4.6.2.2 Flooding and Coastal Erosion

Flooding in the general study area was assessed by accessing the Office of Public Works data portal (www.floodinfo.ie) and the Flood Risk Management Plans for (i) Shannon Estuary South and (ii) Shannon Estuary North & Mal Bay (OPW, 2018). On the southern side of the Shannon Estuary historical flood events and future coastal flood risk has identified Tarbert Island [and its approach road from the south (N67)] as being at risk of flooding in addition to the Ballylongford catchment. On the northern side of the Shannon Estuary historical flood events have been recorded at Kilrush and Cappagh. The Irish Coastal Protection Strategy Study for the South West Coast under the most conservative modelling assumptions have identified areas at potential risk from tidal flooding. These locations are generally located in the immediate environs of the shoreline with the exception of Tarbert Island which is considered to be most vulnerable under the 'high end scenario'. The assessment of coastal erosion risk completed by the OPW did not identify the study area as being at significant risk of erosion.

4.6.2.3 Water Framework Directive – Register of Protected Areas

While the overall objective of the Water Framework Directive is to achieve good status for all waterbodies by 2015, some waterbodies require extra protection by virtue of their location in a protected area or their function as a drinking water or bathing water. In accordance with the requirements of the Water Framework Directive and the associated national regulations a register of protected areas has been set out for each River Basin Districts in Ireland.

The protected areas are identified as those requiring special protection under existing National or European legislation, either to protect the surface water resource, or to conserve habitats or species that directly depend on those waters. The different protected areas included in this register are:

- Drinking waters;
- Nutrient Sensitive Areas (including areas designated as Vulnerable Zones); and
- Water Dependent Habitats & Species (SAC, SPA and Salmonid Water).

Drinking Waters

The Council Directive 98/83/EC of 3rd November 1998 on the quality of water intended for human consumption has been transposed into Irish law by the European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. 278 / 2007). EPA reports annually on the quality of drinking water

in Ireland, the report is based on the monitoring data provided by 34 Water Services Authorities (WSA) submitted to the EPA for 2012. A desktop review of the existing services was undertaken within the project study area, it is noted that there are no drinking water watercourses or lakes located within the project study area.

Nutrient Sensitive Areas

Nutrient Sensitive areas as identified under the Urban Waste Water Treatment Regulations, Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment. There are no nutrient sensitive areas located within the project study area.

Water Dependent Habitats & Species (Designated sites)

Water dependent habitats and areas of ecologically significant within the project study area including all internationally designated habitats, are discussed in detail in the Natural Heritage section of this report. Important groundwater habitats are discussed in the Soil, Sediment and Geology Section 4.7 of this report.

4.6.3 Key Constraints

The key constraints associated with the development of proposed Cross Shannon 400 kV Cable within the project study area in terms of potential to impact on water resources and flood risk are summarised in Table 4.12 below.

Table 4.12: Summary of key Water Resources and Flood Risk Related Constraints

What is the constraint
Proximity to CFRAM Flood Risk Zones: Areas at risk of flooding can pose a risk to locating any structures. In addition, repeated flooding could lead to erosion of material at the base of transmission structures. CFRAM high risk areas have been identified. Areas of high risk have been avoided in the development of feasible options and site location. The potential flood risk arising from water resources fully considered throughout the project process
Pollution potential for accidental spillage of fuel, sediments, chemicals or sewage causing pollution to surface or ground water (protected areas) during construction or maintenance activities. The identification of the constraints within the study area will allow feasible route options and site locations for high voltage transmission infrastructure to be fully considered.

Water resources can act as a physical constraint to the siting of high voltage infrastructure, however there is also the need to ensure sufficient separation distance from water resources are maintained to ensure water quality is not impacted. Major water features and catchment based water quality status within the study area have been identified and mapped.

These features within the study also play an important part in conserving individual species and overall catchment biodiversity and water resources. However, in general, hydrological and flood risk constraints are considered in greater detail in where they can present difficulties for the selection of possible route options and site selection and during the design of the project. Careful route and site selection evaluation will ensure that impacts on these resources are minimised. Where sensitive areas are unavoidable, suitable mitigation measures will be implemented. Under the Flood Directive CFRAM studies, Catchment Flood Management Plans and associated Flood Maps will play a vital reference for the project progression.

4.7 Soils, Sediment and Geology

4.7.1 Resources

The following references and datasets were utilised for this section:

- Sleeman, A. G. and Pracht, M. 1999. Geology of The Shannon Estuary: A Geological Description of The Shannon Estuary Region including parts of Clare, Limerick and Kerry with accompanying bedrock geology. Geological Survey of Ireland. 77pp;
- Geological Survey of Ireland 1:100,000 scale Bedrock Geology Map Series, Sheet 17;
- Soil Mechanics – Pelorus Surveys. Moneypoint to Tarbert submarine cable route survey – Interpretative report on site investigation:
  - Part 1 – Desk Study (2008)
  - Part 2 – Factual report on oceanographic, hydrographic and marine geophysical survey (2009)
  - Part 3 – Geotechnical and geoenvironmental report (2008)
  - Part 4 – Interpretative report (2009);
- Irish Hydrodata Ltd. 2007. Preliminary geophysical survey draft report - Tarbert to Moneypoint, Shannon Estuary;
- RINA. Cross-Shannon Cable Project. Phase 1 Non-Intrusive Geophysical and Hydrographical Marine Survey – Factual Report, Vol 1. Doc. No. P0009436-1-P8 Vol.1; and
- RINA. Cross-Shannon Cable Project. Phase 2 Intrusive Geotechnical Marine Survey – Factual Report, Vol 2. Doc. No. P0009436-1-P8 Vol.2.

4.7.1.1 Published Geology

Superficial deposits

The thickness of superficial deposits encountered in the 2007 ground investigation was variable, ranging from <0.5 m to in excess of 5 m, with the greatest thicknesses predominately encountered in the centre of the estuary and thinnest in the near shore areas. The exact depth to bedrock is difficult to determine due to previous intrusive investigations being limited to vibrocores and Cone Penetration Tests (CPTs) that cannot penetrate bedrock.

The site has been subject to repeated glaciation throughout the Quaternary period (Soil Mechanics 2007 desk study). The distribution of glacial till within the Shannon Estuary is unclear, although some material descriptions in the 2007 offshore borehole logs are consistent with the expected characteristics of glacial deposits.

Two types of till have been identified in the project area:

- A limestone dominated till with a sand and/or silt matrix;
- A shale dominated till with a clay or silty clay matrix.

The two types of till reflect glacial erosion of different bedrock types and both are characterised by a wide distribution of grain sizes (Sleeman and Pracht, 1999).

Post-glacial Alluvium was identified both onshore and offshore during the 2007 investigation. The composition of the Alluvium is variable, with descriptions ranging from very soft CLAY, to silty/sandy/gravelly CLAY, sometimes with shell fragments to clayey/silty/gravelly SAND, to sandy GRAVEL. Sand partings within clay units are sometimes recognised, indicating that bedding-scale variability in grain size is common. Organic odours were also noted infrequently within alluvial material.

Bedrock

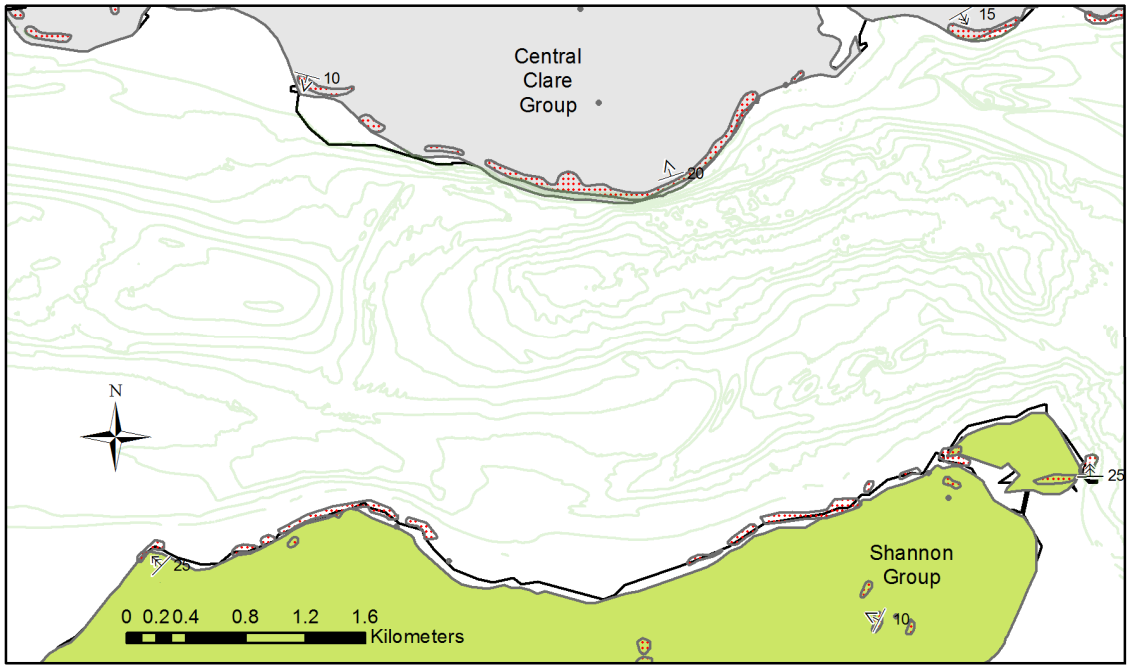
The bedrock along the shores of the Shannon Estuary adjacent to the proposed cable routes has been mapped as Namurian (Upper Carboniferous) sediments). these comprise two groups; the

Central Clare Group to the north and the Shannon Group on the southern shores. These lithologies are described by Sleeman and Pracht (1999) as:

- Central Clare Group – Cyclotherm-controlled prograding deltaic deposits. The sediments usually comprise some or all of the following lithologies; basal marine band overlain by laminated shales, massive grey siltstones and a thick upper unit dominated by laminated sandstone, sometimes capped by coal and rootlets. Syn-sedimentary features are common (e.g. slumping, faulting, flow-folding, ball and pillow structures, sand volcanoes) and channel features/point-bar deposits may also be found.

Shannon Group (undifferentiated) – unit dominated by turbidite sandstones, i.e. most likely to comprise a mixture of grain sizes in generally fining-upward successions.

Figure 4.1: Bedrock geology in the Shannon Estuary area (Shannon group is indicated in green, Bedrock group is shown as dashed red and Central Clare Group shown in grey)



Source: Structural symbols indicated dip and dip-direction of bedding in degrees.

The carboniferous units were deformed during the Variscan Orogeny. The distribution of rock units at the surface is ultimately controlled by the nature and geometry of major folding; in turn this has also affected the topography in the area.

There are no surface faults mapped on the Geological Survey of Ireland 1:100,000 scale map for the area, although brittle Variscan deformation features have also been identified within the carboniferous bedrock (Sleeman and Pracht, 1999). It is postulated by Sleeman and Pracht (1999) that the Nvan-Silvermines fault lies beneath the carboniferous bedrock, which may have had a role in the location of the estuary.

The area has been described as seismo-tectonically stable (Sleeman and Pracht, 1999).

4.7.1.2 Ground Investigations Summary

Introduction

Two phases of ground investigation were commissioned by EirGrid, specified by Mott MacDonald and carried out by RINA Consulting to:

- identify the geological conditions and any geotechnical constraints along the three cable routes under consideration (N1S1, N2S2 and N3S2); and
- help inform the design and cable installation methodology.

The surveys comprised of:

Phase 1 – Non-intrusive - Geophysical survey multibeam and single beam bathymetry, side scan sonar, sub bottom profiler, magnetometer, acoustic ground discrimination, terrestrial UAV survey and tomographic seismic refraction.

Phase 2 – Intrusive – 55 vibrocores and 27 cone penetration tests along preliminary subsea cable corridors with environmental and geotechnical laboratory testing.

In addition, fourteen vibrocore positions from the 2007 ground investigation associated with the existing 220 kV Cross Shannon cable project lie within the project area and as such have been incorporated into the findings presented.

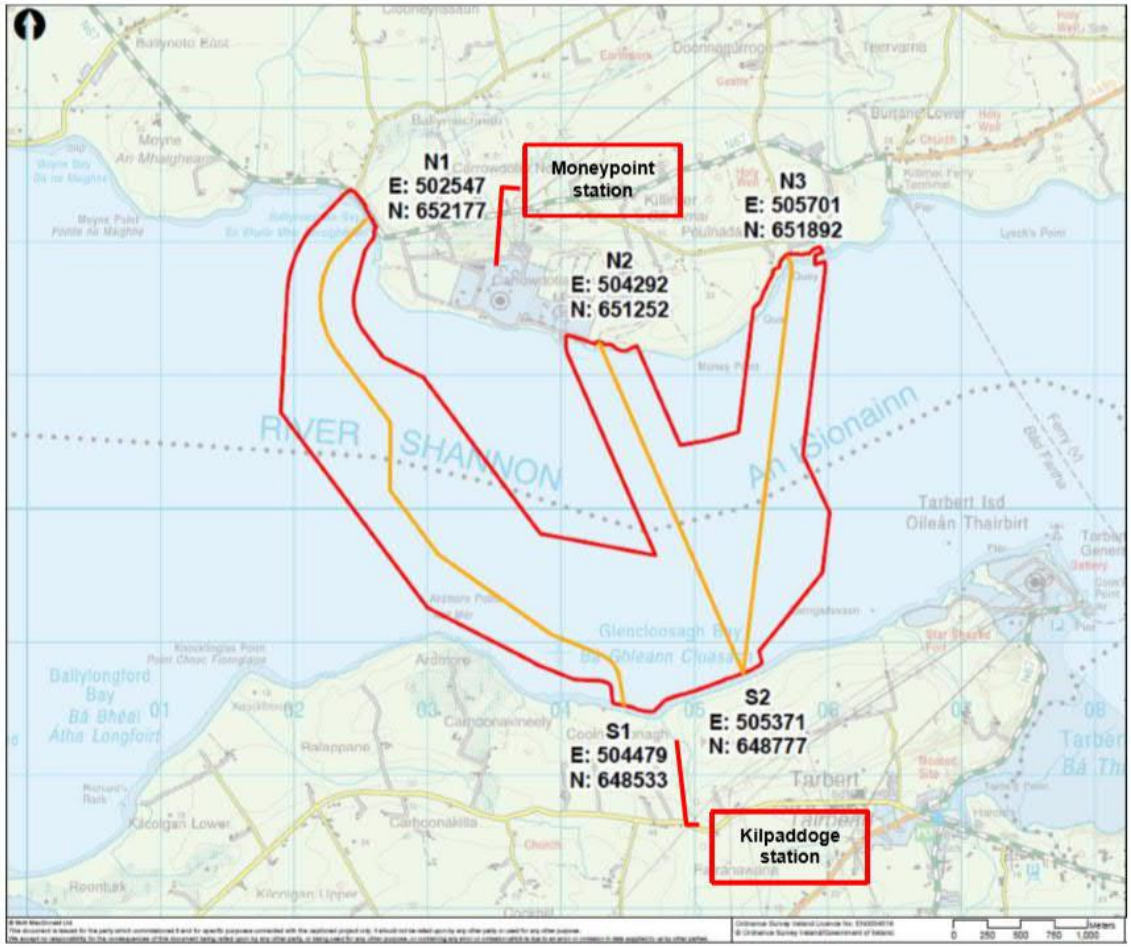
Phase 1 Non-Intrusive Investigation

The Phase 1 survey was a non-intrusive geophysical investigation along three preliminary cable route corridors (refer Figure 4. 2).

The geotechnical aims of the Phase 1 survey were:

- determine the composition of the superficial deposits within the estuary;
- determine the depth to top bedrock;
- obtain riverbed sediment characterisation and bedform mapping (including e.g. striations, scars, depressions, sand wave crest, sand bars, sand ripples, glacial moraine, etc.);
- identify any riverbed obstructions, such as boulders, debris, wrecks and other objects that may have archaeological importance; and
- identify the location and extent of any sand waves/areas of significant sediment mobility and areas where depths can vary significantly due to movement of sediment

Figure 4.2: Extent of Phase 1 Non-intrusive Survey (pre-survey cable alignments shown)



Source: Mott MacDonald

The Phase 1 survey was completed in two stages:

1. A marine survey was carried between the 26th July and 24th August 2018 consisting of:
   - Multibeam and single beam bathymetry; and
   - Side scan sonar, sub bottom profiler, magnetometer and acoustic ground discrimination;
2. A terrestrial UAV survey and tomographic seismic refraction survey were carried out between 19th January and 25th January 2019 across areas not reachable by the survey vessel.

The results of the Phase 1 survey are presented in the Phase 1 Factual Report.

Phase 2 Intrusive Investigation

The Phase 2 intrusive investigation was carried out between 26th November and 19th December 2019 to develop of the findings of Phase 1 and specifically:

- ground truth the non-intrusive data;
- Identify the location and extent of any sand waves/areas of significant sediment mobility;
- obtain samples for environmental testing;

- obtain the geotechnical properties of materials encountered to inform the design and cable installation method.

The survey consisted of:

- 55 No. Vibrocores;
  - 29 locations with a target depth of 6 m;
  - 26 locations with a target depth of 8 m.
- 27 No. Cone Penetration Tests (CPTs) to a target depth of 10 m.

The as-surveyed locations of the Phase 2 intrusive investigation and the 2007 intrusive investigation are shown in Figure 4. 3.

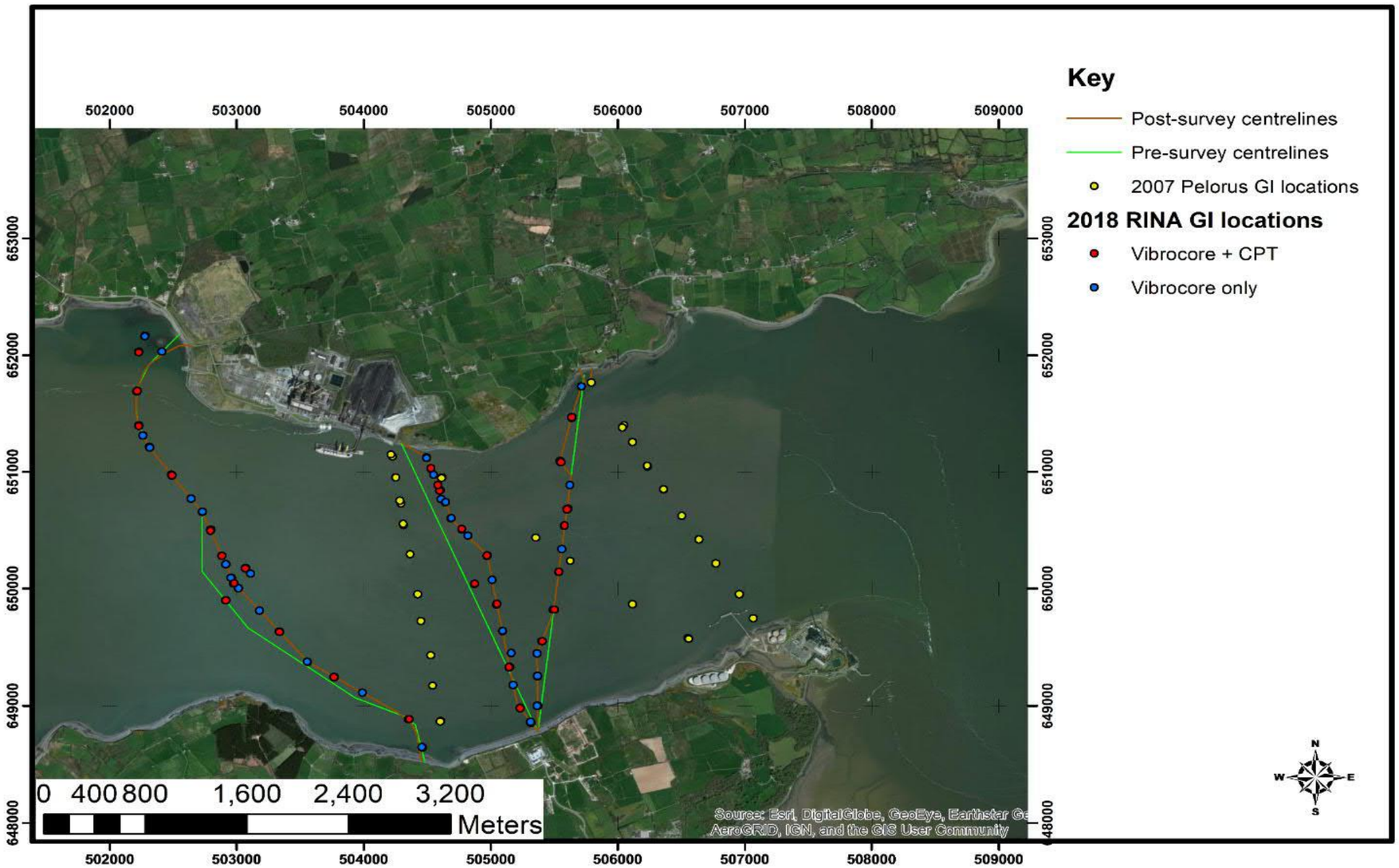
General Ground Conditions

Ground Investigation works were undertaken to determine the general ground conditions, soil electrical and thermal resistivity within Moneypoint electricity generation station. During this survey, 12 trial pits were excavated. Six trial pits were excavated in the elevated access road which borders the coal yard and ash repository. Three of these trial holes towards the western end of access road consisted of sandy & clayey gravel with a high cobble and medium to high boulder content at approximately 1.25 m depth. It appeared to be mostly backfilled material in this area.

Two of the trial pits approaching the estuary encountered dense brown/grey cobbles and boulders at a depth of 1.25 m. A trial pit close to the estuary encountered fine to coarse sandy gravel with a high cobble and boulder content. There appeared to be larger boulders in this area.

A further six trial pits were excavated to the west of the power station beginning just above the foreshore within the power station property. The first four trial pits along the N67 public road and one within the power station encountered firm to stiff brown/grey sandy & gravelly clay with low cobble and boulder content with the trial pit within the power station showing a siltier make-up. A trial pit excavated in the internal access road approaching the substation compound encountered a service at less than 1m depth, the make-up of the ground up to that point was dense grey sandy gravel with high cobble content. The final trial pit excavated in front of the substation encountered firm brown/grey sandy & gravely clay with high cobble and boulder content at 1.25 m deep.

Figure 4.3: Locations of 2007 and 2018 Intrusive Investigation Locations in relation to the Pre-survey and Post -survey Cable Alignments



Source: Mott MacDonald

The following geotechnical lab testing was conducted on selected samples:

- 118 moisture content;
- 73 Density by linear measurement;
- 108 Particle size distribution by wet sieving;
- 54 Sedimentation by hydrometer;
- 55 Liquid limit, plastic limit and plasticity index;
- 15 Specific gravity;
- 6 Min/Max density
- 48 Lab vane (24 remoulded);
- 25 Undrained triaxial;
- 9 Direct shear;
- 36 Thermal conductivity (10 remoulded);
- 10 Chemical (Organic matter content, pH value, sulphate content of water extract from soil, total sulphur and water soluble chloride content).

In addition, pocket penetrometer and tor vane tests were conducted at 1m intervals in encountered cohesive material.

4.7.1.3 Superficial deposits

Thickness

The non-intrusive survey indicated a variable thickness of superficial deposits across all three cable routes with a range between 0.2 m and in excessive of 10 m (refer Figure 4.5). The greatest thickness was encountered in the middle of the estuary along the N2-S2 and N2-S3 routes and southern section of the N1-S1 route, where the seismic data indicates superficial deposits of up to 30 m thick. The seismic data indicates the thinnest superficial deposits are located along the northern sections of all three cable routes and the centre of the N1-S1 route.

The intrusive investigation confirmed the suspected shallow bedrock (<3 m) in the northern sections of the N2-S2 and N3-S2 routes (<0.2 m of penetration at VC27a). Bedrock was also observed to be outcropping on both the northern and southern shores of all three cable routes (refer Figure 4.7.4 below). It should be noted that vibrocore and CPT techniques are not suitable for proving bedrock and therefore the minimum thickness of 0.2 m is considered conservative.

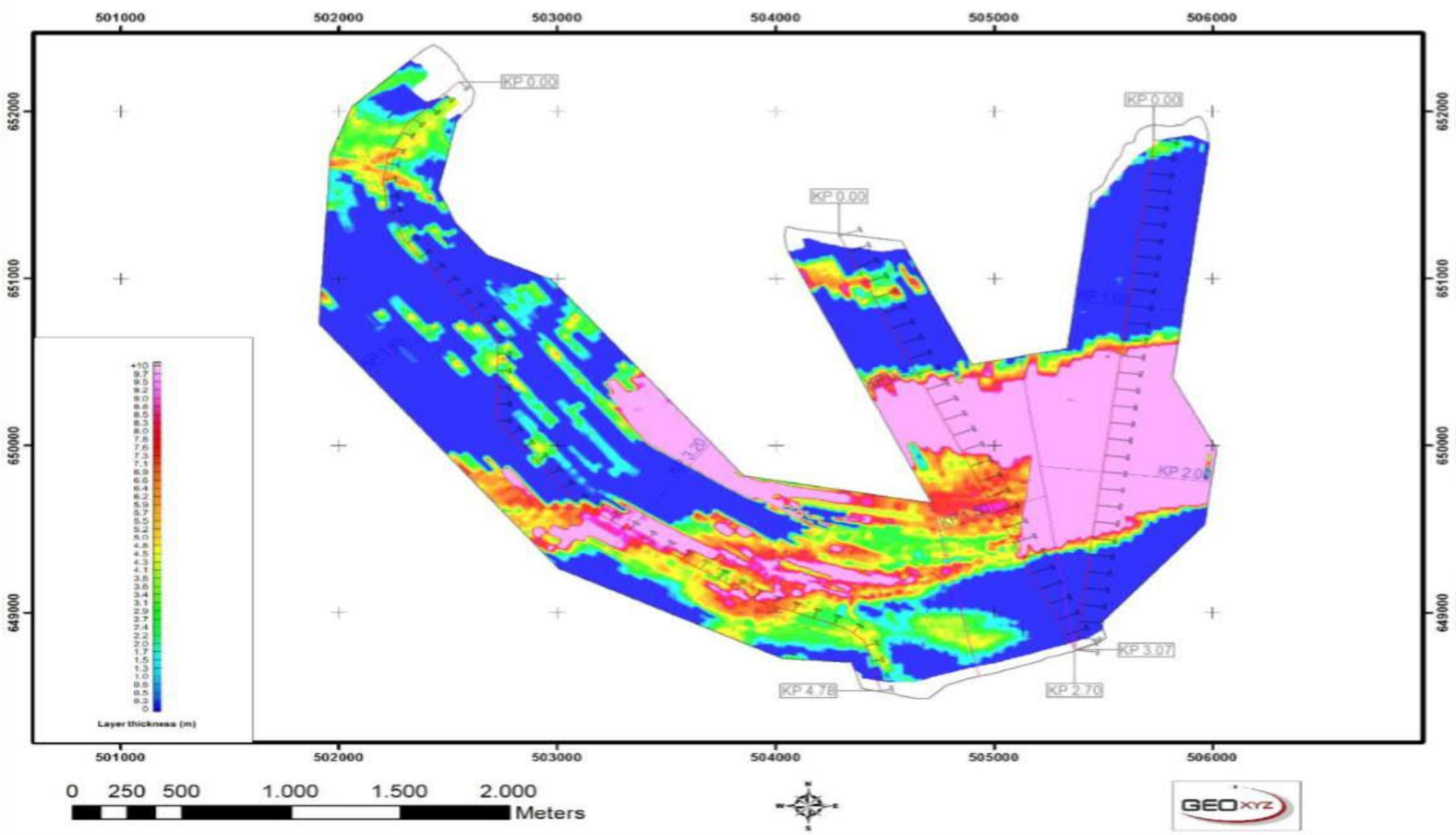
In contrast to the non-intrusive investigation, >5 m penetration was achieved in all locations in the centre of the estuary along the N1-S1 route (refer Figure 4.5). The greatest penetration was achieved around the raised section of sea bed, known locally as ‘the Bridge’ (refer Figure 4.6), which lies ~100 m to the east of the proposed N1-S1 cable alignment.

The nature of the ‘the Bridge’ feature remains unclear though the high penetration depths (>5 m) indicates shallow bedrock is not present. All positions located on ‘the Bridge’ feature encountered sand for their full penetration (7-10 m) suggesting a thick sequence of semi-mobile sediments. This is likely to overlie either bedrock or glacial morraine deposits, which form the core of the feature.

Figure 4.4: Outcrop of bedrock on the northern shore

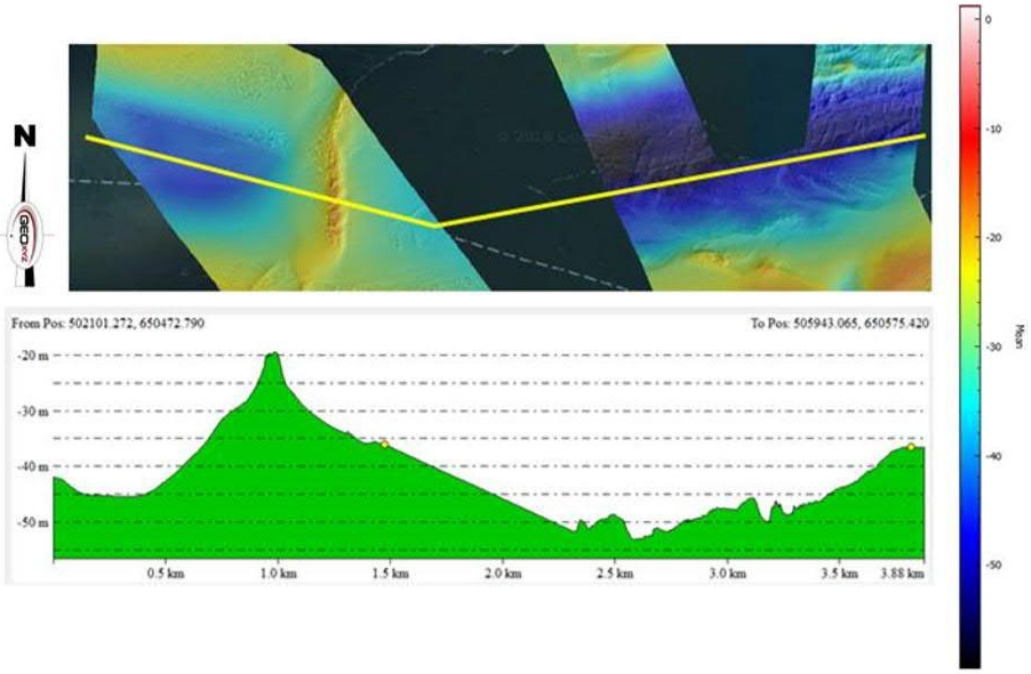
Source: Mott MacDonald

Figure 4.5: Thickness of Superficial Deposits based on the Non-intrusive Investigation with areas highlighted where the Intrusive Data contradicts the Non-intrusive Findings



Source: *Phase 1 factual report*

Figure 4.6: The Bridge' feature identified from the non-intrusive bathometric survey



Source: *Phase 1 Factual Report*

Materials

A summary of the superficial deposits encountered during the intrusive investigation is presented in Table 4.13. The depositional environments in which the materials were formed is transitional in nature, and as such concise boundaries are not always evident. Gradational boundaries up to 2 m thick were encountered in the intrusive ground investigation.

Contrary to the published material no glacial till was encountered during the intrusive investigation. However, this may be due to the fact that the vibrocore and cone penetration testing could not penetrate through the gravel and cobbles within the till.

Table 4.13: Summary of strata encountered and typical descriptions

Stratum no.	Strata	Typical description
1	Fine to coarse gravelly SAND	Medium dense to dense yellowish-brown, slightly silty, gravelly medium to coarse SAND, with abundant medium sand sized shell fragments.
2	Dark grey fine to medium SAND	Very loose to medium dense dark grey slightly silty fine to medium sand with frequent shell fragments (decrease in abundance with depth) with interbedded clay bands
3	Brownish-grey SILT – CLAY	Low to medium strength brownish-grey SILT Or Low to medium strength brownish-grey silty CLAY
4	Grey CLAY	Low strength greenish-grey CLAY with occasional laminations of fine sand
5	Slightly sandy gravelly CLAY	Grey slightly sandy gravelly CLAY. Gravel is fine to coarse sub rounded of mudstone and sandstone.
6	Clayey sandy GRAVEL	Fine to coarse clayey sandy GRAVEL. Gravel is sub angular to subrounded of mudstone and sandstone.

Full details of the materials encountered in the intrusive investigation including the geotechnical properties derived from the in-situ and lab testing can be found in the Phase 2 Factual Report.

Stratum 1 - Fine to coarse gravelly SAND

The sand is typically described as yellowish-brown, slightly silty, gravelly medium to coarse SAND, with abundant medium sand sized shell fragments. A photograph of core obtained from the intrusive investigation considered representative of this material is presented in Figure 4.7. Occasional cobbles and thin beds of clay (up to 0.25 m thick) are recorded in some locations. The sand is typically medium dense to dense based on the CPT records though occasional loose beds are present.

This material is generally located in the centre of the estuary across all three proposed cable routes where the thickest superficial deposits were encountered. However, this material is most prevalent along the N1-S1 route. The thickest deposits were encountered around 'the Bridge' feature on the N1-S1 route (refer **Error! Reference source not found.**4.7), where thicknesses of up to 6 m was encountered. The sand deposits are suspected to be associated with the high sediment mobility areas which are discussed in further detail in Section 4.8 Marine Aspects.

Figure 4.7: Thick sequence of coarse sand deposits encountered in VC16 at 'the Bridge'

Stratum 2 - Dark grey fine to medium SAND

Typically described as a dark grey fine to medium sand with frequent shell fragments (that decrease in abundance with depth) with interbedded clay bands (Figure 4. 9) and pockets of black organic clay throughout. The abundance of clay increases with depth. CPT records indicate the density of the sand reduces from medium dense at the surface to very loose - likely due to the increasing clay content.

The fine sand is encountered below the coarse sands (most common on N1-S1 route) or from the surface (more common along N2-S2 and N3-S2 routes). Like the coarse sands they are limited to the centre of the estuary though do extent to the near shore on the N1-S1 route (VC04 and VC22).

Stratum 3 - Brownish-grey SILT – CLAY;

Typically described as brownish-grey SILT, though occasionally described as a silty CLAY (e.g. VC33 as included in Figure 4. 9 below). Field pocket penetrometer and tor vane testing indicate a typical strength of low to medium.

The silt is encountered in a select number of vibrocores (VC33, VC35, VC36, VC49 and VC56) located in and around the channel that intersects the N2-S2 and N3-S2 routes in the south eastern corner of the site. It is found at the top or within the grey clay and is typically 1 m thick. The depth it is encountered is variable and is dependent on the sea bed elevation of the borehole that it was encountered.

Stratum 4 - Grey CLAY

Grey clay is encountered across all three routes though is limited in extent in the near shore areas. It is typically described as a low strength (based on field pocket penetrometer and tor vane testing) greenish-grey clay with Laminations of fine sand are recorded throughout the clay. The clay is almost always encountered at a depth of >2 m and beneath the fine sands (with the exception of VC40 were it was encountered from the surface). The depth to the clay increases in the centre of the estuary on the N1-S1 route due to the thicker sand deposits. The thickness of the clay is unclear due to limited exploratory holes penetrating the base of unit though is expected to be thickest in the centre of the estuary.

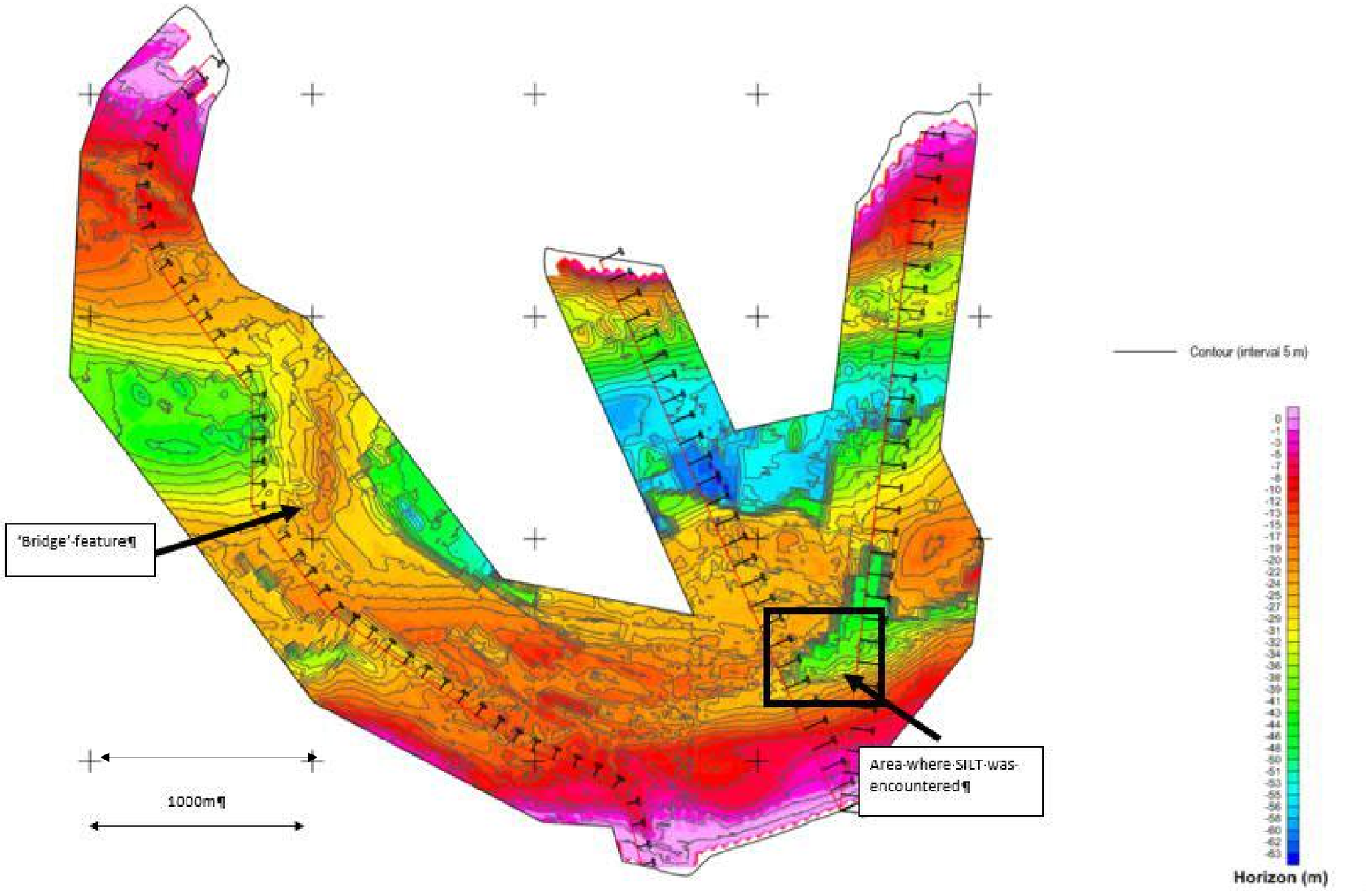
Stratum 5 - Slightly sandy gravelly CLAY

The gravelly clay is limited to the near shore areas and deepest section of the N2-S2 and N3-S2 routes. The material is typically described as slightly sandy gravelly CLAY where the gravel is fine – coarse sub rounded of mudstone and sandstone. The material is thought to be derived from Glacial Till which has become softened and transported a short distance.

Stratum 6 - Clayey sandy GRAVEL

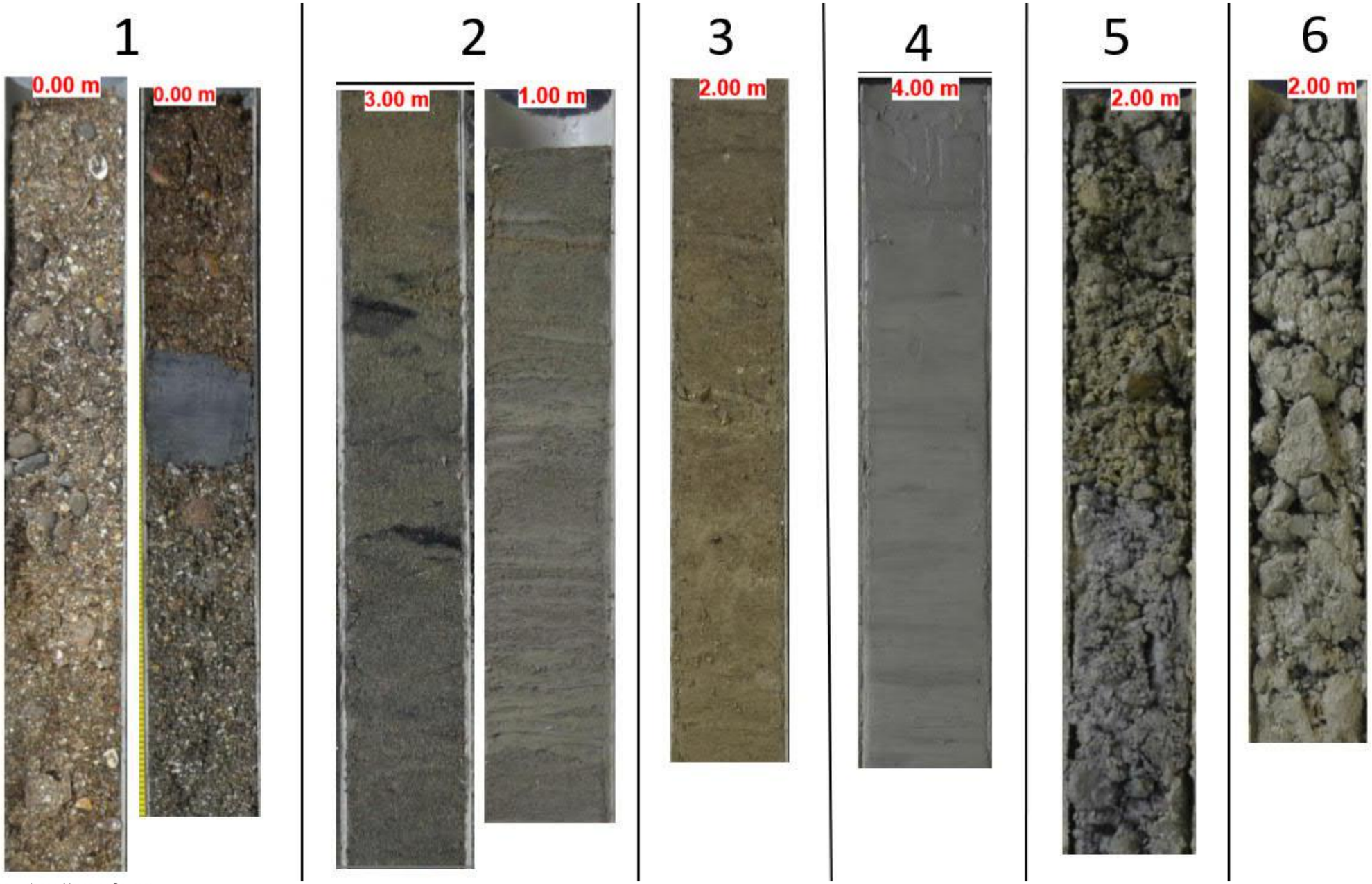
Like the gravelly clay, the gravel was only encountered in near shore exploratory locations. Typically described as a fine to coarse clayey sandy GRAVEL (sub angular to subrounded mudstone and sandstone) though occasional cobbles are present (refer Figure 4. 9). In CPT27a the gravel was encountered above the grey clay indicating it is not weathered bedrock, but more likely the same glacial origin as the gravelly clay.

Figure 4.8: Valley feature where Silt was Encountered and 'The Bridge' feature evident on the Bathometric Survey (pre-survey route alignments presented



Source: *Phase 1 Factual Repor*

Figure 4.9: Superficial deposits encountered across the three proposed cable routes 1) Fine to coarse gravelly SAND 2) Dark grey fine SAND 3) Brownish-grey SILT – CLAY 4) Grey Clay 5) Slightly sandy gravelly CLAY 6) Clayey sandy GRAVEL



Source: <Insert Notes or Source>

Bedrock

No bedrock was encountered during the intrusive investigation due to the survey techniques employed. However, outcrops of sandstone, siltstone and mudstone that are expected to belong to the Central Clare and Shannon Groups were observed on both sides of the estuary. The variation in composition of the bedrock means the material and rock mass properties of the bedrock are expected to vary significantly across the estuary. This will impact the choice of the cable installation method employed should bedrock be encountered.

4.7.2 Key Constraints

Based on the aforementioned understanding of the ground conditions, as developed through both desk based and field studies, the following key geological hazards, specific to the selection of cable routing and their constraints and impacts have been identified are summarised in Table 4.14.

Table 4.14: Summary of key Sediment, Soils and Geological constraints

What is the constraint?
Shallow bedrock: Installation of the cable in bedrock is typically slower and more expensive. If the is placed on the seabed then additional cable protection may be required to protect cable. This increases the cost of a cable route in areas of shallow or exposed bedrock. There is a risk of cable abrasion against the bedrock.
Mass movement (submarine landslide): Subsea erosion has oversteepend some sections of the river channel slopes. The cable(s) could be damaged by slope failures in steepened sections of the river channel. Slope failures would be expected to be localised and shallow in locations where steep slope gradients are present. Deeper cable burial may be required to reduce the risk to the cable from such failures.
Boulders: Areas of boulders increase the risk of abrasion of the cable if the cable is installed on the seabed.
High sediment mobility: Areas of high sediment mobility increase the risk that the cable could become exposed on the seabed or even undermining the cable resulting in free spanning cables. Conversely, movement of sediment over the cable could lead to the cable being buried to greater depth than intended causing the cable to de-rate and making maintenance or recovery of cable more difficult and expensive.
Shallow bedrock adjacent to deep superficial deposits: Differential settlement of different materials could occur if a load is applied (e.g. rock armour). The cable installations method will need to be adapted to suit the material encountered.

4.8 Marine Aspects

4.8.1 Resources

Several sources of information have been used to help draw conclusions identified on marine aspects and human constraints. The information compiled throughout the project lifecycle is provided below:

- Ordnance Survey Ireland (OSI) - historical erosion records within the Cross Shannon project area;
- SeaZone - The sourced dataset covers a multitude of land and marine features, including (But not limited to): Depth soundings and contours, coastal defences, docking and mooring installations, all standalone structures, seabed forms, historical features and wrecks;
- INFOMAR - The data source that covers the Irish territorial waters was used for its bathymetric dataset. The bathymetry was used to identify any significant seabed features prior to the Phase I geophysical survey;

- Google Earth - Used for base-mapping datasets to provide greater visual representation of the location and proximity of information compiled. Understanding marine and terrestrial tie in locations for the 400 kV cable is critical;
- RINA Phase I Geophysical Dataset - Overarching purpose was to inform the Geotechnical Phase II borehole locations, and once the borehole information was made available, to interpret between the boreholes using the geophysical information. Additionally, the geophysical dataset allows high level identification of all seabed features (environmental and human);
- RINA Phase II Geotechnical Dataset;
- PELORUS Geophysical and Geotechnical Datasets - Overwater surveys completed during 2007 for the existing 220 kV cables. The information was used to understand temporal changes of the seabed, mainly changes in dynamic sand waves. The information further supplemented the existing information and the latest geophysical and geotechnical datasets. The borehole information was further used to ground truth geophysical information and to identify its congruency with the 2018 geotechnical borehole information;
- Shannon Foynes Port Company (SFPC) AIS Vessel data - All AIS tracked vessel movements within the project area for periods 2015-2018 were provided by the port company. Critically, the information provided DWT of all vessels. This information was used to calculate approximate anchor size and typical BPI needed within the survey area;
- Admiralty Chart: River Shannon, Republic of Ireland - Used for identification of known seabed characteristics/features, depth soundings, estimated velocity recordings within the channel and marine/terrestrial structures (environmental and human);
- Marine Traffic Database - AIS vessel information, providing vessel weight, draft and location within the Shannon Estuary. This information informed the BPI, allowing the permissible limits of vessel location within the estuary based on vessel draft versus water depth;
- ADCO Marine Archaeology Targets - The dataset provided known/historical targets within the Shannon Estuary, which were used to inform the primary route prior to the availability of the Phase I Geophysical dataset. The information was also used to cross-reference and to add to the Phase I geophysical dataset; and
- Irish Coastal Protection Strategy Study Phase 4 – South West Coast (Work Packages 2, 3 & 4A) - The data source provided detailed and robust information regarding both erosion and flood risk within the River Shannon and therefore was used to inform future erosion located around the landfall regions.

4.8.2 Key Constraints

This section aims to cover all identified environmental constraints that may have an impact on the feasibility of a cable route selection such as installation techniques, installation capability and performance lifecycle. The environmental constraints have been identified by evaluating the resources listed above.

4.8.2.1 Water Depths

To evaluate all bathymetric and intertidal water levels for the project area, the overwater MBES dataset was combined with the onshore topographic UAV survey, giving depth levels up to (and in some instances above) mean high-water springs. All water depth recordings are in metres relative to Chart Datum. The tidal levels for the project area are provided in Table 4.15.

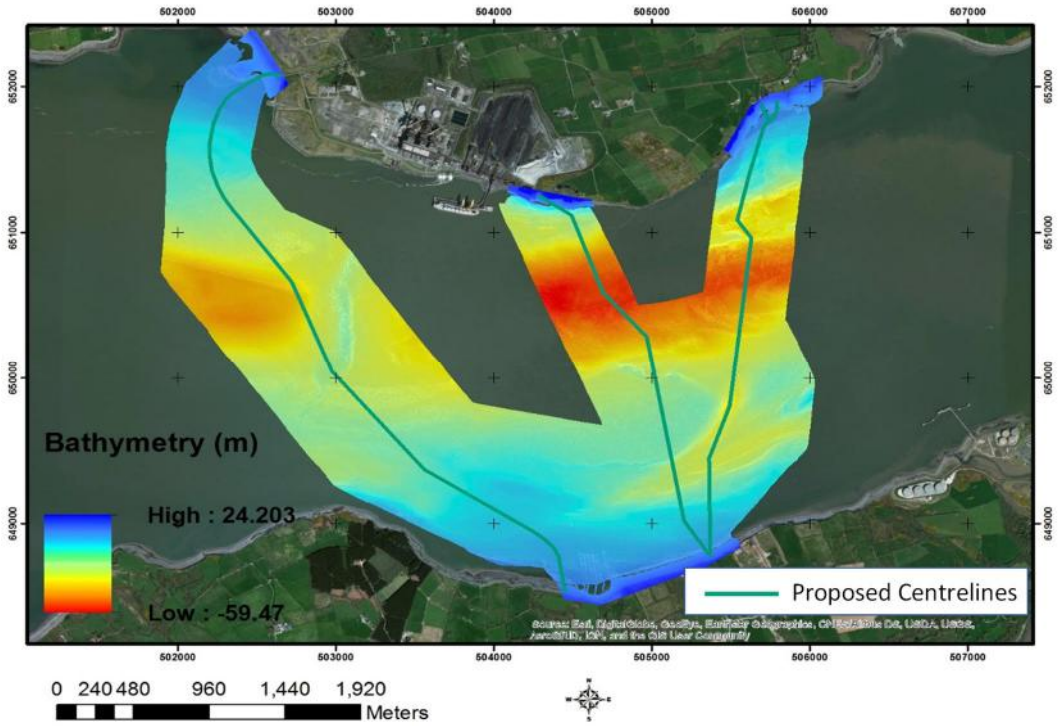
Table 4.15: Project Tide Levels

Tide	Level (m above Chart Datum)
MHWS	5.0
MHWN	3.8
MSL	2.77
MLWN	1.7
MLWS	0.5

Source: 0715 Tarbert Island, Admiralty Tide Tables 2016

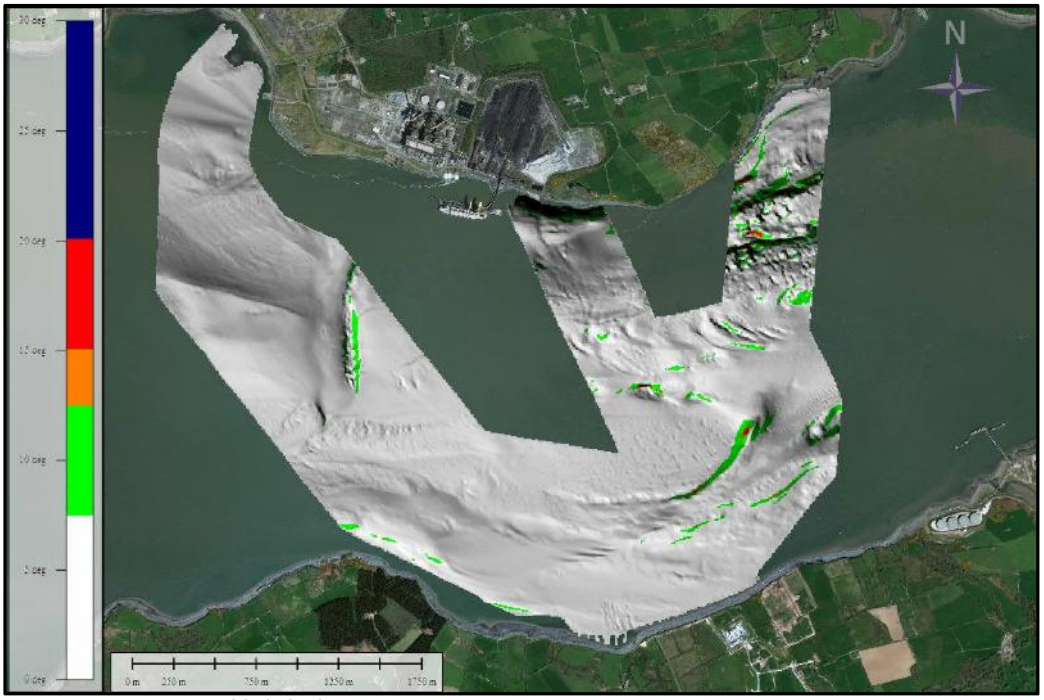
As the bathymetric dataset provides a high-level resolution map of the seabed, key environmental seabed features can be observed. Significant features, for example 'the Bridge' feature found within the N1-S1 route corridor can be observed in greater detail. Areas of sand waves can be identified, with the high-resolution dataset enabling further interrogation of sand wave wavelength and amplitude. Areas of shallow and deep water can be seen in Figure 4.10. The bathymetry data has been analysed to identify areas of steep slopes that could prove difficult from a cable installation perspective. Figure 4.11 shows areas of steep slopes categorised into regions 7.5 to 12.5 degrees (green), 12.5 to 15 degrees (orange), 15 to 20 degrees (red) and >20 degrees (blue). Areas >15 degrees may prove more difficult for cable installation however this is dependent on a number of other factors such as orientation of the slope to the cable alignment, water depth, sediment type and cable installation technique.

Figure 4.10: Bathymetry Map



Source: Mott MacDonald Limited.

Figure 4.11: Analsysed Bathymetry Data showing areas of Steep Slopes [categorised into regions 7.5 to 12.5 degrees (green), 12.5 to 15 degrees (orange), 15 to 20 degrees (red) and >20 degrees (blue)]



Source: Mott MacDonald Limited.

4.8.2.2 Tidal currents

The Shannon Estuary is approximately 100 km in length and has a tidal range of approximately 5m during spring tides. Therefore, there is a large discharge of water volume in a relatively short period. Tidal currents can reach peak velocities of 6 knots during the ebb tide. Tidal currents of this strength are limited to certain points of the tide, however, are likely to be a constraint for cable installation. Detailed tidal current data was collected continuously for 12 hours over spring and neap tidal cycles during the 2007 SM Pelorus surveys. Figure 4.12 below shows the observed peak velocities during the ebb tide (tide flowing out to sea) on a spring tidal phase.

Studying the available data, it is noted that the flood (tide flowing in) and the ebb cause different flow characteristics during the spring tides. The flood tide propagates up the estuary (propagating east), with velocities up to 120-150 cm/s measured at approximately 30 m water depth within the main channel. During the flood tide, current velocities close to the northern shoreline and shallower southern regions are relatively benign.

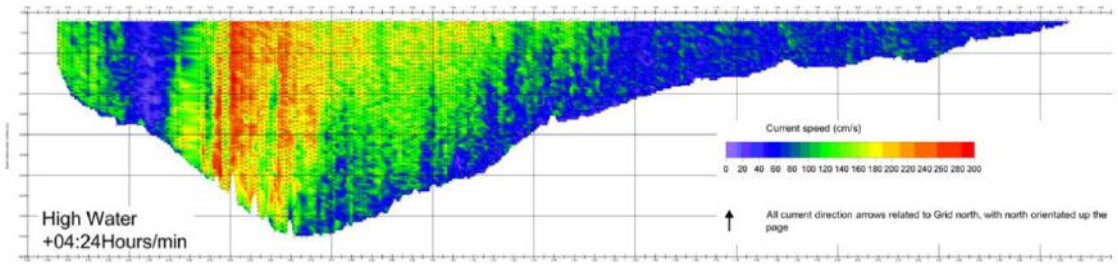
The ebb tide has noticeably different behavioural patterns compared to the flood tide. The most significant tidal velocities are observed approximately 1.25 km south of the northern shoreline (refer Figure 4.12 below). From the start of the ebb tide, to approximately +1.5 hours after high water the velocities typically reach speeds of 120-180 cm/s. These velocities are predominantly observed as surface currents and do not penetrate to a significant water depth. Velocities at or near the seabed are observed to be relatively benign at this point of the tide. A lack of deeper flow is likely due to bottom friction preventing the water mass initially moving, with the surface water not feeling the effects of bottom friction. In addition, the surface flow is likely combining with

the natural flow of the River Shannon. Between +3.5 and 5 hours after the high water, peak current velocities reach speeds of up to 240-260 cm/s (~5 knots).

The magnitude of tidal velocities recorded during the 2007 survey campaign are supported by the admiralty chart for the project area which specifies surface current velocities up to 4 knots (205 cm/s) within the main channel / northern section of the project area.

It should also be noted that current velocities made it difficult to conduct the 2018 marine survey campaign in some parts of the project area, in particular in the areas approaching 'the Bridge' feature and the northern parts of the main channel east of 'the Bridge'. The current velocities during spring tide impeded the ability for towed survey equipment to travel perpendicular to the currents. These observations give insight into how the tidal currents may make installation of the cable in some regions of the project area difficult at some states of the tide.

Figure 4.12: 2007 tidal current data showing the peak current velocities of up to 260 cm/s in the northern section of the Shannon Estuary



Source: <Insert Notes or Source>

4.8.2.3 Mobile Sediments

Mobile sediments within the Shannon Estuary lead to the formation of mobile seabed features such as ripples and sand waves. These features are dynamic in nature, and are observed (with limited datasets) to migrate along the seabed. Their movement is caused by current velocities influencing the sediment particles such that the effect of gravity is overcome and the sediment particles are lifted/moved in the direction of the flowing current.

It should first be noted that the information provided within this section is mainly compiled from the overwater non-intrusive Geophysical Surveys completed by RINA Consulting in July/August 2018. To further supplement the dataset, information was taken from the 2012-2013 INFOMAR and 2007 SM PELORUS overwater geophysical surveys. All this information enabled sand waves to be analysed over a larger temporal frame, to identify areas of significant sediment mobility.

These dynamic features are found throughout the project area but are thought to be relatively benign (under 1 m in amplitude) across most of the area. There are some areas of exception, which are shown in Figure 4.13, with the amber and red regions highlighting areas of significant sediment mobility or large amplitude seabed features (2-3 m and 4-5 m amplitudes respectively). It should be noted that the regions do not necessarily have the specified amplitude everywhere within the region, but rather the size represents the maximum amplitude found within this region.

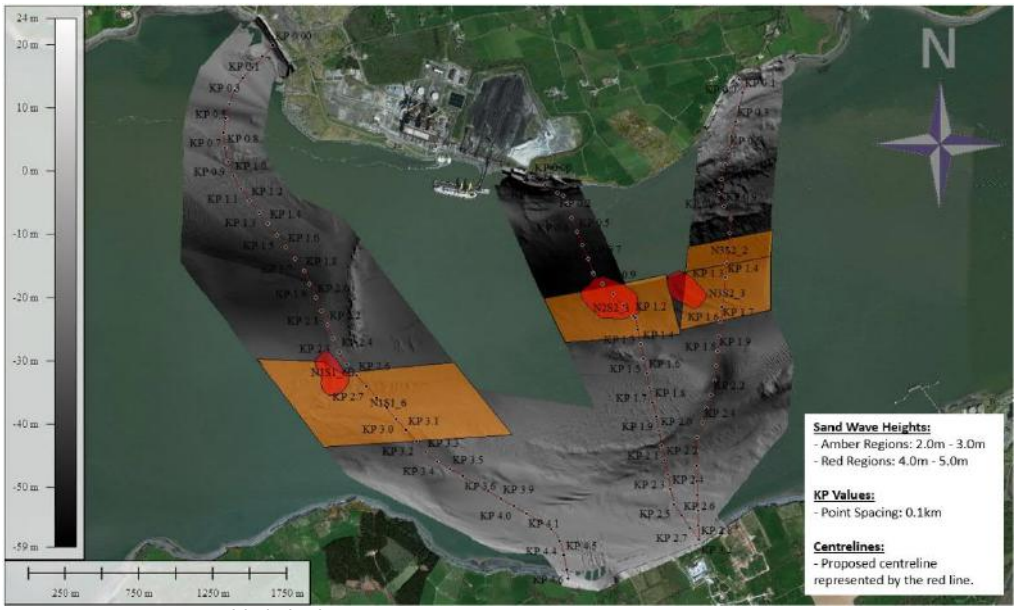
Cross sections through areas of sand waves identified during the sand wave mobility surveys conducted during the Phase 1 non-intrusive surveys are shown in **Error! Reference source not found.**4.15. The yellow line represents the cross section of the sand wave surveyed on 29th July 2018, and the magenta line represents the location of the sand wave one week later on 5th August 2018. The results from the sand wave mobility surveys found that there was no significant

movement of the sand waves during a single tidal cycle (i.e. 12 hours), however, areas between the spring and neap tides (~7 days) these features were shown to migrate in some cases up 5 m horizontally. From the data analysed from the Phase 1 non-intrusive surveys there was limited evidence to show that these features were increasing or decreasing in size significantly, however the dataset is limited.

Sand waves and areas of significant sediment mobility have been identified as an environmental constraint due to their potential impact on cable performance (ratings) and maintenance. In these areas, deeper burial of the cable may be required in combination with trenching to enable adequate cable burial with installation tools available on the market for the encountered sediment type. Micro-routing of one or more cables may be necessary to avoid areas of significant risk.

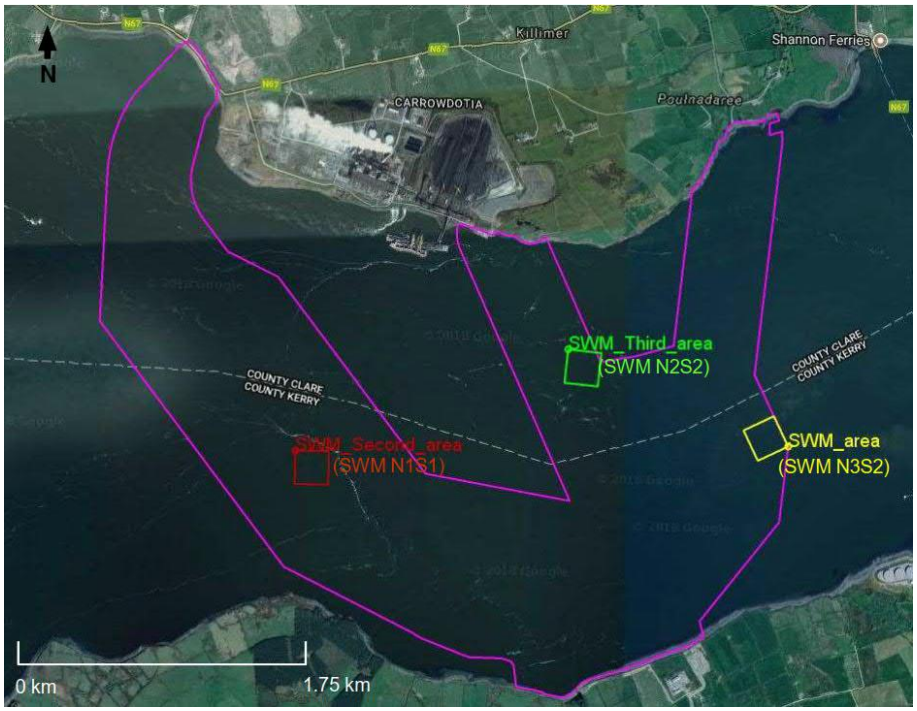
If the required burial depth is not achieved, there is the possibility of cable spanning along the route, and therefore opportunity for the cable to over-bend or be impacted by human factors. The migrating sand waves may also lead to the cable being buried deep, impacting on cable ratings and making it difficult to recoverable, if for example maintenance is necessary during the design life.

Figure 4.13: Areas of Significant Sediment Mobility and Sand Wave Features identified from Existing and Past Survey Data. [Amber and red areas represent areas of large amplitude seabed features* (2-3 m and 4-5 m amplitudes respectively)].



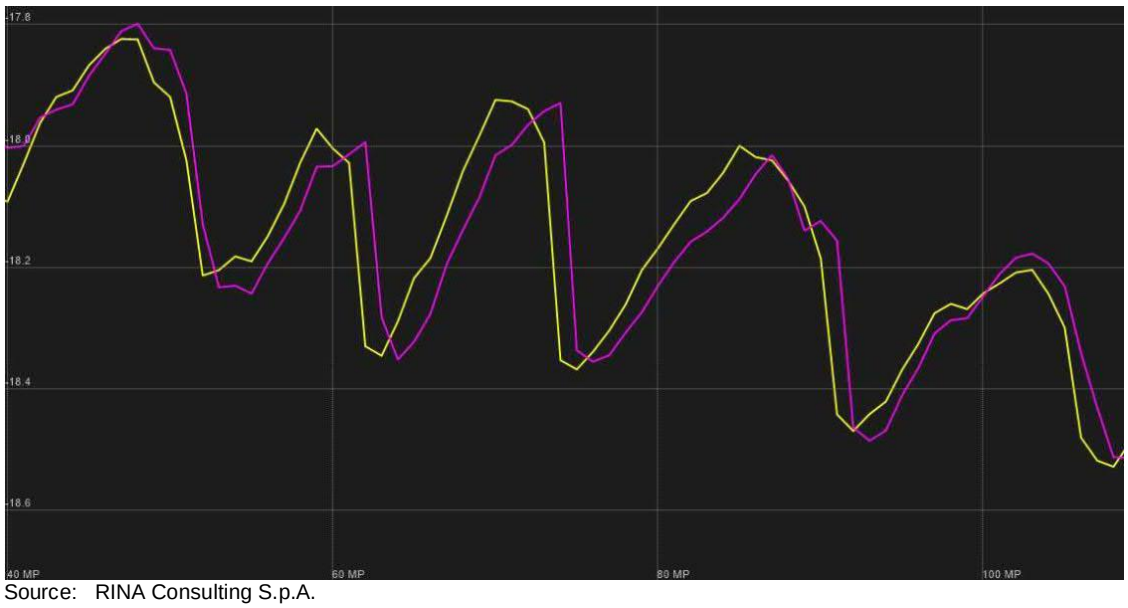
Source: Mott MacDonald Limited.
* It should be noted that the regions do not necessarily have the specified amplitude

Figure 4.14: Sand Wave Mobility (SWM) Boxes Surveyed during the Phase 1 Non-intrusive survey campaign in summer of 2018



Source: RINA Consulting S.p.A

Figure 4.15: Comparison of the Migration of Sand Wave features at SWM box N3S2 between 29th July 2018 (yellow line) and 5th August 2018 (magenta line).



Source: RINA Consulting S.p.A.

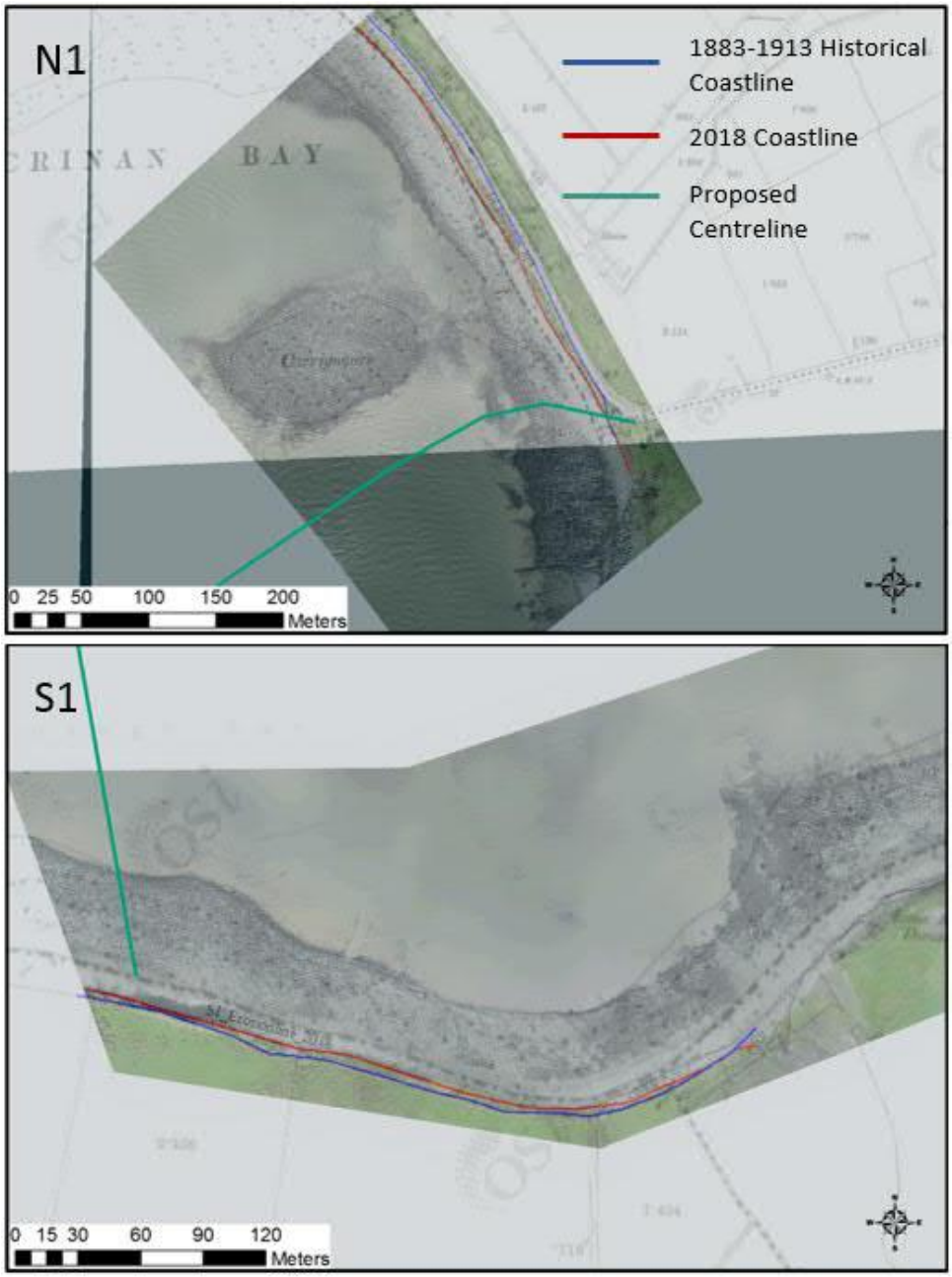
4.8.2.4 Erosion

Within the project area, shoreline erosion was assessed to understand the requirements around nearshore cable burial, impact on the location of the cable landfall over the cable design life. Historic erosion at shorelines across the project area, defined as N1, N2, N3, S1 and S2, were assessed (refer Figure 4.16 below).

Due to limited historical datasets available within the project area, only locations N1, N2 and S1 were assessed. Historical shoreline maps dating back to 1883-1913 (as taken from Ordinance Survey Ireland Dataset) has been overlaid with the latest ortho-rectified aerial imagery provided by RINA S.p.A (2018), which was obtained during the Terrestrial UAV survey. Further information regarding this UAV survey can be found within P0009436 P8 Vol1 of the non-intrusive overwater geophysical Factual Report. The shoreline has been plotted using both datasets and it can be concluded that no significant erosion has occurred at these locations over the assessed ~100 year period.

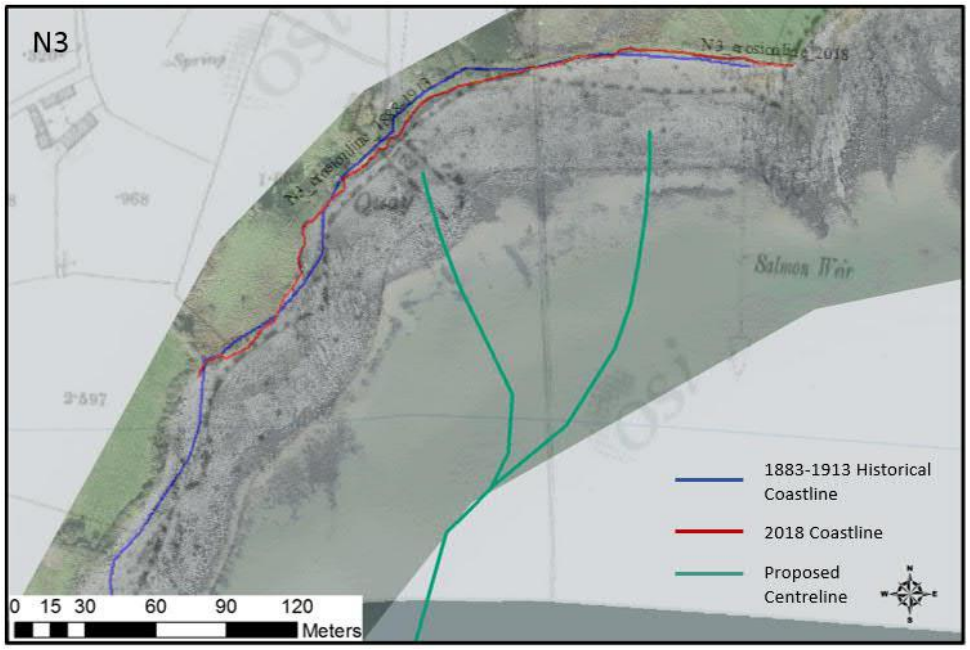
To further supplement our dataset, The Irish Coastal Protection Strategy Study Phase 4 – South West Coast (Work Packages 2, 3 & 4A) has been obtained. Coastal erosion maps for certain sections along the coastline within the Shannon Estuary have been produced, with the maps identifying minimal erosion from the baseline (2000) to the year 2050. This information supports the limited historical erosion identified.

Figure 4.16: Erosion Assessment Study areas, N1 and S1. [The historical coastline (blue) is found to be landward of the current 2018 coastline (red). This would therefore imply that accretion has in fact taken place, however it is more likely attributed to the ortho-rectification process, or it may be related to the resolution and accuracy of the historical maps].



Mott MacDonald

Figure 4.17: Erosion Assessment Study Area, N3



Source: Mott MacDonald

4.8.2.5 Dredging and Blasting

Existing or future plans for dredging and/or blasting in the Shannon Estuary could have a significant impact on the feasibility and cost of a cable route. To understand whether capital/maintenance dredging and/or blasting activities have taken place or are planned within the project area, Shannon Foynes Port Company (SFPC) were consulted.

Regarding dredging activities within the project area, SFPC stated that they do not believe any such activities have been carried out and that a Disposal at Sea (DAS) licence is not held within the project area. SFPC stated that it is unlikely that there will be any future dredging requirements in the broader channel area, or adjacent to Moneypoint. Regarding blasting activities within the project area, SFPC believe that such activities may have been conducted as part of the Moneypoint construction project in the 1970s-1980s.

SFPC state that the proposed LNG Terminal located on the southern estuary shoreline to the west of the Cross Shannon Cable Project area may require blasting for the deep-water jetty. SFPC believe that the jetty will not require capital/maintenance dredging within the future, but it is stated that this isn't currently confirmed.

4.8.2.6 Seabed obstructions/Constraints

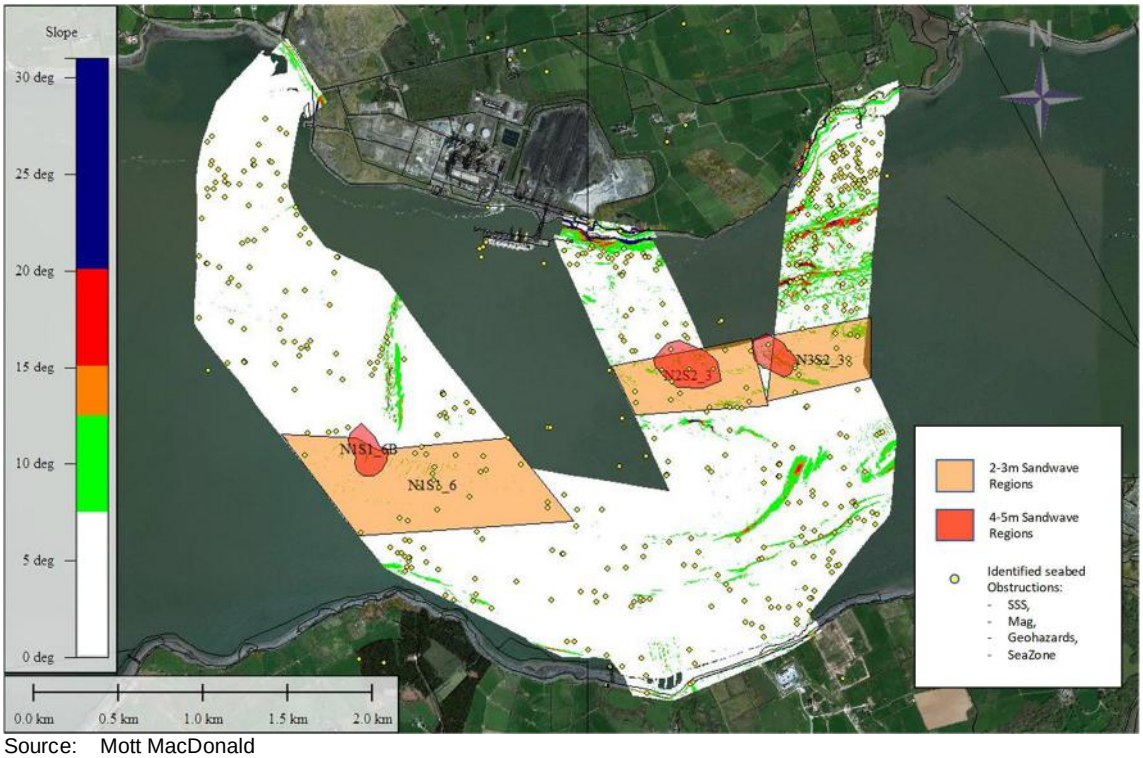
When considering seabed obstructions within the project area, it is necessary to consider all environmental and human constraints together. Many of the obstructions identified during the phase 1 non-intrusive geophysical survey were not identified as either human or environmental obstructions, and therefore lends to the point of grouping all obstructions together once more. Figure 4.18 below displays all known obstructions within the project area, which includes:

- The SeaZone dataset compiled during the desktop study. This SeaZone information identified the following relevant obstruction/ constraints:

  - Industrial installations, military constructions, navigational installations, standalone structures, stations and terminals, bedrock, historical features, wrecks, coastal defences, shoreline obstructions, transport routes, production and storage areas, docking and mooring installations, aquaculture and fisheries activity, land forms, seabed forms.
- Pre and post Phase 1 non-intrusive geophysical survey archaeological obstructions. The available survey information within the project area was assessed by ADCO, an independent archaeological survey company. The assessment carried out by ADCO has been incorporated into Figure 4.18 below.
- All obstructions identified by during the Phase 1 non-intrusive geophysical survey. This includes all identified obstructions found using the side scan sonar and magnetometer.
- All 'Geohazards' highlighted by The Contractor. This includes large seabed features, such as 'the Bridge' located within the N1-S1 route, the 'reef' structure located at the N1 landfall and the existing 220 kV cables running North to South across the River Shannon. This information is represented by the blue polygons and red lines shown in Figure 4.18.

It should be noted that all seabed obstructions identified by the marine survey contractor and ADCO are represented by the purple markers within Figure 4.18 and are not to scale. The post survey centreline represented has been engineered to actively avoid all major obstructions, accounting for all findings to date.

Figure 4.18: Summary of Key Marine Aspects and Human Obstructions/constraints



Source: Mott MacDonald

4.8.2.7 Human Constraints

The following section summarises the human constraints that may play a role in the decision of the chosen cable route, how it is buried within the marine environment and also how it is brought

ashore at the landfall locations. Highlighting the key human constraints allows feasible cable routes to be identified with the minimum amount of interference and disturbance to the existing human factors.

Existing Infrastructure

The existing infrastructure can be split into the different types that are found within the project area. Some bear greater significance when choosing the cable route alignment. Figure 4.18 identifies existing infrastructure within the project area and provides further reference to the human constraint subsections.

Outfalls and intakes

Two outfalls are located at Ballymacrinan Bay (northern shoreline, west of Moneypoint Electricity Generation Station), with both outfalls exposed at all states of the tide. The structures are shown in **Error! Reference source not found.** 4.18 and can be avoided by micro-routing cables.

Subsea Cables and Pipelines

The most significant existing infrastructure within the project area are the existing no. 7 220 kV cables, spanning from Moneypoint electricity generation station on the northern shoreline of the Shannon Estuary, to the southern shoreline where the cables make landfall approximately 600m west of the Kilpaddoge substation.

Jetties

The Moneypoint electricity generation station jetty is the largest jetty within the project area, facilitating 180,000 DWT vessels to berth to unload coal for the power station. The jetty is located on the northern shoreline of the Shannon Estuary, and is approximately 600 m in length and positioned 200 m seaward of the shoreline.

A disused slipway is located on the western side of Moneypoint electricity generation station. This slipway is thought to be currently unused.

Based on the desktop study completed for the project area, historical jetties/slipways have been located at both N2 and N3, in which all are no longer in use.

Three fish weirs are charted on the admiralty chart, two on the northern shoreline at Ballymacrinan Bay and east of the shoreline at Killimer. The other fish weir is shown to be located on the southern shoreline at Glencloosagh Bay. These shoreline structures are not considered to have a significant impact from a human constraints perspective.

Navigation

Two defined anchorage areas lie within the project area. Both are located 500 m from the southern shoreline. SFPC have confirmed that these anchorages are no longer in use due to the fact that there are now high voltage cables running from Moneypoint to Kilpaddoge through these areas. Analysis of freely available Marine Traffic information shows that the largest vessels often anchor to the west of the project area.

SFPC confirmed that there is not a defined navigational channel in this part of the Shannon Estuary, meaning that ships pass freely within these waters. Based on advice from local vessel owners, the experience from the marine survey campaign and analysing freely available Marine Traffic information the largest vessels tend to use the centre and northern part of the Shannon Estuary to navigate upstream and downstream of the project area.

SFPC also confirmed that they are not aware of any restrictions in place for installation of surface structures (e.g. rock or concrete mattresses).

Wrecks

Digital marine chart data purchased SeaZone does not identify areas of ship wrecks or seabed debris within the project area. It should be noted that the Contractor's non-intrusive geophysical dataset review, along with ADCO's review, did not find any evidence of debris or ship wrecks within the region. All three available datasets have come to the same conclusion, however the possibility of wrecks within the project area cannot be completely ruled out.

Future Development(s)

Plans for a Liquified Natural Gas (LNG) import terminal have been proposed on the southern shores of the Shannon Estuary. It should be noted that the LNG terminal has been proposed for over 10 years, with no defined build date put in place as of Oct 2019. The proposed location of the LNG Import terminal and jetty are shown in Figure 4.19 below .

If the LNG terminal was constructed it would lead to the construction of a jetty capable of receiving Q-max LNG tankers twice per month, with the potential for this frequency to increase in the future. The proposed jetty location is situated approximately 600 m south west of the project area.

The SPFC Masterplan (2013) has been put in place to help increase both volume and tonnage of vessels transiting to Foynes Harbour over the next 20 years. Consideration should be given to the potential impact of increased in vessel traffic volume on anchor strike risk and navigation during the construction phase.

Figure 4.19: Proposed LNG Import Terminal

Click or tap here to enter text.

Marine Traffic

The Shannon Estuary is a deep-water estuary and therefore can facilitate all vessel sizes. Currently the estuary is commercially active, with vessels travelling to Moneypoint Electricity Generation Station, Foynes Harbour, Aughinish, Limerick and Tarbert. Approximately 1800 vessel movements are made within the estuary, equating to 900 different AIS (automatic identification system) tracked vessels travelling into the estuary annually. Based on records

maintained by the SFPC, this value is believed to stay consistent year on year even as vessel tonnage is forecast to increase.

Within the project area, there is not a defined navigation channel and therefore, for the purposes of assessment of vessel movement, it should be assumed that vessels may travel anywhere that is practically feasible at any time of the day/night. SFPC also state that vessel movements are relatively sporadic, and the Shannon Estuary does not have a defined high season for vessel movements. Marine traffic records have been kindly provided by SFPC including dead weight tonnage (DWT), vessel dimensions, port of call. This data will inform Mott MacDonald's preliminary burial protection study of the proposed 400 kV subsea cables along with understanding on how marine traffic will impact the construction phase.

The following subsections have been informed by data sources provided by the SFPC and the Marine Traffic Online database. It should be noted that the vessels tracked by the data sources are only vessels with AIS available on board, and therefore, typically smaller vessels (often pleasure crafts) are not tracked and accounted. Smaller vessels have less significance compared to larger vessels as they are less likely to directly impact cable burial or route due to their relatively small DWT and dimensions.

Commercial and Recreational

Within the Shannon Estuary, the majority of the 900 vessels passing annually are bulk carriers, cargo ships or chemical/oil tankers. Many of these journeys berth at Aughinish and Foynes Harbour. The largest DWT vessels that were recorded, berth at Moneypoint Electricity Generation Station.

Table 4.16: Records of the 10 largest vessels within the Project Area and their Berth Location

Vessel Name	Vessel Type	Berth	Dead Weight Tonnage (t)	Length (m)	Draught (m)
Cape Amanda	Bulk Carrier	Moneypoint	182,741	292	12.6
Frontier Queen	Bulk Carrier	Moneypoint	182,663	292	17
Sea Triumph	Bulk Carrier	Moneypoint	181,415	292	18.1
Herun Global	Bulk Carrier	Moneypoint	181,056	292	18.2
KSL Sapporo	Bulk Carrier	Moneypoint	180,960	292	15.2
Anangel Horizon	Bulk Carrier	Moneypoint	180,940	292	18.2
Xin Jin Hai	Bulk Carrier	Moneypoint	180,406	295	11.1
Mineral Kyoto	Bulk Carrier	Moneypoint	180,310	289	8.2
Sandra	Bulk Carrier	Moneypoint	180,274	288	18.2
Saiko	Bulk Carrier	Moneypoint	180,178	288	10.5
Marivictoria	Bulk Carrier	Moneypoint	179,759	292	17.8

A minority of vessels passing within the Shannon Estuary and the project area are fishing vessels, tug boats or passenger ferries. These vessels generally have smaller DWTs and dimensions and are therefore less significant when compared to the bulk carriers, cargo ships and tankers.

The Shannon Estuary is predominantly a commercial estuary, with little recreational boats accessing the estuary. The largest recreational marina within the proximity of the project area is Kilrush Marina, with 120 fully serviced berths accommodating vessels with a maximum length of 30 m, a beam of 8 m and draft of 3 m.

4.8.2.8 Construction phase

The construction phase has the potential to cause significant disruption to marine traffic in the Shannon Estuary. However, through future consultation with SFPC and other relevant regulators as part of the Foreshore Licence process, the impact can be mitigated.

Careful consideration would need to be given to management of the marine traffic, in particular around confined areas of the estuary, such as near the Moneypoint jetty. Further consultation with SFPC should be undertaken at the next project stage to identify mitigation measures to reduce the impact of any cable laying operations that may be required in these areas identified above. 220 kV cables have recently been installed across the Shannon Estuary within close proximity of the proposed routes for the 400 kV cables, as such there are no perceived blockers that will cause significant construction issues at this stage of the project.

4.8.2.9 Unexploded Ordnance

A project specific Preliminary UXO Threat Assessment was completed by Dynasafe BACTEC in March 2017. The assessment concluded that the site area is a “Low Risk” with respect to the threat of unexploded ordnance in relation to the currently proposed works. The following recommendations were made:

- Site specific explosive ordnance safety and awareness briefings to all personnel conducting intrusive works.
- Provision of unexploded ordnance site safety instructions.

To complement the findings of the Dynasafe BACTEC UXO Threat Assessment, magnetometer and SSS survey information was gathered during the Phase 1 non-intrusive Geophysical survey in August 2018. All magnetometer data was processed to include for UXO marine findings, with targets considered as significant above a value of 5nT peak to peak. Within the project area, 231 magnetic targets were identified, with 16 of these targets correlating to the SSS targets identified. It should be noted that the majority of these corresponding SSS and Magnetometry targets are understood to not be UXO targets, and are classified as ‘Geohazards’. These Geohazards capture all corresponding SSS and magnetometer findings but are not necessarily strictly identified as a particular object. Detailed information for all 231 magnetometer findings can be found within the Contractors Factual Report – Volume I – Phase I – Non-intrusive Geophysical and Hydrographical Survey. Magnetometer targets identified in the project area have been included in **Error! Reference source not found.**. Pre-sweeping, further analysis, inspection or detailed routing surveys may be necessary to confirm if targets need to be avoided or removed.

4.8.3 Key Constraints

The key constraints associated with the development of the proposed project within the study area in terms of marine aspect are summarised below.

Table 4.17: Summary of key Marine Aspect constraints

What is the Constraint
Mobile Sediments: Mobile sediments within the Shannon Estuary lead to the formation of mobile seabed features such as ripples and sand waves. These features are dynamic in nature, and are observed (with limited datasets) to migrate along the seabed. Although most of the route has relatively benign sand waves (less than 1 m in amplitude), there are three defined regions of 2-3 m amplitude sand waves and three regions of 4-5 m amplitude sand waves. In these areas, deeper burial of the cable may be required in combination with protection measure to enable adequate cable burial with installation tools available on the market for the encountered sediment type. Micro-routing of one or more cables may be necessary to avoid areas of significant risk.
Seabed Slopes: Certain regions within the project area are identified to have significant seabed slopes.. The slopes may have a significant impact during subsea cable installation and maintenance. Further identification of the

What is the Constraint
installation equipment operable limits will inform routing, along with careful micro-routing of the cables during future design phases.
Tidal Currents: Due to the large tidal amplitude (approximately 5.7 m) and the influence of the riverine flow from the River Shannon, larger currents occur at certain phases of the tide. Peak spring tides generate current velocities within the region of 120-260 cm/s throughout the ebb tide. Flood tide recordings reach speeds of 160 cm/s below the surface, with these currently potentially reaching the surface. These currents may play a vital role during the installation and maintenance of the cable if equipment and vessel operable limits are not understood and assessed.
Seabed Obstructions: Identification and understanding of all obstructions on and below the seabed should be understood prior to installation of the cable. With this in mind, the identified obstructions along each route will need further assessment to absolutely rule out the possibility of the obstruction being a major constraint to the project. Major project constraints thus have been highlighted as 'Geohazards', and these include all known marine infrastructure within the project area.
Subsea Cables and Pipelines: 7 No. 220 kV subsea cables run from Moneypoint Electricity Generation Station on the northern shoreline, to Kilpaddoge substation on the southern shoreline. Installation of cables in the vicinity of the existing cables increases the risk of damage to the existing cables during construction and operation (if maintenance is required).
Marine Traffic: The Shannon Estuary has approximately 900 vessels enter annually, accessing 1 of the 5 berthing areas, with all ship movements crossing the project area. Large vessels approximately 180,000 DWT travel within the estuary, with no defined navigation channel for any ships passing within the SFPC region. The size, volume and navigation of marine traffic will impact on the cable burial depth. A preliminary cable burial risk assessment should take into account this information to determine the target cable burial depth

4.9 Noise and Air

A desktop assessment was undertaken to identify noise sensitive receptors within the project study area. Noise sensitive receptors will be considered further during the design of the cable installation and associated transmission infrastructure

The key constraints within the project study area are mapped on the accompanying constraints drawings.

4.9.1 Resources

A review of the following information took place in order to inform the noise assessment:

- A review of Ordnance Survey Ireland maps;
- A review of Fáilte Ireland in relation to tourism as well as websites on local tourism organisations and enterprises within Counties Clare and Kerry;
- A review of the local authority Development Plans to identify any other settlement and land use characteristic and activities regarded as significant; and
- British Standard 5228 Part 1 and Part 2 Code of Practice for Noise and Vibration Control on Construction and Open Sites (2009+A1:2014) (BS 5228:2009+A1:2014).

4.9.2 Existing Constraints

The project study area predominantly comprises a combination of rural settlements (Killimer, County Clare and Tarbert in County Kerry), agricultural pasturelands and industrial sites. The ESB Moneypoint electricity generation station (County Clare) and the SSE Tarbert electricity generation station (County Kerry) are noteworthy facilities to reference as due to the significance of their environmental emissions that are licensed by the Environmental Protection Agency under Industrial Emissions Directive Licences register references (PO-605-04 and PO-607-02 respectively).

4.9.2.1 Sensitive Receptors

An understanding of the land use characteristics at the constraints stage will inform the route selection of the proposed cable infrastructure and associated transmission infrastructure in terms of potential noise impacts to sensitive receptors. Land use characteristics are discussed in detail in Section 4.4. Within the study area the densest concentration of dwellings are located within or adjacent to the villages of Killimer (County Clare) and Tarbert (County Kerry). There are a number of agricultural holdings and associated residential dwellings. In addition, there are a number of residential dwellings occur within the project study area, particularly adjacent the N69 between the ESB Moneypoint electricity generation station and Killimer (County Clare) and along the L1010 road south of the Kilpaddoge 220/110/kV subsection on the approaches to Tarbert (County Kerry)

According to the Department of Education website, there is a national school (Tarbert National School) and a secondary school (Tarbert Comprehensive School) within or in close proximity to the study area. There are no schools within the study area in County Clare. Having reviewed the Health Service Executive web-site, health services within the study area are located within the village of Tarbert and include a medical centre and a pharmacy.

Tourism is a sector of significant economic value in the Shannon Estuary which is intrinsically linked to the natural environment of the area. Tourism activities in the general area include for example;

- Wild Atlantic Way;
- Dolphin Watching;
- RIB tours (rigid inflatable boats);
- Royal Western Yacht Club of Ireland (Kilrush);
- Kilrush Creek Adventure Centre;
- Scattery Island Ferries; and
- Shore Angling.

4.9.3 Key Constraints

The key constraints associated with the development of the proposed project within the study area in terms of potential of noise impacts to sensitive receptors are summarised in Table 4.9.1 below.

Table 4.18: Summary of Key Noise and Air Related Constraints

What is the Constraint
Noise/dust impacts associated with the construction phase: The construction works will result in a temporary increase in noise and dust in the vicinity of the study area. Site selection of the project should be cognisant of sensitive receptors such as domestic dwellings or recreational areas. Structures and dwellings have been mapped on the accompanying constraints drawing. The potential construction noise impacts on the sensitive receptors will be considered further at the next stage of the project development.
Increase in traffic construction: The proposed construction works will result in a temporary increase in construction traffic within the study area during the duration of the works. The potential construction traffic noise and air quality impacts on the sensitive receptors will be considered further at the next stage of the project development.

A review of the potential key sensitive receptors in associated with noise is outlined above. All sensitive receptors located within the study area have been identified and mapped as part of this constraints assessment. Residential dwellings and recreational facilities may present significant constraints within the study area and should be considered when identifying site selection.

5 Design Considerations

5.1 Introduction

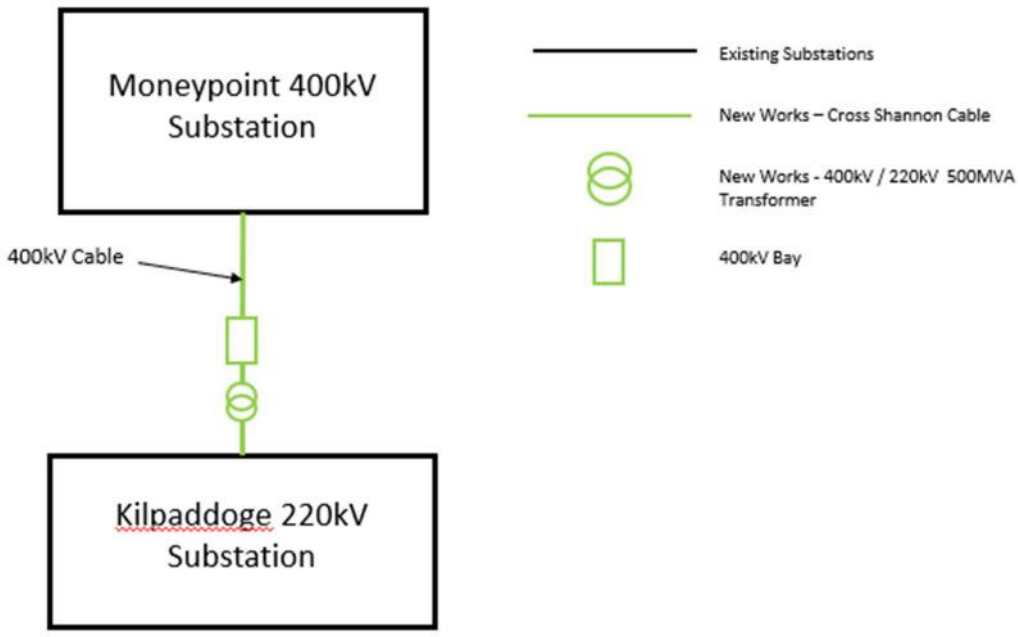
The new High Voltage (HV) connection between two existing transmission substations, considered below, is required to transfer power generated in the area to load centres on the transmission network. This HV connection will require a 400 kV underground AC cable connection which will consist of both land and subsea sections.

This section of the report reviews the technical considerations associated with the following elements:

- Cable Design;
- Connection at Moneypoint 400 kV Substation;
- Land Cable Route;
- Landfall;
- Submarine Cable Route; and
- Connection at Kilpaddoge 220 kV Substation.

Figure 5.1 below provides a high-level schematic of the proposed connection arrangement.

Figure 5.1: Schematic of the Proposed 400 kV Connection



Source: Mott MacDonald

5.2 Cable Design

For the land based three phase 400 kV underground AC cable connection, three power cables are to be considered. A one cable per phase design is considered as this achieves the required rating of 1210MVA at 400 kV. The cable comprises a single core copper conductor, and the cable size calculated for the required power transfer capacity has a cross sectional area of 2500mm^2. This conductor is typically surrounded by a triple-extruded, dry-cured, crosslinked polyethylene (XLPE) insulation screen. Extruded over this screen is a sheath, which depending on the application can be made of lead, aluminium or copper. For the land-based cable, the sheath material is expected to be aluminium. For the submarine cable, the sheath is made of lead as it will provide water blocking capabilities and decrease the buoyancy of the cable. The submarine cable has an additional layer of armour made up of copper or stainless steel wires in the case of single core cables which increases the cables tensile strength. This armouring increases the weight and overall diameter of the submarine cable in comparison to the land-based cable. The cable is then typically surrounded by an outer serving of polypropylene yarn .

400 kV, 2500mm^2 armoured submarine cables are presently not commercially available from cable suppliers. The cable being proposed is believed to be within the capabilities of the main cable manufacturers in the near term. However, enough time would need to be given to engage with the cable manufacturers and to develop the cable, which would involve, but not be limited to, assurance from the manufacturer for type test approval, and a period of pre-qualification. The proposed submarine cable has been built up from existing similar type cables. Based on preliminary rating calculations, when modelled at one cable per phase this cable achieves the required rating of 1210MVA.

Figure 5.2: Land Based Cable Construction

Source: LS Cable

Figure 5.3: Submarine Cable Construction

Source: ABB

5.2.1 Connection at Moneypoint 400 kV Substation

The substation is the marshalling point for the electricity and it acts as a node on the transmission network.

Moneypoint 400 kV substation is a Gas Insulated Switchgear (GIS) type substation and is located inside the existing operational Moneypoint Electricity Generation Station.

GIS substations comprise busbars and switchgear that are contained within metal ducts and enclosures. These ducts and enclosures are pressurised with SF_6 gas and this gas acts as an insulator to prevent the busbars from arcing to the enclosure. The GIS equipment can be installed in a much more compact manner compared to an Air Insulated Switchgear (AIS) equivalent.

GIS substations are normally located indoors in a steel portal frame building. This allows for easier installation and maintenance. It also provides better security and allows cable circuits to be installed in a more flexible manner. The building is also used to house, control and protection equipment, battery systems and welfare facilities.

All options under consideration will terminate at Moneypoint 400 kV substation, where an existing spare bay has been allocated for this connection. For the cable connection, the outdoor cable trench will run right up to the outside wall of the GIS building and the ducts enter a cable basement located below the outdoor final ground level. The cables can then be routed through the basement in air to terminate at the allocated spare bay.

Moneypoint Electricity Generation Station is an existing operational coal fired power station which consists of three generators to produce electricity to supply the main transmission network. In addition to the three generators, the power station comprises of HV electrical infrastructure, associated ancillary process plants and an extensive coal yard connected by a network of internal access roads. Various underground services are routed within this road network and throughout the extent of the site. There are also a number of wind turbines located around the perimeter of the site with associated underground cable systems connected into the electrical infrastructure on site.

Figure 5.4: Moneypoint 400 kV GIS Substation building

Source: Mott MacDonald

5.2.2 Land Cable Route

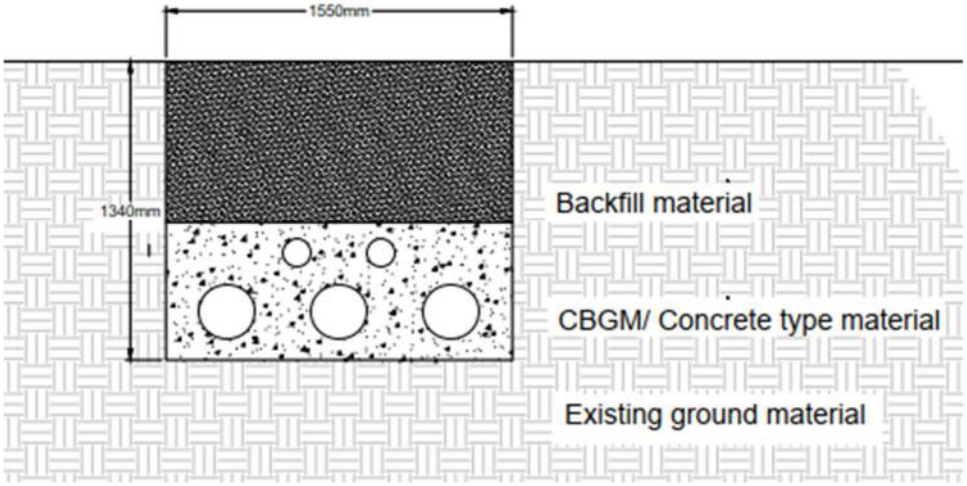
Where a grid connection can be accommodated by using High Voltage (HV) underground cables, EirGrid's preference is to install these cables in the public road network rather than across third party lands where possible. In the case where the route crosses third party lands, an access track will be required above the cable trench for the length of the route in that land. Access will be required for any joint bays on a regular basis for maintenance purposes. The exact route and width of cable swathe across any third-party lands will need to be agreed with the landowners.

A cable connection will require a specific type of trench for the circuit. The trench will be approximately 1550mm wide and 1340mm deep, which is based on an EirGrid standard trench profile with an increased phase separation of 500mm centre to centre to achieve the required rating. The trench will contain three plastic ducts that will be laid in a flat formation at the bottom. Three power cables, one cable per phase, will be pulled into these ducts following completion of the civil works. The standard trench configuration has a further two smaller diameter ducts for communication cables that are located above the three power ducts.

A typical 400 kV Trench Section is shown in Figure 5.5 below.

The size of the cable trench required has been based on a single cable per phase arrangement. A typical cross of the trench is provided in Figure 5.6.

Figure 5.5: Trench Cross Section



Source: Mott MacDonald

Table 5.1 below presents a summary of the rating results and trench arrangement for a land-based 400 kV 2500mm^2 XLPE Copper cable at one cable per phase.

Table 5.1: Land Cable Details & Ratings

Cable Size	2500mm^2
Cable Depth	1200mm
Duct size	250mm
Duct spacing	250mm
Trench width	1550mm
Trench depth	1340mm
Thermal Resistivity (Winter/Summer)	1.0 / 1.2 k.m/W
Ambient Temperature (Winter/Summer)	10 / 20oC
Indicative circuit rating	1389/1217 MVA

Source Mott MacDonald

Heat is generated when electricity flows through cables and the cable insulation needs to be maintained at a temperature below 90 degrees Celsius to avoid premature ageing and possible failure. This means that the individual cables need to be spaced away from each-other to avoid overheating. This can prove challenging when more than one cable per phase is required, especially in a narrow corridor such as a local roadway. A similar consideration, where space is required to avoid overheating, is where two or more circuits either run in parallel or cross over or under each other.

The maximum length of individual High Voltage 400 kV cables section is limited by the size of the cable drum and this restricts the length to approximately 600m metres however, design considerations, such as induced sheath voltages will likely limit the individual sections lengths to less than this. Cable joints are required to join two sections of cables together. The joints are installed in concrete precast joint bays and these need to be installed along the cable route at

regular intervals. The joint bays need to be accessible to replace a section of faulty cable or to repair any faulty joint if required over the lifetime of the cable and therefore the location of these joint bays requires careful consideration. The approximate dimensions of this type of joint bay are 10m (length), 2.5m (width) and 2m (depth).

The design of the cable route should consider obstacles such as underground utilities, bridge crossings, proximity of wall foundations, culverts and any obstacle that could influence the separation distance or depth of the cables as such obstacles may adversely affect the ability of the cable to transport power from the grid to the substation.

5.2.3 Landfall

The landfall is the location where the submarine cable is brought ashore. The landfall generally comprises concrete cable toughing, associated civil works and a transition joint bay. The joint bay encloses the connections made between the land-based cables and the submarine cables. The intention is to have the joint bay at or below ground level and above the inter-tidal zone or areas of potential flood risk.

The approximate overall footprint of the transition joint bay to accommodate the four cables is 10m (length), 10m (width) and 2m (depth). An indicative design for a typical jointing bay prior to reinstatement is shown in Figure 5.5. During construction the landfall area will require access for equipment associated with the construction and cable installation, as well as access for replacing a section of faulty cable or repair work on joints.

The jointing bay is to be constructed with concrete floor and sidewalls. Once the cables are connected to the relevant joints within the jointing bay, compact cement-bound sand is put into the bay to surround the cables and joints. Additional sand and excavated material is then backfilled into the bay and the bay is subsequently covered over.

The geology of the nearshore approaches/intertidal area will determine how the cable will be installed into the transition joint bay. Usually, the cable is brought ashore by an open cut trench requiring access for excavation equipment. Where a steep rock shelf is present, further civil works may be required, taking the form of gabion bags filled with stone and revetments to support the approach by securing and protecting the cable installation

Figure 5.6: Typical Transition Joint Bay Before Final reinstatement

Source: Mott MacDonald

5.2.4 Submarine Cable Route

Submarine cables will be installed across the Shannon Estuary from a cable laying vessel (CLV) which is equipped with a turntable for storing of the cable to be installed. The CLV will be set up in a suitable position in the estuary and include Dynamic Positioning Class 1 or Class 2 to maintain position in strong tidal currents and wind. An example of typical CLV is shown in Figure 5.7.

Figure 5.7: Example of a typical CLV

Source: www.marinetraffic.com

The cable is paid out from the CLV turntable and is floated into the landfall location. For protection against anchor strikes and other third-party damage, the cable is buried at a determined depth. The target burial depth can be determined by completing a cable burial risk assessment. One cable burial risk assessment method is the Burial Protection Index (BPI) method. At Step 4, the BPI method has been adopted for the Cross Shannon 400 kV Cable project. This is a preliminary cable burial risk assessment methodology developed by Mole et al (1997) [4]. This methodology is considered by the project team to be appropriate for the level of study, i.e. to support the identification of feasible options. The burial risk assessment identifies the target burial depth having due regard to the seabed level, water depth at high water (relative to metres above chart datum) and vessel characteristics (draft, vessel length, DWT and anchor size) using the study area as well as the sediment or substrate type within which the proposed cable installation is proposed to be located. Prior to, or at detailed design, a full cable burial risk assessment in line with the Carbon Trust Cable Burial Risk Assessment Methodology[5] is recommended to be carried out to optimise the Best Performing Option cable route design and cost.

Figure 5.8 shows the output from the method developed by Mole et al (1997). The BPI score (y axis) corresponds to a vessel anchor size, which can be directly related to typical vessel dead weight tonnages (DWT). Therefore, for a known seabed sediment type, between fine sand and very soft clay (lines plotted on Figure 5.8), the target burial depth can be determined using the following criteria.

- A BPI score of 1 corresponds to a depth of burial consistent with protecting a cable from normal fishing gear only. This would be appropriate for water depths greater than say 50 to 100 m, where anchoring of ships is unlikely.

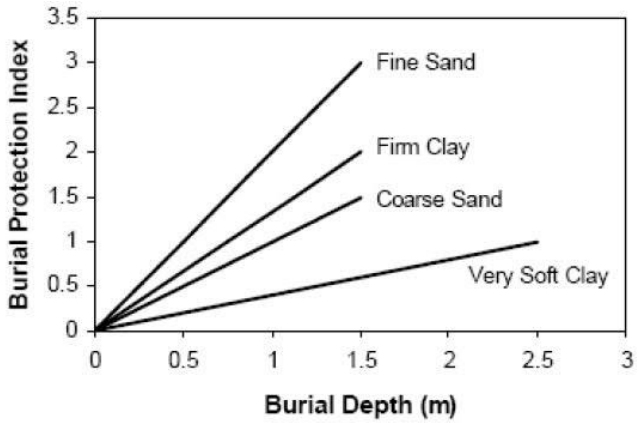
[4] Mole, P., Featherstone, J. and Winter, S. (1997). *Cable Protection – Solutions Through New Installation and Burial Approaches.* SubOptic '97. San Francisco.

[5] Carbon Trust (2015). Cable Burial Risk Assessment Methodology, Guidance for the Preparation of Cable Burial Depth of Lowering Specification. London: Carbon Trust.

- A BPI of 2 corresponds to a depth of burial to provide protection from vessel with anchors up to approximately two tonnes. This may be adequate for normal fishing activity but would not be adequate for large ships (e.g. tankers, large container ships).

BPI of 3 corresponds to a depth of burial sufficient to protect from anchors of all but the largest ships

Figure 5.8: Burial Protection Index (BPI) method



Source: Mole et al (1997)

The maximum length of the 400 kV submarine cable section is limited to the capabilities of the manufacturing facility. In general, when considering the approximate length of the submarine route, within the range of 4.5km, factory joints may not be required as each cable could potentially be produced in one single length. However, assurance should be sought from the manufacturer on the deliverable lengths of cable.

The spacing of each of the cables in the subtidal area is determined by several factors, including the risk of anchor damage and to minimise risk for required maintenance. Although a spare cable is to be installed, in the unlikely event that multiple cables are damaged, and a repair joint is required, a repair vessel will be deployed, the cable lifted and a repair length & joint installed. The length of the cable repair bight, which is a function of the water depth, factors into the spacing of the cables. So, consideration should be given to spacing the cables at the maximum water depth – approximately 60m.

In the intertidal area, as the cables approach the landfall and transition joint bay, the trenches will converge and the cable spacing will narrow to approximately 2m apart to enter the joint bay.

Table 5.2 presents a summary of the rating results and arrangement for the submarine 400 kV 2500mm^2 XLPE Copper cable at one cable per phase both in the subtidal and landfall installations. For the subtidal installation, the cable ampacity was modelled at 7.5m depth which equates to a sand wave maximum recorded amplitude of 5m plus 2.5m protected burial depth. Through the marine surveys the thermal resistivity of the soil was measured at various locations within the study area in the estuary. This measured value has been used when modelling the cable in both the subtidal and intertidal installations. The ambient temperature used in modelling the subtidal installation is in reference to IEC 60287-3-1. Within the intertidal and landfall areas where the cables begin to converge as they approach the transition joint bay, the risk of anchor strike and third-party damage is reduced and therefore the burial depth of the cables is reduced. The ambient temperature used in the cable modelling for the landfall area is as per EirGrid requirements for summer conditions.

Table 5.2: Submarine Cable Details & Ratings

	Subtidal	Intertidal/Landfall
Cable Size	2500mm^2	2500mm^2
Cable depth	7.5m	1m
Phase spacing	25m	2m
Thermal Resistivity	1.0 k.m/W	1.0 k.m/W
Ambient Temperature (IEC 60287 3-1 for subtidal)	15^{o}C	20^{o}C
Indicative circuit rating	1219 MVA	1354 MVA

Subtidal installations will vary according to the geology encountered in the area. In locations where the seabed is comprised of softer sediments, consideration will be given to water jetting for cable laying in the subtidal area. Where the seabed presents coarse sediments and rock-based conditions, consideration will also be given to mechanical cutters, ploughing and/or additional protection such as rock placement or installation of concrete mattresses. Cables are buried using the technique most suitable for the seabed type in the area. Typically, burial is achieved by ploughing, jetting, trenching or cutting the seabed material, and can take place pre- or post-cable laying. These methodologies are outlined in more detail below.

Water Jetting

This technique achieves burial by fluidising the soil beneath the cable allowing the cable to fall through the loosened soil under its self-weight to the base of the fluid zone. This results in the cable sinking to the required burial depth. Typically, the cable is pre-laid on the seabed in advance of the jetting tool, called a post-lay burial (PLB) water jetting system.

The water jetting equipment is usually mounted on a remotely operated vehicle (ROV) but can be put on a sled. The ROV is capable of operation in shallow water, close inshore. This facilitates the use of this method in the intertidal area where possible. Figure 5.9 shows an example of a typical jetting tool.

Figure 5.9: Example of a Typical Jetting Tool

Source: Example of a Typical Jetting Tool

Typical cable burial depths that can be achieved with modern water jetting tools is in the region of 3 m with soil capacity being sand and clay up to 100 kPa. Burial speeds up to 400 m / hr cab be achieved in optimal conditions using an ROV.

The primary advantages of water jetting are:

- There are all terrain jetting ROVs available for more uneven or steep sub-sea profiles. Cable installation accuracy can be very high, and the risk of damaging adjacent structures is lower than ploughing due to less intrusive fluidising technique;
- ROVs are self-propelled, mobile devices that are easily deployed, deep water capable and particularly suited to granular type seabed materials; and
- A combined lay and burial technique makes the process relatively quick.

The main disadvantages of water jetting are:

- Burial depths can be limited for low power jetting units compared to ploughs, and soil types are generally limited to sands, gravels and soft clays for all but the most powerful units. May not be feasible for materials above 100 kPa;
- Not suited to stiff cohesive or particularly gravelly soils;
- Potentially limited burial depth;
- Variable installation rate in comparison to ploughing; and
- May not be feasible in very strong tidal currents.

Ploughing

Cable ploughing techniques can be used in areas of coarse and more mixed sediment, gravel and cobble seabed areas.

The displacement ploughing technique creates an open V-shaped trench in which the cable is placed. This technique requires high pulling forces. The sediment amount of seabed removed is displaced next to the trench. The trench is left to refill naturally through sedimentation and sediment movement processes. The plough is supported on a sled, which is towed from the cable laying barge or vessel. The sled plough can bury cables in soils and rock, creating comparatively low levels of turbidity. A typical burial speed is in the region of 200 m / hr.

More modern cable ploughs use a non-displacement jetting plough approach, where the cable is lead through a thin-bladed ploughshare, directly laying the cable in the seabed avoiding an open trench and thus causing minimal disturbance to the seabed. This ploughing technique uses water jets to lubricate the blade as it requires less strength to bury the cable to the same depth as a classic plough share.

Typical cable burial depths that can be achieved with modern ploughing tools is in the region of 2-3 m in granular sand, clays and fractured rock.

The main disadvantages of ploughing are:

- Limited shallow water applications, as the plough is towed by a CLV;
- Limited to large cable bend radii of around 500 m;
- More difficult to steer as towed - lower laying accuracy;
- Cable installation is completed in one pass, requires remediation works if burial is not adequate first time;
- Difficult to monitor cable tensions;
- Can cause damaging tension spikes;

- Difficult to manoeuvre and position near foundations;
- Requires tow cable catenary and umbilical management;
- Risk of mechanical impact/abrasion/stress on cable;
- Higher risk in vicinity of adjacent cables;
- Plough “grade in” and “grade out” at each end of span, or a recovery leaves exposed cable requiring post lay inspection and burial;
- Can’t “cut and grip” damaged cable;
- Requires a larger cable ship with more operational personnel all charged at a higher day rate;
- Controlling plough operations can be challenging on steep slopes and/or strong currents. Ploughing is generally less accurate than ROV installation.;
- Will need the route to be pre-cleared prior to installation, e.g. a pre-lay grapnel run (PLGR), a seabed clearance operation; and
- The sled needs adequate pull force and relies on its self-weight to maintain plough engagement into the soil.

Trenching

Trenching is an alternative cable burial technique compared to the combined lay and burial methods. This technique requires the installation of a trench prior to cable laying. The trench may also be sized to allow for placement of armour on completion of the cable installation activities. The trenching operation can store the material and then re-use it. There will need to be an intermediate storage area before this can be completed. The delay between trenching and cable laying will be dependent on a number of factors including trench wall stability, siltation and erosion rates, the relative rates of trenching, cable laying and programme constraints.

The nature of trenching operations and possible environmental impacts is dependent on the surrounding environment and significance of the trenching activity.

The primary advantages of trenching are:

- Bed debris and obstructions can be relatively easily removed prior to cable laying;
- Burial depths are greater than combined lay and bury methods;
- Compatible with all soil types including cohesive materials;
- Well suited to cable burial where additional armour protection is required; and
- Less sophisticated laying equipment needed.

The main disadvantages of trenching are:

- Excavated material may contain contamination;
- Separate laying burial procedures required; and
- Relatively slow.

Mechanical cutters

For hard seabed materials, self-propelled mechanical cutters can be used. Such devices can produce slot or V-type trenches, depending on whether cable protection or stability is the main priority. They typically deploy chain, wheel or scoop type slot cutters to mechanically remove spoil and can be used in both shallow and deep water for post-lay or simultaneous operations.

The main disadvantages of mechanical cutters are:

- Extended deck space will be required to accommodate a mechanical trencher;
- Typically more expensive to maintain due to equipment complexity; and

- Large turning circle is required if a mechanical trencher is to be deployed successfully.

Additional Cable Protection

If cable burial is not an option due to adverse geological and environmental condition allowed within a given distance of the route the cable can be placed on the seabed and additional cable protection provided. This is typically provided by rock placement or installing a series of concrete mattresses or rick filled gabions over the top of the cable for resilience and security. This will protect the cable from damage through potential dredging or other activities. This type of cable protection may also be necessary in areas of shallow bedrock or very soft geology, where the cable is buried but cannot be buried to sufficient depth to reduce the risk of anchor strike or third-party damage to acceptable levels. In addition, articulated pipes can be used as additional protection in areas above and below the lowest astronomical tide (LAT) mark, typically constructed from cast iron, Figure 5.10 provides an example of a typical articulated pipe.

Figure 5.10: Example of a typical articulated pipe

Source: :https://www.cpnl.eu/

Sediment Mobility

The design of the cable route should also consider the seabed topography, the geology and the dynamic nature of the seabed for example where sand waves occur. Sand waves is the generic term that is often used to describe a range of seabed features or bedforms. They are encountered throughout the world and present particular problems for cable engineers. Cables crossing these areas must be properly engineered if they are to be secure and not suffer from faults during their lifetime. Particular aspects of cable engineering are associated with bedforms. These include the effect of lay tension and the burial methods that must be considered if a cable is to be buried and remain free of suspensions.

Due to mobile sediments cables undergo self-burial that is either temporary or permanent. Where routes traverse fields of mobile sand waves, burial takes place as the sand-wave crest passes across the cable. These sand waves can vary in amplitude and effectively can bury the cable deeper than it's intended burial depth and conversely, they can potentially expose the cable to external forces and increased risk of damage.

The nature of the bedforms is largely dependent on metocean conditions and the sediment characteristics. Wave and current action, including tidal flows can move these sand waves over varying temporal periods and result in the burial, exposure or even undermining of a cable. Where undermining is significant, the suspended cable can vibrate or strum under the water motions.

Such actions may abrade the cable itself. Where the suspensions are long lived, they can be colonized by encrusting marine biota that can biologically cement the cable.

Temporary burial may also occur nearshore, where 'fair-weather' accumulation of sand may be interrupted by storm-forced waves and currents that erode the substrate to expose a previously buried cable.

In zones of high sediment accumulation, cables can be rapidly buried by depositing sediment or simply settle into a soft substrate. Differential settlement should also be considered. This can occur along a cable route where the substrate below the cable changes from a significantly harder substrate to a significantly softer substrate over a relatively short distance. If the substrate is loaded (e.g. rock placement) settlement of the cable and rock could occur in the softer substrate. If this was significant enough it could pose a risk to damaging the cable.

By conducting various different marine survey techniques including collection of samples and testing, data can be analysed in conjunction with previous survey data and expert judgement to identify areas of high sediment mobility that may pose a risk to cable installation or operation.

Sand waves also effect the selection and/or performance of cable installation method, for example for ploughing. Sand waves with long wavelengths compared with the plough length can be followed by the plough but are more likely to result in larger out-of-straightness of the trench. Shorter wavelengths will result in less out-of-straightness, but larger variations of trench depth as the trench profile will not be in phase with the sand waves.

5.2.5 Connection at Kilpaddoge 220 kV Substation

Kilpaddoge 220 kV substation is a GIS type substation which is currently operational with a number of existing HV circuits connected into it.

All options under consideration will terminate at Kilpaddoge 220 kV substation, where an existing spare bay has been allocated for the connection of the 220 kV circuit from the 400/220 kV transformer. For the cable connection, it is expected that the outdoor 220 kV cable trench will run right up to the outside wall of the GIS building and that the ducts enter a cable basement located below the outdoor final ground level. The cables can then be routed through the basement in air to terminate at the allocated spare bay.

Gas Insulated Busbar (GIB) has not been deemed suitable as a connection method for the 220 kV connection to the substation. This is due to the arrangement and spatial constraints of the existing switchgear within the GIS hall.

The cable design within the Kilpaddoge 220 kV substation compound should consider the existing buried HV cables, other buried services and existing items of electrical plant. The area to the north between the foreshore and the existing Kilpaddoge substation has been allotted for future infrastructure development.

The substation itself is elevated in relation to the land around it, and as a result there are embankments to the immediate north and east. These areas may need to be filled to bring them up to the level of the substation should the equipment be located there.

In order for the 400 kV cable circuit to connect to the 220 kV substation, a power transformer is required. This transformer is a piece of outdoor electrical plant that is used to change the system voltage from one level to another and will have a rated power of 500MVA. Since the transformers main insulating medium is oil which is contained in the main tank, the transformer will be located within a bund. The approximate overall footprint of the transformer and bund is 25m x 10m

Figure 5.11: Kilpaddoge 220 kV Substation

Source: Mott MacDonald

5.2.6 GIS/AIS Connection

To facilitate the connection of the 400 kV cable to the transformer and for switching of the circuit, 400 kV equipment in the form of switchgear and measuring devices are required. This 400 kV equipment can either be AIS or GIS type.

AIS equipment uses atmospheric air as the main insulation for the exposed electrical conductors. AIS equipment is usually located outdoors, and the live equipment is spaced at a sufficient distance from ground and from other equipment to maintain safe electrical and maintenance clearances.

GIS substations comprise busbars and switchgear that are contained within metal ducts and enclosures. These ducts and enclosures are pressurised with SF_6 gas and this gas acts as an insulator to prevent the busbars from arcing to the enclosure. The GIS equipment can be installed in a much more compact manner compared to an Air Insulated Switchgear (AIS) equivalent. GIS substations are normally located indoors in a steel portal frame building. This allows for easier installation and maintenance. It also provides better security and allows cable circuits to be installed in a more flexible manner. The building is also used to house, control and protection equipment, battery systems and welfare facilities.

The table below presents the advantages of both AIS and GIS equipment.

Table 5.3: AIS & GIS Technologies

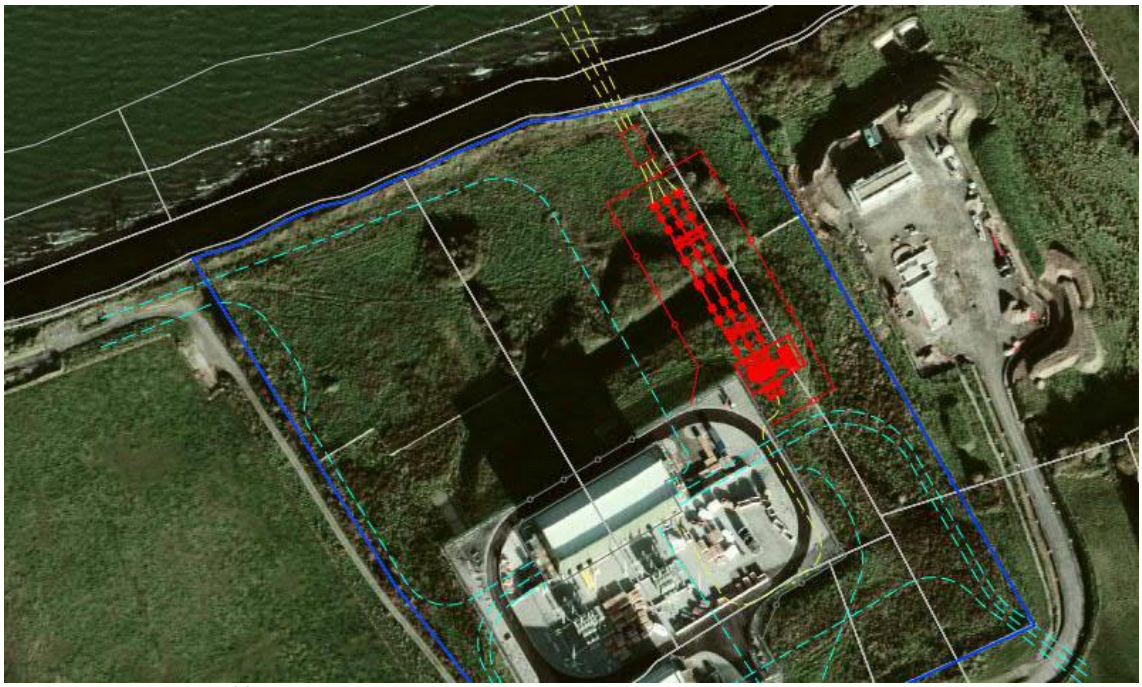
Advantages of AIS over GIS	Advantages of GIS over AIS
The AIS equipment is usually less expensive	GIS equipment is advantageous in terms of space constraints

Advantages of AIS over GIS	Advantages of GIS over AIS
With an AIS design, the transformer connections can be made with overhead busbar/conductor	GIS equipment is housed within a portal frame building which helps reduce visual impact
Easier access to individual items of plant for discrete replacement or maintenance	Increased security from third party interference and protection from the elements as the primary plant is installed indoors

Following discussions with EirGrid, an outdoor AIS arrangement was deemed the most appropriate solution for the connection at Kilpaddoge. This decision was based on the following main considerations:

- Cost - AIS is more cost effective for a single bay arrangement ;
- Extendibility - A GIS building with a single bay is not readily extendable; and
- Programme - AIS can be constructed and commissioned in a shorter timeframe.

Figure 5.12: Indicative 400 kV AIS Layout at Kilpaddoge



Source: Mott MacDonald

6 Consultation and Engagement

6.1 Introduction

Public and stakeholder engagement is a key principal in EirGrid's project development process. EirGrid's approach, which is outlined in EirGrid's publication "Have your Say" provides for the local community, landowners, elected representatives, media and prescribed bodies be made aware of the project and most importantly have the opportunities to provide feedback as the project develops. This section summarises community and planning consultations undertaken as part of the Step 4 process.

6.2 Landowner and Community Engagement

A stakeholder engagement plan was initially formulated at the outset of Step 4 in order to identify the relevant stakeholders for the project. As part of this plan, a programme for the stakeholder engagement was created in order to reflect the key issues and observations received. EirGrid has dedicated Agricultural and Community Liaison Officers (ALO's and CLOs) who have been talking and meeting with stakeholders and landowners within the study area. The engagement typically involved door to door visits and follow up meetings as necessary. Engagement at this stage was sought to raise awareness of the project and key information was provided being the project need and the main elements that it would consist of. Two public events were held in Tarbert Co. Kerry and Killimer Co. Clare in June 2019 to raise awareness of the project and seek feedback from the public to feed into the EirGird project development process and seek views on the Best Performing Option.

EirGrid ALO's and CLOs and MM staff also engaged in discussions with directly affected landowners to confirm land ownership, seek access for surveys, to discuss potential design and siting/routing options and to record any issues raised in respect to the Cross Shannon 400 kV Project during the phase 4 process. Where specific concerns were raised these were recorded and these have been addressed by the ALO's and CLOs with follow up meetings as necessary. The final programme of stakeholder engagement and the key issues identified during the Step 4 consultation process is summarised in Table 6.1 below.

6.3 Public Events

As noted above, a public event was held in Kirby's Lartern Hotel, Tarbert Co. Kerry on the 17th June 2019 and on the 18th June 2019 in Killimer Community Hall, Killimer Co. Clare. The events were advertised in the local newspapers (The Kerryman and the Clare Champion) prior to the event, and all those living within the study area were also advised of the upcoming events by the ALO/CLO's during any visit. Details of the meetings were also advertised in advance in the local media, and on social media. The purpose of the meetings were to consult with landowners, local communities, organisations and elected representatives to seek views on the Best Performing Option.

Overall the feedback received at the events were offered was generally positive and supportive of the Cross Shannon 400 kV Project. The general themes within the feedback consisted of;

- General queries related to the continued operation of the Moneypoint Generation Station and the potential ongoing supply chain opportunities within the study area. It is noted that the general area of Tarbert and Killimer has a long history of accommodating energy infrastructure

and the local population expressed concerns on the decline in the industry and potential adverse effects on the local economy and employment within the wider area.

- Queries were raised on the potential environmental impacts associated with the installation of the subsea cable within the Shannon Estuary and potential noise concerns associated with the proposed Kilpaddoge Substation. It was noted that the potential environmental impacts will be comprehensively assessed as part the next step in EirGrid Development Framework (i.e. as part of the planning approval).

6.4 Pre application Consultation with An Bord Pleanála

EirGrid entered into consultations with An Bord Pleanála (ABP) under Section 182E of the Planning and Development Act 2000, as amended. It was requested that the Board advise whether or not the proposed development is Strategic Infrastructure Development (SID) in accordance with the provisions of Section 182A of the Planning and Development Act 2000, as amended. A pre-application meeting is scheduled due to be held with ABP on the 25th October 2019. The purpose of the meeting is to provide an overview of the need for the Cross Shannon 400 kV Project and provide the Board with information on the project option evaluation process.

6.5 Planning and Foreshore Consultation

Mott MacDonald identified the relevant prescribed bodies to be consulted as part of a Step 4 framework process that will influence the future planning application and Foreshore licence application. Consultation also carried out as part of the future foreshore licence application included the prescribed bodies as set out in the Marine Licence Vetting Committee.

Table 6.1: Summary of Consultations

Stakeholder Name	Summary of Key Issues
Clare County Council	A pre application meeting was held with Clare County Council on the 4th October 2019. The purpose of the meeting was to discuss the key information of the proposed development including setting out the proposed project need and outlining the main elements of the project. It was noted that the proposed project will likely be deemed to be SID under Section 182A of the P&D Act. An open discussion occurred with questions and issues raised by Clare County Council which included matters related to construction traffic management, cumulative impacts and how and whether they would be assessed, construction methodologies, in particular how the cable would be laid in the foreshore and whether dredging would be occurring. It was confirmed that the proposed subsea cable installation will not require dredging and there is no need for disposal within a maritime area. Senior Planner raised issue on the continuity of Foynes Port and shipping channels, it was advised that consultation occur with the relevant bodies. Similarly, there was a discussion on the future use of lands as a result of the cable in reference to the SIFP. A wider discussion occurred in relation to energy and transmission issues in the area. The meeting concluded that the development was consistent with the development plan policies for the area subject the usual planning environmental assessments.
Kerry County Council	A pre application meeting was held with Kerry County Council on the 3rd October 2019. The purpose of the meeting was to discuss the key information of the proposed development including setting out the proposed project need and outlining the main elements of the project. It was noted that the proposed project will likely be deemed to be SID under Section 182A of the P&D Act. An overview was provided on the EirGrid Development Framework It was followed by an overview of how Step 5 – the planning process would proceed and included detail on the SID process, Foreshore Licences, EIA, AA. It was also advised that a Planning and Environmental Report would be included in the application and an overview of the entire project and would include a Construction Environmental Management Plan (CEMP). An open discussion occurred with questions and issues raised by Kerry County Council which included matters related to construction traffic management, landscape and visual and, cumulative impacts and how and whether they would be assessed, construction methodologies, in particular how the subsea cable would be laid in the foreshore and whether dredging would be occurring. It was confirmed that the proposed subsea cable installation will not require dredging and there is no need for disposal within a maritime area Issues were raised on potential impacts on recorded Neolithic Archaeology between the lands and the foreshore by the County Archaeologist. The meeting concluded that the development was consistent with the development plan policies for the area subject the usual planning environmental assessment

Stakeholder Name	Summary of Key Issues
Coastal Zone Management Division (Department Housing, Planning, Community and Local Government).	Ongoing discussions will be held with the Department as required through foreshore licensing process. EirGrid has provided the Department with an updated of the EirGrid Development process and details on the step 4 emerging best preforming option.
National Monuments (Underwater Archaeology Unit) Department Arts, Heritage and the Gaeltacht	A formal consultation letter was issued to the Development Application Unit (DAU) on behalf of NMU. Formal contact was also made through the Foreshore Licensing consultation process. A meeting is scheduled with the Department on 29th October 2019.
National Parks and Wildlife Service	A formal consultation letter was issued to the Development Application Unit (DAU) on behalf of NPWS and meeting was held with the Department. The key items addressed at the meeting included; it was advised that Foreshore Licence Application will be required. The Department noted that the project should have regard to the Article 6 (3) and 6(4) of the Habitat Directive DL advised a stage 2 Appropriate Assessment be completed, committing to the full implementation of the NPWS Guidelines (2014). Due regard should be provided to Dolphin Calving season and It was agreed that understanding the nature and extent of reef habitat would be an important issue to consider in the selection of the BPO for the proposed submarine cable.
Inland Fisheries Ireland	A consultation letter was issued to IFI and a follow up meeting was held on 22 July 2019 with IFI. A discussion on the need for the project and an overview of the project development comments on the emerging best performing route option to date was presented at the meeting. EirGrid outlined the campaign of surveys carried out to date and the findings of same in terms of understanding the terrain. The key items addressed at the meeting included; Technical queries in relation to cable laying phases and scheduling. IFI acknowledged that N2 / S2 is probably the most appropriate route and advised that key considerations should include sediment mobility, water quality and the zone of passage of migratory fish IFI agreed to forward on available information of seasonal constraints of migratory fish in study area and it was agreed a MMO will be on board the vessel during construction. Mott MacDonald confirmed that the Marine Institute had been consulted as part of the Step 4 consultations IFI requested biosecurity measures, biodegradable hydraulic fluids and oil spill accident response equipment included in mitigation. IFI requested details to be provided in the application regarding the sourcing of rock for rock placement (including screening processes), confirmation that fines would not be introduced, and proposals relating to washing of the rock prior to placement, if considered appropriate.
Sea Fisheries Protection Authority	A consultation letter was issued as part of the formal contact made through Foreshore Licensing consultation process. No feedback has been provided at this stage.
Department of Agriculture, Food and the Marine	A consultation letter was issued as part of the formal contact made through Foreshore Licensing consultation process. No feedback has been provided at this stage
Marine Institute	Mott MacDonald contacted the Marine Institute on 23rd July 2019 and received a response querying if there are any dredging or dumping at sea elements to the project. MM further informed Marine Institute on 2nd August of potential techniques required advising that confirmation regarding techniques will be provided at the next stage of the project development. Details of the proposed construction approach will be set out the next stage of the project development. It should be noted however that it can now be confirmed that dredging and / or dumping at sea does not form part of the proposed works.
Shannon Dolphin and Wildlife Foundation	Correspondence is ongoing between Mott MacDonald and representative of the foundation. No preference was noted on the routing of the proposed subsea cable. It is noted that appropriate mitigation such as the use of an MMO should be considered during the installation of the cables.
New Fortress Energy (Shannon LNG)	Correspondence received from Shannon LNG with query regarding cable route 1 interfering with marine works and proximity to Shannon LNG Foreshore lease area. All services within each route option were identified as part of the Step 4 process.
Atlantic Shellfish Ltd	A meeting was held with Atlantic Shellfish Limited on 22nd July 2019. Queries raised in relation to routing of cables in licenced area held by Atlantic Shellfish. EirGrid confirmed engagement would be undertaken with Atlantic Shellfish as to the exact placement of the cables and the cable installation methodologies when these are confirmed along with further design work requirements.

Stakeholder Name	Summary of Key Issues
Kilpaddoge Energy Limited	Correspondence and brochure was issued 31st May 2017 to the company. No feedback has been provided at this stage
Shannon Estuary - Strategic Integrated Framework Plan	EirGrid has been in contact with the Chair of steering group regarding the project progress and the emerging Best Performing Option.
Tarbert Development Association	TDA attended a public event day in Tarbert. Pre-meeting held with the TDA associates on 17th June. The purpose of the meeting was to discuss the key information of the proposed development including setting out the proposed project need and outlining the main elements of project. An overview was provided on the emerging Best Performing Option available at the time.

Feedback from all engagement recorded as part of the Step 4 was disseminated to the project team. Following the completion of the Step 4, the route of the Cross-Shannon Cable will be finalised to allow the project to progress to Step 5, 'The Planning Process'. The new underwater cable installation across the River Shannon will connect to the existing substation building at Moneypoint electricity generation station in County Clare. The connection in County Kerry will need the construction of extension to the existing Kilpaddoge substation on existing ESB lands. This extension will include a substation building and outdoor electrical equipment.

EirGrid will prepare a foreshore licence application and planning application during the Autumn of 2019. The planning application is likely to be made directly to An Bord Pleanála and the foreshore licence application will be made to the Department of Housing, Planning and Local Government. Both applications will be advertised in the local media and the documentation will be available for public inspection and submissions.

7 Identification of Feasible Options

7.1 Introduction

This section of the report provides a summary of the Step 4A process (identification of preliminary options) and methodology used to identify the options.

7.2 Works at Moneypoint 400 kV GIS Station

7.2.1 General

The proposed new 400 kV cable across the Shannon Estuary will connect Kilpaddoge and Moneypoint substations. There are three proposed landfall locations at the northern/Moneypoint side of the estuary. These landfalls are designated as N01, N02 and N03 and are located along the coast from west to east in proximity to Moneypoint Electricity Generation Station.

Four land cable route options associated with these landfalls have been brought forward:

- Option 1 – Land Cable Route from N01 through the Public Road;
- Option 2 - Land Cable Route from N02 through the Elevated Access Road (“High Road”);
- Option 3 – Land Cable Route from N03A through Public Road (local road) and Private Land; and
- Option 4 – Land Cable Route from N03B through Public Road (N67).

Each of these options is depicted on drawing 229379408-MMD-XX-GIS-Y-108 (Feasible Cable Route Options General) included in Appendix A *Drawings*.

7.2.2 Option 1 - Land Cable Route from N01 through the Public Road

This option considers the 400 kV cable circuit running from landfall location N01 to the existing Moneypoint 400 kV GIS substation. Landfall N01 is located about 140m west of the main entrance to Moneypoint Electricity Generation Station. The alignment of this route option can be seen on drawing 229379408-MMD-XX-GIS-Y-108 (Feasible Cable Route Options General). The overall estimated land route length is approximately 1.4km.

The transition joint pit would be installed in the green area off the N67 public road where there appears to be available space for its installation.

The cable route would come off the beach, at a slight incline, and follow the N67 east for about 400m up to the contractor entrance where it would then divert into the Power Station. The N67 is a national road which runs adjacent to the Power Station with a grass verge running on the northern side of it up to the entrance.

At this point the cable route would continue through the entrance which is a narrower internal access road and then turn south east passed the security office and through a disused access road which connects with the internal access road servicing the ash field, both of which should be wide enough to accommodate the 2m wide trench.

The cable route would then head south at a slight incline along the ash field service road which reaches a junction after 185m and then turns east towards the substation. A grass verge runs alongside this 185m section of access road. The route then runs east in the access road for 540m

and passes in front of the existing Moneypoint substation compound. At this point the cable turns into the existing substation compound and will be terminated into the 400 kV GIS substation.

A desktop assessment of the of the existing buried services along this identified cable route option was carried out. The main services encountered along this route are predominantly within the power station. Many of the services indicated on existing services drawings are redundant, including LV electrical and water supplies. The area around the security office is congested, however these are small services which can be crossed without significant impact to them.

The main services encountered in the internal access road are the 20 kV underground cables from the windfarm. The cable would both cross and run parallel to this 20 kV circuit up to where it would turn into the 400 kV substation.

As the identified route approaches the substation compound it would turn into the compound before three off 400 kV generator cables which cross the road in front of the first 400 kV substation. The route would then turn east towards the 'new' 400 kV substation and run between the existing 400 kV generator circuits and the existing 400 kV substation. At this stage, transformer T4202 should be removed allowing the 400 kV cables to be routed that way and into the 400 kV substation building on the western side.

7.2.3 Option 2 - Land Cable Route from N02 through the Elevated Access Road ("High Road")

This option considers the 400 kV cable circuit running from landfall location N02 to the existing Moneypoint 400 kV GIS substation. Landfall N02 is located to the south of the main coal yard within Moneypoint Electricity Generation Station. The landfall is located just east of the existing Moneypoint-Kilpaddoge 1 & 2 220 kV cable landfall. The alignment of this route option can be seen on drawing 229379408-MMD-XX-GIS-Y-108 (Feasible Cable Route Options General). The overall estimated land route length is approximately 1.8km.

The transition joint pit would be installed to the east of the existing Moneypoint-Kilpaddoge 1 & 2 220 kV cable transition joint bay. There are opportunities to land the cable in a small cove quite close to the existing installation however, a steep rock shelf is present, and extensive civil works may be required, which may take the form of gabion bags filled with stone and revetments to support the approach and transition pit. There is an area further east from the cove that also offers a good option for the cable landing, however private landowners will be impacted as a section of private land will be required to accommodate the construction of the cable troughs and transition joint pit.

The cable route identified would head north from the landfall and join the access road which is elevated and skirts the perimeter of the ash depository and the power station. This route continues north/north east along the road and then turns west towards the 400 kV substation when it inclines and joins on to another access road which runs in front of the substation compound. This access road is approximately 5m wide and mostly made up ground with rock and gravel fill.

A desktop assessment of the buried services along the identified route was carried out. The main services along this route were identified at the landfall and approaching the substation. There are minimal services within the elevated access road.

Where the route heads north from the landfall it would run in parallel to the existing Kilpaddoge-Moneypoint 220 kV cable circuit for approximately 70m. Additional land may be required to accommodate the space between circuits to mitigate any derating. The cable route again runs parallel to the Kilpaddoge-Moneypoint 220 kV cable circuit 220 kV circuit on approach to the substation where it will also cross it and another 220 kV cable circuit to enter the 400 kV

substation. A 20 kV cable also runs in the road in front of the substation compound. Adequate space between these circuits will need to be achieved to mitigate any risk of derating either of the circuits.

7.2.4 Option 3 – Land Cable Route from N03A through Public Road (local road) and Private Land

This option considers the 400 kV cable circuit running from landfall location N03 to the existing Moneypoint 400 kV GIS substation. Landfall N03 is located to the east of Moneypoint Electricity Generation Station approximately 1.8km east of N02. Access to the landfall can be gained by a local road. The alignment of this route option can be seen on drawing 229379408-MMD-XX-GIS-Y-108 (Feasible Cable Route Options General). The overall estimated land route length is approximately 2.3km.

The transition joint pit would be installed above the small beach area where the rock shelves gently from the shore. It appears that there is a parking area where the road ends at the beach which may accommodate the transition joint bay. However, the parking area may not be large enough, so landowners may be impacted as a section of private land may be required to allow for the construction of this transition joint pit.

From the landfall the identified cable route option heads north for 160m in the local road which is narrow at about 4m in width. There appears to be an existing farm building to the east with access off this local road. Where a road closure on this section may be required for construction, access to this property may be impacted. However, it appears that it can be accessed from the west.

After approximately 160m the route would follow the road to the west for 700m before turning northwest towards Moneypoint Electricity Generation Station for 210m where it would turn west and head through private land to join up with the elevated access road within Moneypoint Electricity Generation Station. This section of public road is narrow between 3m & 4m wide with narrow verges on either side. There are a number of dwellings and farm buildings off it. However, where a road closure is required for construction of the cable trench, a section of the road would be closed at a time and alternative access is available through the existing road network.

An existing watermain runs the along this public road in parallel to the identified cable route. As per EirGrid requirements adequate space between the cable circuit and watermain would need to be maintained. Further investigation of the location of this service would be required to determine the available space in the road for the cable circuit. However, relocation of this service may be possible. There are also two MV overhead lines and telecom lines traversing the area along the cable route.

Where the cable route diverts westward off the road it would route through private land, impacting existing landowners, where it would cross two access roads and an existing drainage ditch. The land slopes downward on approach to the elevated access road in the power station causing a significant change in elevation for the cable route. Therefore, the route would need to be brought up to the level of the access road at a more gradual angle and civil works would be required to fill this section to achieve this.

The cable route then runs west towards the 400 kV substation for 650m where it inclines and joins on to another access road which runs in front of the substation compound. This access road is approximately 5m wide and mostly made up ground with rock and gravel fill. The cable route runs parallel to the Kilpaddoge-Moneypoint 220 kV cable circuit on approach to the substation where it will also cross it and another 220 kV cable circuit to enter the 400 kV substation. A 20 kV cable also runs in the road in front of the substation compound. Adequate space between these circuits will need to be achieved to mitigate any risk of derating either of the circuits.

7.2.5 Option 4 – Land Cable Route from N03B through Public Road (N67)

This option considers the 400 kV cable circuit running from landfall location N03 to the existing Moneypoint 400 kV GIS substation. Landfall N03 is located to the east of Moneypoint Electricity Generation Station approximately 1.8km east of N02. Access to the landfall can be gained by a local road. The alignment of this route option can be seen on drawing 229379408-MMD-XX-GIS-Y-108 (Feasible Cable Route Options General). The overall estimated land route length is approximately 4.3km.

The transition joint pit would be installed above the small beach area where the rock shelves gently from the shore. It appears that there is a parking area where the road ends at the beach which may accommodate the transition joint bay. However, the parking area may not be large enough, so landowners may be impacted as a section of private land may be required to allow for the construction of this transition joint pit.

From the landfall the identified cable route option heads north towards the N67 for 915m in the local road which is narrow at about 4m in width. There appears to be an existing farm building to the east with access off this local road as well as a dwelling further north just before the N67. Since the cables will be provided in lengths of approximately 700m, a joint bay in this section of the route will be required and therefore a road closure would most likely be required. Where a road closure on this section is required for construction of the cable trench and installation of the pre-cast concrete joint bay, access to this property may be impacted. However, it appears that it can be accessed from the west.

Where this local road meets the N67, the cable route would follow the public road to the west for 2.5km before turning southeast towards Moneypoint Electricity Generation Station for 1km through power station internal access roads and into the substation compound from the west. This section of public road is a two-lane road between 6m & 8m wide. There are a number of dwellings and farm buildings along this road. A road closure is not envisaged given the width of the road. Traffic management would be put in place with one lane of the road closed. However, if a road closure is required for construction of the cable trench, a section of the road would be closed at a time and alternative access is available through the existing road network.

An existing watermain runs the along this N67 public road in parallel to the identified cable route. As per EirGrid requirements adequate space between the cable circuit and watermain would need to be maintained. Further investigation of the location of this service would be required to determine the available space in the road for the cable circuit. However, the road should be wide enough to accommodate the cable arrangement. There are also two MV overhead lines and telecom lines traversing the area along the cable route.

7.3 Submarine/River Shannon Crossing

7.3.1 General

The proposed new 400 kV cable across the Shannon Estuary will connect Kilpaddoge and Moneypoint substations. Three cable route options have been brought forward, designated N01-S01, N02-S02 and N03-S02:

- Option 1 – Marine Cable Route from N01 to S01 (4.6 km route length)
  - The marine cable route N01-S01 is the most westerly route running from a landfall at Ballymacrinan Bay (N01) on the north side of the Shannon Estuary to a landfall at Glencloosagh Bay (S01) on the south side.
- Option 2 – Marine Cable Route from N02 to S02(2.8 km route length)

  - The marine cable route N02-S02 is the central route running from a landfall adjacent to the Moneypoint Electricity Generation Station (N02) on the north side of the Shannon Estuary to a landfall at Glencloosagh Bay (S02), directly in front of Kilpaddoge substation on the south side.
- Option 3 – Marine Cable Route from N03 to S02 (3.2 km route length)
  - The marine cable route N03-S02 is the most easterly route running from the shoreline near Killimer (N03) on the north side of the Shannon Estuary to a landfall at Glencloosagh Bay (S02), directly in front of Kilpaddoge substation on the south side.

The alignment of the three marine route options can be seen on drawing 229379408-MMD-XX GIS-Y-108 (Feasible Cable Route Options General).

The marine cable route centrelines have taken into account the findings of the Phase 1 and Phase 2 marine surveys conducted in 2018. The pre-survey centrelines were revised following analysis of the survey findings and routed to avoid identified targets and archaeological features. Further consideration should be given to targets and other key constraints discussed in this report when developing the Best Performing Option.

7.3.2 Option 1 – Marine Cable Route from N01 to S01

This option considers the 400 kV cable circuit running from landfall location N01 to landfall location S01. The alignment of this route option can be seen on drawing 229379408-MMD-XX-GIS-Y-108. The overall estimated marine cable route length is approximately 4.6 km.

Figure 7.1 presents a cross section of the route centreline (the bathymetry) of the proposed from north to south. The maximum water depth reaches 40 m Chart Datum (CD) at the centre of the Shannon Estuary, west of the Bridge feature, at approximately Chainage KP 1.9. Maximum slope angles are typically less than 10 degrees.

A summary of the strata encountered along the N01-S01 route during the non-intrusive and intrusive investigations is presented in Figure 7.1 below. The interpreted geological profile along the N01-S01 route and the associated geological constraints are outlined in Section 4.8. The constraints outlined for each section are the most likely constraints based on the intrusive and non-intrusive data available but the other constraints outlined in Section 4.7 may also be present, particularly were intrusive locations are offset from the route alignment.

Figure 7.1 presents the output from the preliminary cable burial risk assessment completed to assist in comparing the feasible cable routes. The burial risk assessment identifies the target burial depth having due regard to the seabed level, water depth at high water (relative to metres above chart datum) and vessel characteristics (draft, vessel length, DWT and anchor size) using the study area as well as the sediment or substrate type within which the proposed cable installation is proposed to be located. Approximately 60 m of additional protection is identified to be required at the approach to landfall S02. This is at a seabed elevation above 0 m CD, therefore can be installed from the land. The average target burial depth is 2.5 m, with approximately 15% of the route length (650 m) exceeding 3 m burial depth. The maximum burial depth is 4.5 m. This occurs for approximately 650 m of the proposed route centreline (between KP 2.55 to 3.2).

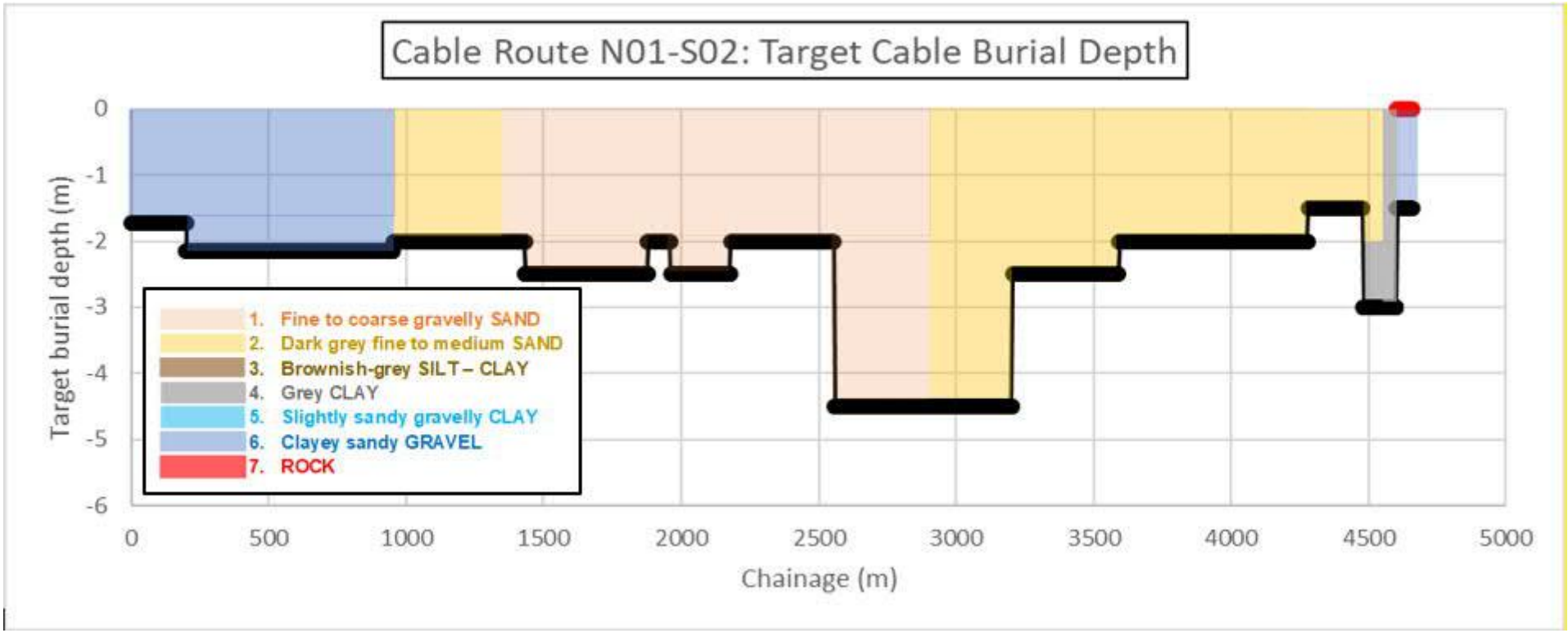
The proposed cable route has taken into consideration the key constraints identified from Section 4 (Planning and Environment Considerations) and Section 5 (Design Considerations) of this report. The key constraints associated with this cable route are:

- **Route chainage KP 0.1 to 0.2:** Shallow and/or exposed bedrock in the approach to, and at landfall N01:

  - A natural reef feature was identified during the marine survey campaign approximately 150 m west from landfall N01. The pre-survey route centreline has been revised following analysis of the survey results to avoid areas identified as shallow or exposed bedrock at N01.
- **Route chainage KP 2.4:** Geomorphological feature locally known as ‘the Bridge’:
  - This geomorphological feature is likely to be a glacial moraine with overlying mobile sediments. The proposed cable route centreline has been routed to avoid this feature due to the steep slopes and high likelihood of mobile sediments.
- **Route chainage KP 2.3 to 2.6:** Mobile sediments:
  - An area of high sediment mobility was identified following analysis of the survey results approximately 50 m west of the proposed cable route centreline. A cable corridor width of approximately 100 m is measured between this area of potential high sediment mobility and the Bridge feature to the north east.
- **Route chainage KP 4.4 to 4.6:** Existing Infrastructure

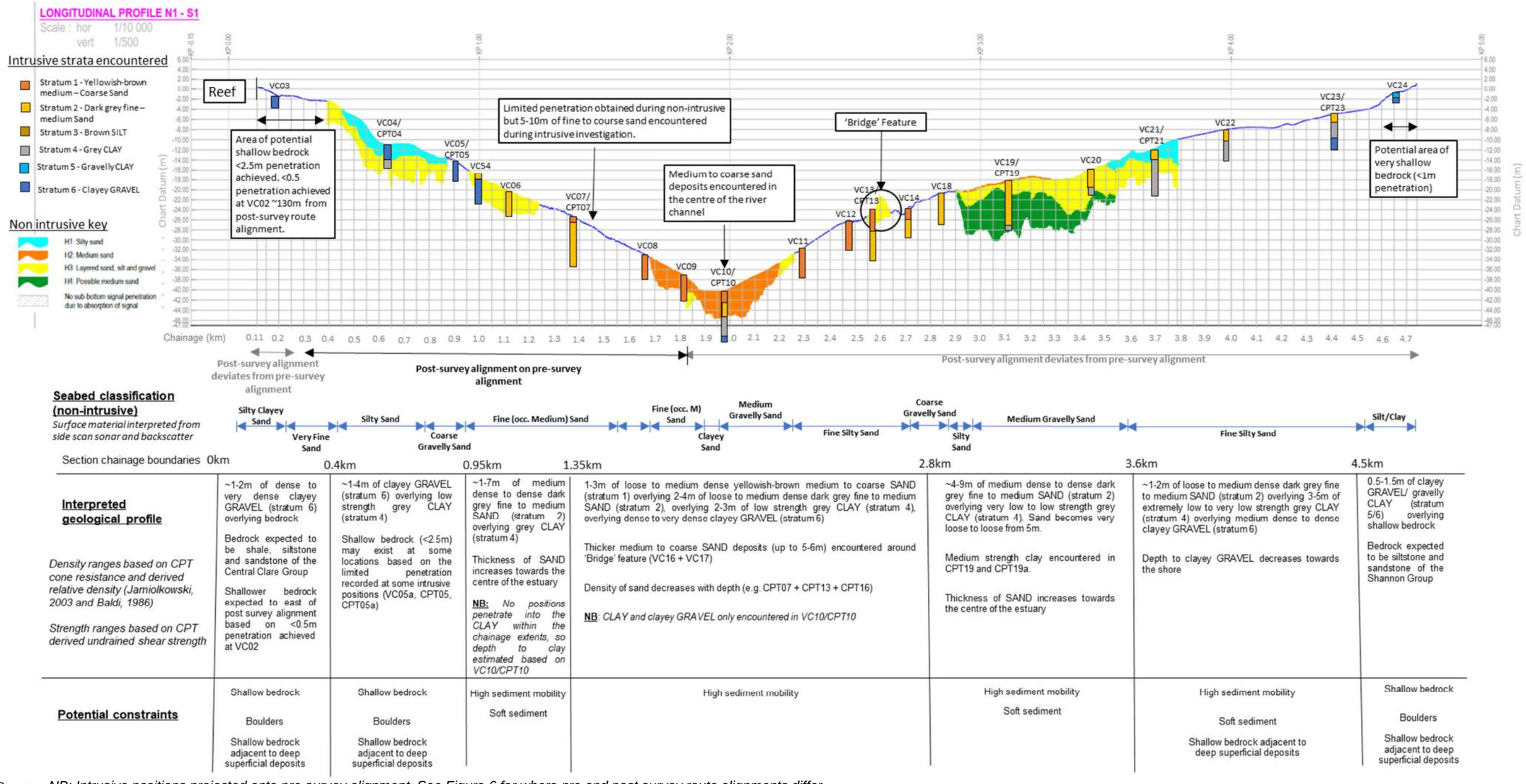
  Existing 220 kV subsea cables are located approximately 100 m east of the proposed landfall S02 centreline. The cable route at landfall S02 has been routed to avoid the existing cables, no marine crossing of the existing cables is considered .

Figure 7.1: Target Burial Depth for Option 1 – N01 to S01 [This shows the route centreline chainage, m (x-axis), target burial depth, m below the seabed (y-axis), sediment type (colour polygons) and additional cable protection (red line)]



Source: Mott MacDonald

Figure 7.2: Geological long section along N01-S01 pre-survey cable



Interpreted geological profile *Density ranges based on CPT cone resistance and derived relative density (Jamiolkowski, 2003 and Baldi, 1986)* *Strength ranges based on CPT derived undrained shear strength*	~1-2m of dense to very dense clayey GRAVEL (stratum 6) overlying bedrock Bedrock expected to be shale, siltstone and sandstone of the Central Clare Group Shallower bedrock expected to east of post survey alignment based on <0.5m penetration achieved at VC02	~1-4m of clayey GRAVEL (stratum 6) overlying low strength grey CLAY (stratum 4) Shallow bedrock (<2.5m) may exist at some locations based on the limited penetration recorded at some intrusive positions (VC05a, CPT05, CPT05a)	~1-7m of medium dense to dense dark grey fine to medium SAND (stratum 2) overlying grey CLAY (stratum 4) Thickness of SAND increases towards the centre of the estuary **NB:** *No positions penetrate into the CLAY within the chainage extents, so depth to clay estimated based on VC10/CPT10*	1-3m of loose to medium dense yellowish-brown medium to coarse SAND (stratum 1) overlying 2-4m of loose to medium dense dark grey fine to medium SAND (stratum 2), overlying 2-3m of low strength grey CLAY (stratum 4), overlying dense to very dense clayey GRAVEL (stratum 6) Thicker medium to coarse SAND deposits (up to 5-6m) encountered around 'Bridge' feature (VC16 + VC17) Density of sand decreases with depth (e.g. CPT07 + CPT13 + CPT16) **NB**: *CLAY and clayey GRAVEL only encountered in VC10/CPT10*	~4-9m of medium dense to dense dark grey fine to medium SAND (stratum 2) overlying very low to low strength grey CLAY (stratum 4). Sand becomes very loose to loose from 5m. Medium strength clay encountered in CPT19 and CPT19a. Thickness of SAND increases towards the centre of the estuary	~1-2m of loose to medium dense dark grey fine to medium SAND (stratum 2) overlying 3-5m of extremely low to very low strength grey CLAY (stratum 4) overlying medium dense to dense clayey GRAVEL (stratum 6) Depth to clayey GRAVEL decreases towards the shore	0.5-1.5m of clayey GRAVEL/ gravelly CLAY (stratum 5/6) overlying shallow bedrock Bedrock expected to be siltstone and sandstone of the Shannon Group
Potential constraints	Shallow bedrock Boulders Shallow bedrock adjacent to deep superficial deposits	Shallow bedrock Boulders Shallow bedrock adjacent to deep superficial deposits	High sediment mobility Soft sediment	High sediment mobility	High sediment mobility Soft sediment	High sediment mobility Soft sediment Shallow bedrock adjacent to deep superficial deposits	Shallow bedrock Boulders Shallow bedrock adjacent to deep superficial deposits

Source: *NB: Intrusive positions projected onto pre-survey alignment. See Figure 6 for where pre and post survey route alignments differ*

Table 7.1: Interpreted geological profile and constraints along the N01-S01 route

Start Chainage (km)	End Chainage (km)	Expected Geological Profile	Potential Constraints
0	0.4	~1-2m of clayey GRAVEL (stratum 6) overlying bedrock Bedrock expected to be shale, siltstone and sandstone of the Central Clare Group Shallower bedrock expected east of post survey alignment based on <0.5m penetration achieved at VC02	Shallow bedrock Boulders Shallow bedrock adjacent to deep superficial deposits
0.4	0.95	~1-4m of clayey GRAVEL (stratum 6) overlying grey CLAY (stratum 4) Shallow bedrock (<2.5m) may exist at some locations based on the limited penetration recorded at some intrusive positions (VC05a, CPT05, CPT05a)	Shallow bedrock Boulders Shallow bedrock adjacent to deep superficial deposits
0.95	1.35	~1-7m of dark grey fine to medium SAND (stratum 2) overlying grey CLAY (stratum 4) Thickness of SAND increases towards the centre of the estuary **NB:** No positions penetrate into the CLAY within the chainage extents, therefore depth to clay estimated based on VC10/CPT10	High sediment mobility Soft sediment
1.35	2.8	1-3m of yellowish-brown medium to coarse SAND (stratum 1) overlying 2-4m of dark grey fine to medium SAND (stratum 2), overlying 2-3m of grey CLAY (stratum 4), overlying clayey GRAVEL (stratum 6) **NB**: CLAY and clayey GRAVEL only encountered in VC10/CPT10 Thicker medium to coarse SAND deposits (up to 5-6m) encountered around 'Bridge' feature (VC16 + VC17)	High sediment mobility

Start Chainage (km)	End Chainage (km)	Expected Geological Profile	Potential Constraints
2.8	3.6	~4-9m of dark grey fine to medium SAND (stratum 2) overlying grey CLAY (stratum 4) Thickness of SAND increases towards the centre of the estuary	High sediment mobility Soft sediment
3.6	4.5	~1-2m of dark grey fine to medium SAND (stratum 2) overlying 3-5m of grey CLAY (stratum 4) overlying clayey GRAVEL (stratum 6) Depth to clayey GRAVEL expected to decrease towards the shore	High sediment mobility Soft sediment Shallow bedrock adjacent to deep superficial deposits
4.5	4.7	0.5-1.5m of clayey GRAVEL/gravelly CLAY (stratum 5/6) overlying shallow bedrock Bedrock expected to be siltstone and sandstone of the Shannon Group	Shallow bedrock Boulders Shallow bedrock adjacent to deep superficial deposits

NB: Chainage begins at N01.

7.3.3 Option 2 – Marine Cable Route from N02 to S02

This option considers the 400 kV cable circuit running from landfall location N02 to landfall location S02. The alignment of this route option can be seen on drawing 229379408-MMD-XX-GIS-Y-108. The overall estimated marine cable route length is approximately 2.8 km.

Figure 7.5 presents the seabed topography (bathymetry) of the proposed cable route centreline from north to south. The maximum water depth reaches 58 m CD, at the centre of the Shannon Estuary, east of the Bridge feature, at approximately Chainage KP 0.95. Maximum slope angles are up to 15 degrees, mostly confined to the northern half of the route. The maximum slope angle is found close to KP 0.8.

A summary of the strata encountered along the N02-S02 route during the non-intrusive and intrusive investigations is presented in Figure 7.5. The interpreted geological profile along the N02-S02 route and the associated geological constraints are outlined in Table 6.2. The constraints outlined for each section are the most likely constraints based on the intrusive and non-intrusive data available.

Figure 7.3 below presents the output from the preliminary cable burial risk assessment completed to assist in comparing the feasible cable routes. Approximately 1000 m of additional protection is identified as required at the approach to landfall N02 (KP 0 to 0.2), near the centre of the channel (KP 0.65 to 0.85) and landfall S02 (KP 2.2 to 2.8). Approximately 90% of the length of the additional cable protection is located in water depths exceeding 3 m, therefore marine installation is required. The average target burial depth is 2.75 m, with approximately 20% of the route length (600 m) exceeding 3 m burial depth and 20% of the route length (500 m) exceeding 5 m burial

depth. The maximum burial depth is 7.5 m. This occurs for approximately 350 m of the proposed route centreline (between KP 0.85 to 1.2).

The key constraints associated with this cable route are:

- **Route chainage KP 0.0 to 0.2 and KP 0.65 to 0.85:** Shallow and/or exposed bedrock:
  - Shallow and exposed bedrock has been identified for the first 200 m of the cable route at landfall N01 and for another 200 m of the cable route near the base of the main channel (KP 0.65 to 0.85). Bedrock is observed at the landfall at low tide and is evident by the steep rocky cliffs rising approximately 10 m adjacent to landfall N02. Data made available to Mott MacDonald from the existing 220 kV cable installation and previous marine survey campaign agrees with the shallow and exposed bedrock at these locations (see). Additional cable protection is proposed along the first 200 m of this route due to the shallow bedrock and risk from anchor strike.
- **Route chainage KP 0 to 0.2:** Existing Infrastructure
  - Existing 220 kV subsea cables are located approximately 60 - 100 m east of the proposed landfall N01 centreline. The cable route at landfall N01 has been routed to avoid the existing cables, no marine crossing of the existing cables is considered.
- **Route chainage KP 0.25 to 1.0:** Tidal currents
  - Peak tidal velocities of up to 5 knots (260 cm / s) occur during spring tides between KP 0.25 and 1.0. This typically occurs 3.5 to 5 hours after high water. High tidal velocities may limit the time periods for cable installation depending on the capability of the cable laying tool and vessel, however this is not considered to be a significant risk and can be mitigated.
- **Route chainage KP 1.45:** Steep slopes
  - Steep slopes, exceeding 15 degrees, have been identified in the region between N02 and S02. Slopes exceeding 15 degrees are considered to be more difficult for cable installation tools, especially when considering the high tidal currents that can occur. The cable route centreline has been routed to avoid areas of steep slopes.
- **Route chainage KP 0.85 to 1.2:** Mobile sediments:

An area of high sediment mobility was identified following analysis of the survey results between KP 0.85 and 1.2 (350 m). Sand waves with an amplitude of up 0.25 to 0.5 m and wavelengths up to 5 - 10 m have been measured. Based on analysis of historical bathymetry data, larger scale seabed features have been identified that may be moving over longer timescales (years) than the relatively small sand waves (days / weeks). The height of these features are up to 4 to 5 m and 50 to 250 m wide. The cable route cannot be routed around this area due to the proximity of the existing cables to the west. An alternative route to the east of this area may be possible however this area has limited survey data coverage. Furthermore, a second area of high sediment mobility was identified 200 m east of the one located between KP 0.85 and 1.2. Trenching and or use of a scar plough is likely to be required to install the cable to a sufficient depth to reduce the risk of anchor strike. This is discussed further in relation to target burial depth below. This should be considered further at the Best Performing Option and subsequent detailed design phase of the project

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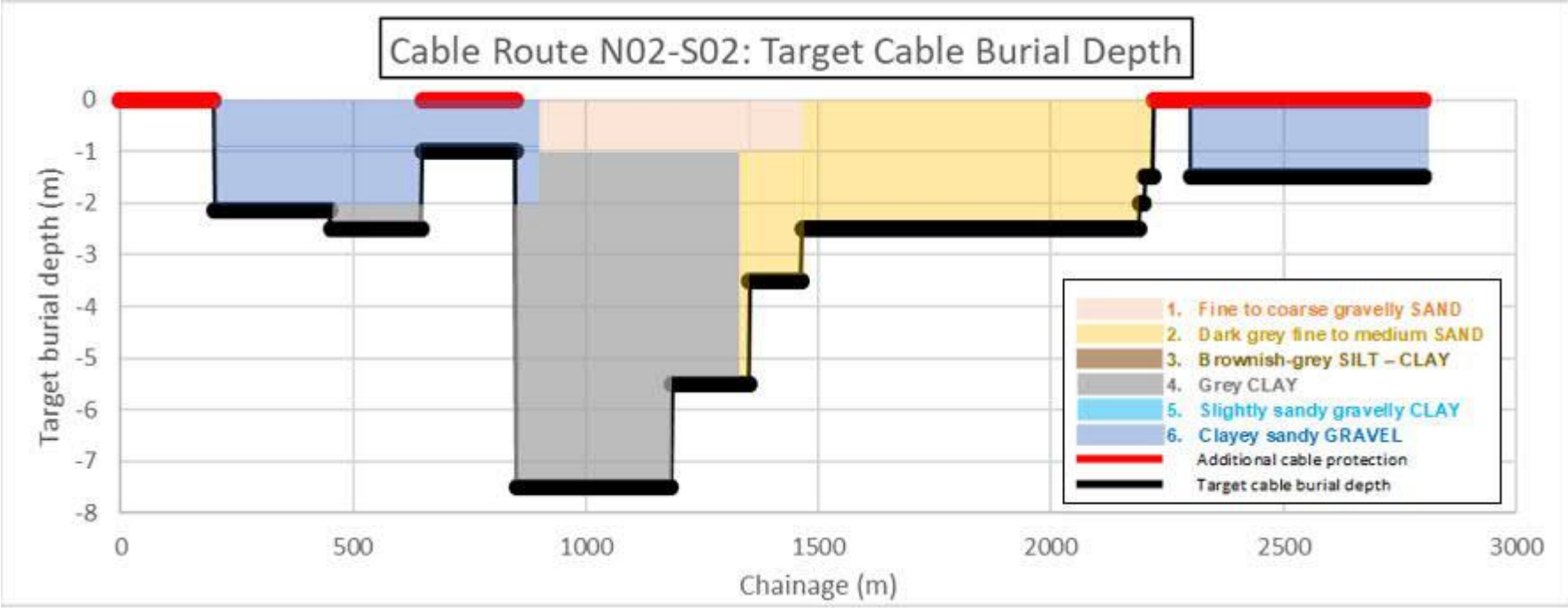
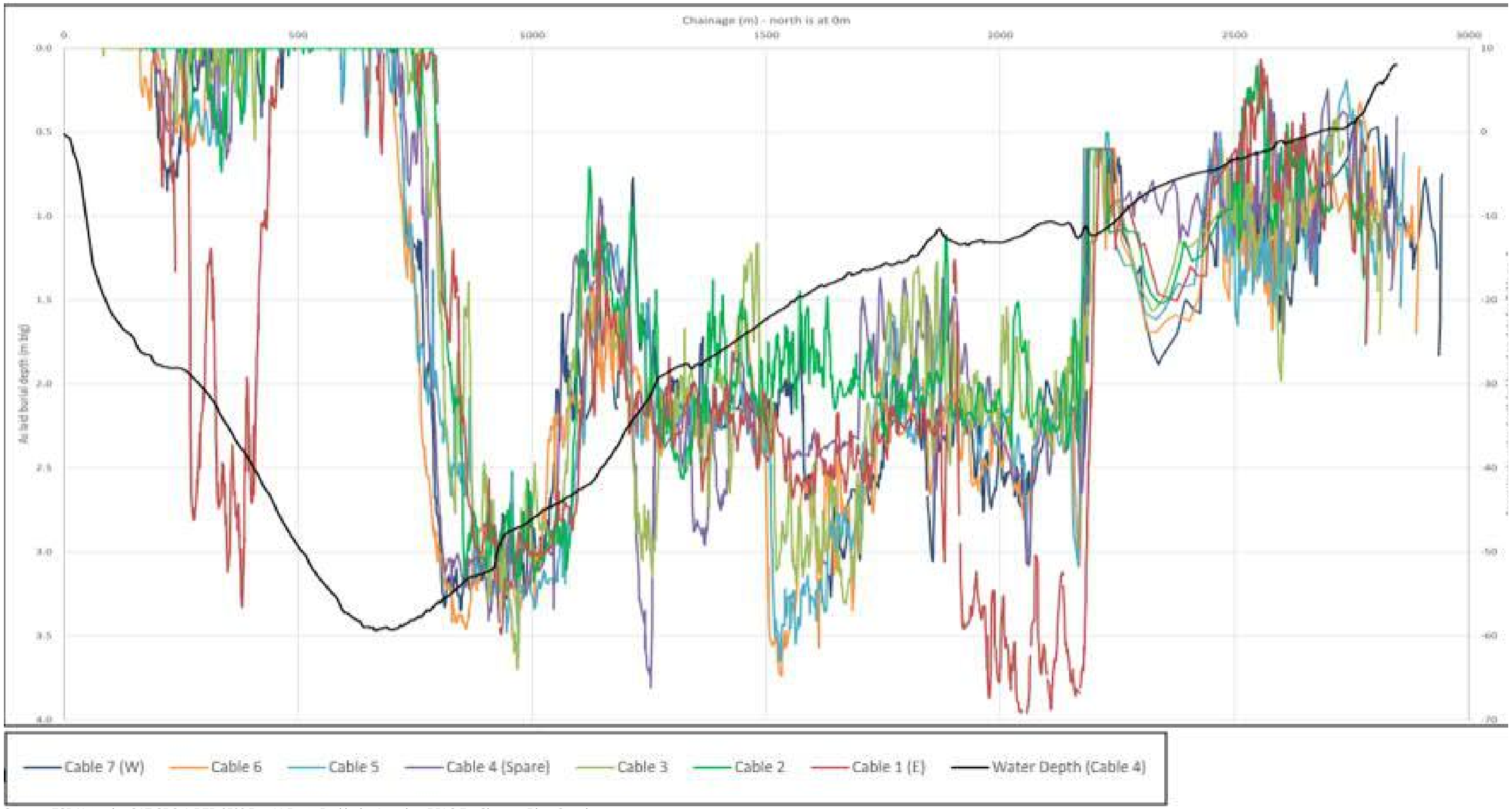
Figure 7.3: Target burial depth for Option 1 – N02 to S02. This shows the route centreline chainage, m (x-axis), target burial depth, m below the seabed (y-axis), sediment type (colour polygons) and additional cable protection (red line



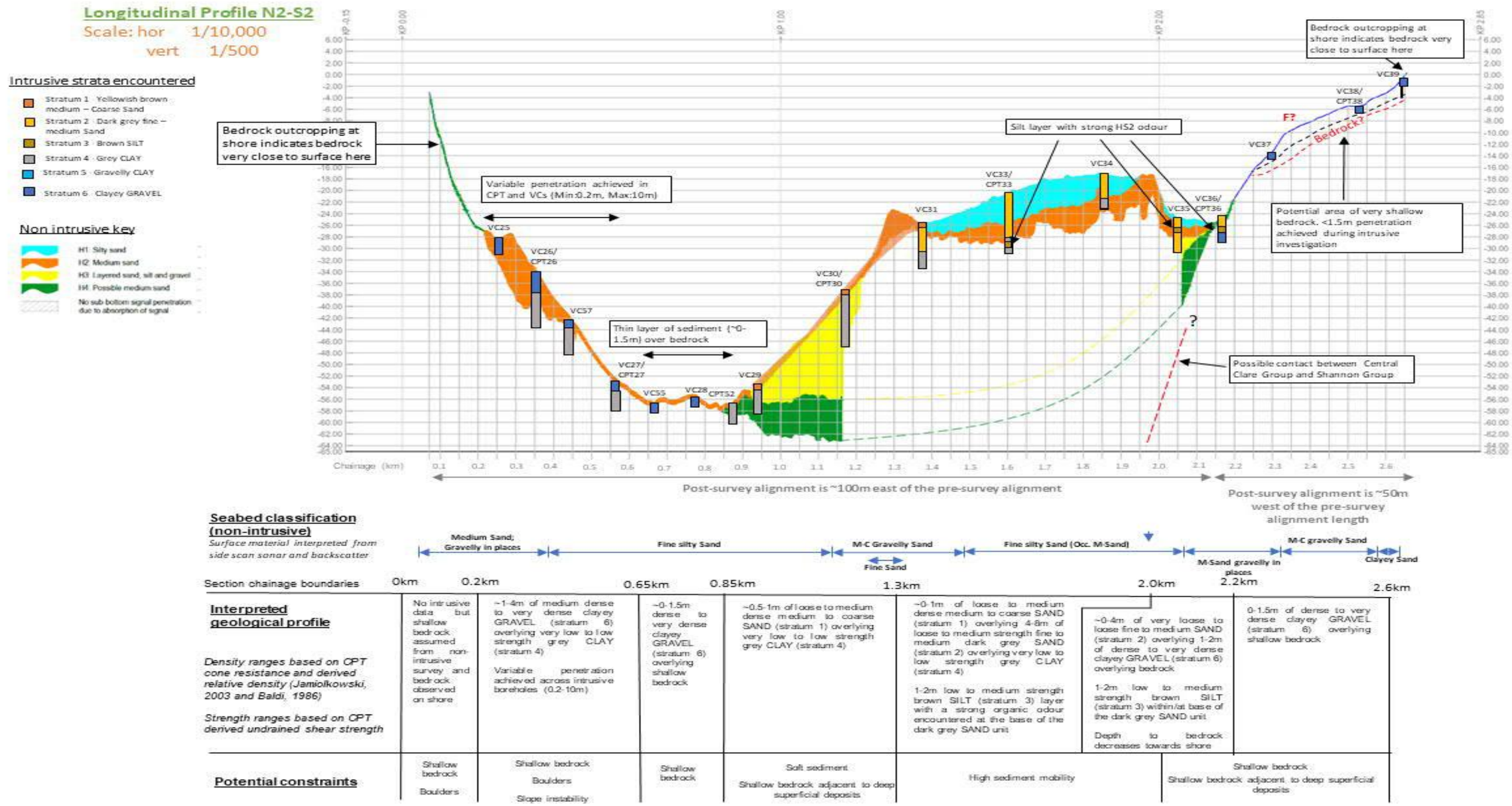
Source: Mott MacDonald

Figure 7.4: As-laid Data for the 220 kV Moneypoint to Kilpaddoge Submarine Circuits (7no. cables) [The data indicates shallow or surface laid cables up to approximately 800 m south of the northern landfall. Burial depth along the southern slopes of the channel range between 1.0 to 3.0m. The cable separation distance is typically 25 m. The proposed cable route option 2 (N02 to S02) is located closest to the existing 220 kV cables. The as laid data is consistent with the proposed target burial depth for option 2 (see Figure 7.3



Source: ESB Networks; CAT-SRC-A-REP-8500 Rev 11 Route Positioning Lengths - RPLS For Shannon River Crossing

Figure 7.5: Geological Long Section along N02-S02 Pre-survey Cable Route (See Error! Reference source not found.**)**



Source: *NB: Intrusive positions projected onto pre-survey alignment. See Figure 6 for where pre and post survey route alignments differ*

Table 7.2: Interpreted geological profile and constraints along the N02-S02 route

Start Chainage (km)	End Chainage (km)	Expected Geological Profile	Potential Constraints
0	0.2	No intrusive data but shallow bedrock assumed from non-intrusive survey and bedrock observed on shore.	Shallow bedrock Boulders
0.2	0.65	~1-4m of medium dense to very dense clayey GRAVEL (stratum 6) overlying very low to low strength grey CLAY (stratum 4). Variable penetration achieved across intrusive boreholes (0.2-10m).	Shallow bedrock Boulders Slope instability
0.65	0.85	~0-1.5m dense to very dense clayey GRAVEL (stratum 6) overlying shallow bedrock.	Shallow bedrock
0.85	1.30	~0.5-1m of loose to medium dense/ medium to coarse SAND (stratum 1) overlying very low to low strength grey CLAY (stratum 4).	Soft sediment Shallow bedrock adjacent to deep superficial deposits
1.30	2.0	~0-1m of loose to medium dense medium to coarse SAND (stratum 1) overlying 4-8m of loose to medium strength/ fine to medium dark grey SAND (stratum 2) overlying very low to low strength grey CLAY (stratum 4). 1-2m low to medium strength brown SILT (stratum 3) layer with a strong organic odour encountered at the base of the dark grey SAND unit.	High sediment mobility
2.0	2.2	~0-4m of very loose to loose/ medium to coarse SAND (stratum 1) overlying 1-2m of dense to very dense clayey GRAVEL (stratum 6) overlying bedrock. 1-2m low to medium strength brown SILT (stratum 3) within/at base of the dark grey SAND unit.	Shallow bedrock Shallow bedrock adjacent to deep superficial deposits

Start Chainage (km)	End Chainage (km)	Expected Geological Profile	Potential Constraints
		Depth to bedrock decreases towards shore.	
2.2	2.6	0-1.5m of dense to very dense clayey GRAVEL (stratum 6) overlying shallow bedrock	Shallow bedrock Shallow bedrock adjacent to deep superficial deposits

NB: Chainage begins at N02

7.3.4 Option 3 and 4 – Marine Cable Route from N03 to S02

This option considers the 400 kV cable circuit running from landfall location N03 to landfall location S02. The alignment of this route option can be seen on drawing 229379408-MMD-XX-GIS-Y-108. The overall estimated marine cable route length is approximately 3.2 km.

Section 7.6 presents the seabed topography (bathymetry) of the proposed cable route centreline from north to south. The maximum water depth reaches 53 m CD, at the centre of the Shannon Estuary at approximately Chainage KP 1.3. Maximum slope angles are up to 20 degrees, however these slopes are localised and confined to two seabed ridges close to KP 0.7 and 1.0.

A summary of the strata encountered along the N03-S02 route during the non-intrusive and intrusive investigations is presented in Section 7.7. The interpreted geological profile along the N03-S02 route and the associated geological constraints are outlined in Section 7.3. The constraints outlined for each section are the most likely constraints based on the intrusive and non-intrusive data available but the other constraints outlined in Section 4.7 may also be present, particularly were intrusive locations are offset from the route alignment.

Section 7.6 below presents the output from the preliminary cable burial risk assessment completed to assist in comparing the feasible cable routes. Approximately 250 m of additional protection is identified as required at the approach to landfall S02 (KP 2.95 to 3.2). Approximately 50% of this length is located in water depths exceeding 3 m, therefore marine installation is required. The average target burial depth is 2.6 m, with approximately 25% of the route length (800 m) exceeding 3 m burial depth and 5% of the route length (100 m) exceeding 5 m burial depth, between KP 1.15 and 1.25. The maximum burial depth is 5.5 m. This occurs for approximately 100 m of the proposed route centreline (at KP 1.2).

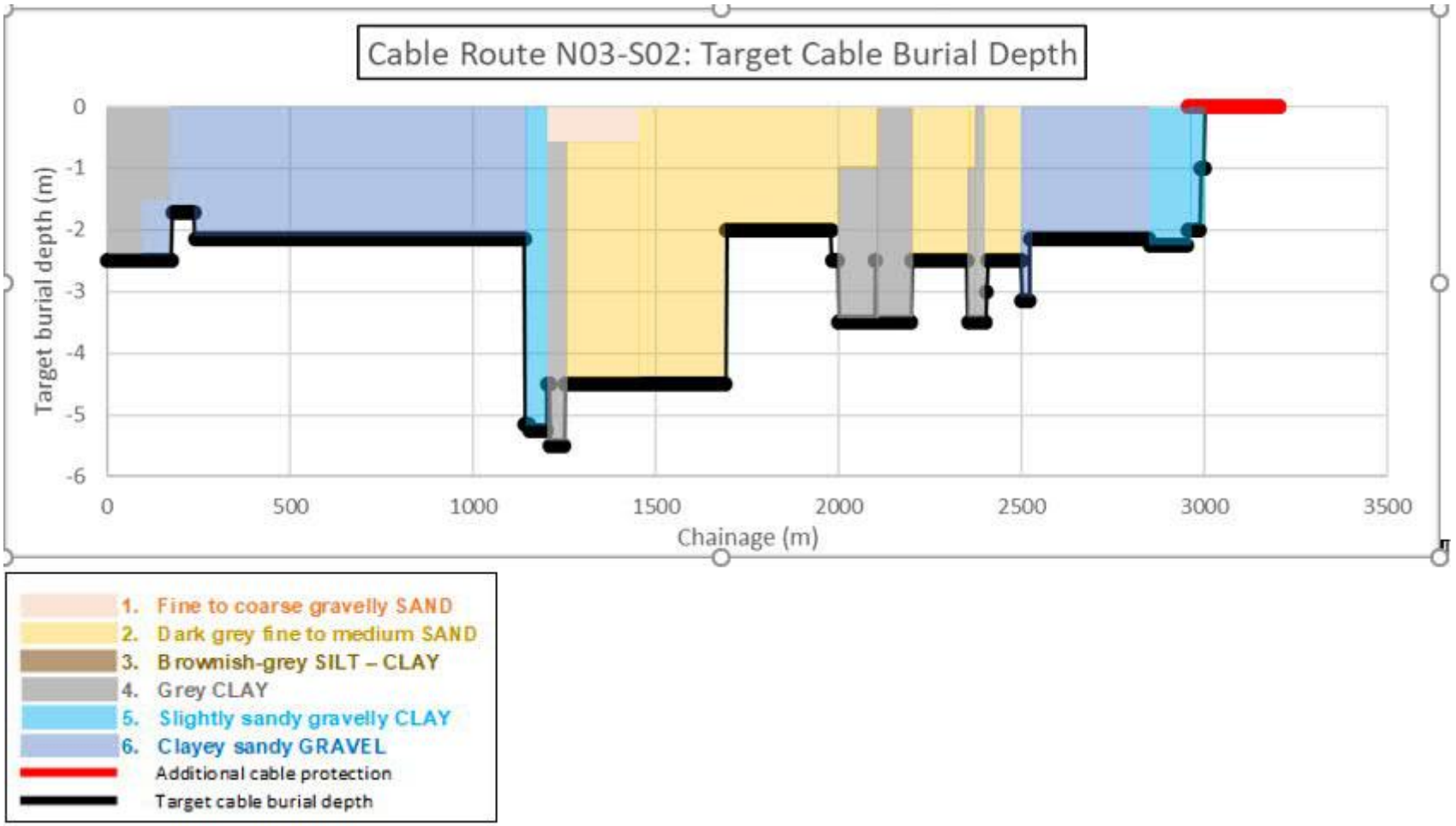
The key constraints associated with this cable route are:

- **Route chainage KP 0.25 to 1.0:** Tidal currents
  - Current data along N03-S02 is not available, however, nearby tidal velocities records have been reviewed. Based on the bathymetry data along with the experience of conducting marine surveys along this route, peak tidal velocities of up to 5 knots (260 cm / s) could occur during spring tides in the northern part of the route, between KP 0.5 and 1.2. High tidal velocities may limit the time periods for cable installation depending on the capability of the cable laying tool and vessel, however this is not considered to be a significant risk and can be mitigated.
- **Route chainage KP 0.7 and 1.0:** Steep slopes
  - Steep slopes, between 15 to 20 degrees, have been measured between KP 0.7 and 1.0. Slopes exceeding 15 degrees are considered to be more difficult for cable installation tools, especially when considering the high tidal currents that can occur. The micro-routing of

cables should be considered further as the project progressed if this option is identified as the Best Performing Option. The localised steep slopes are not considered a significant risk and can be mitigated.

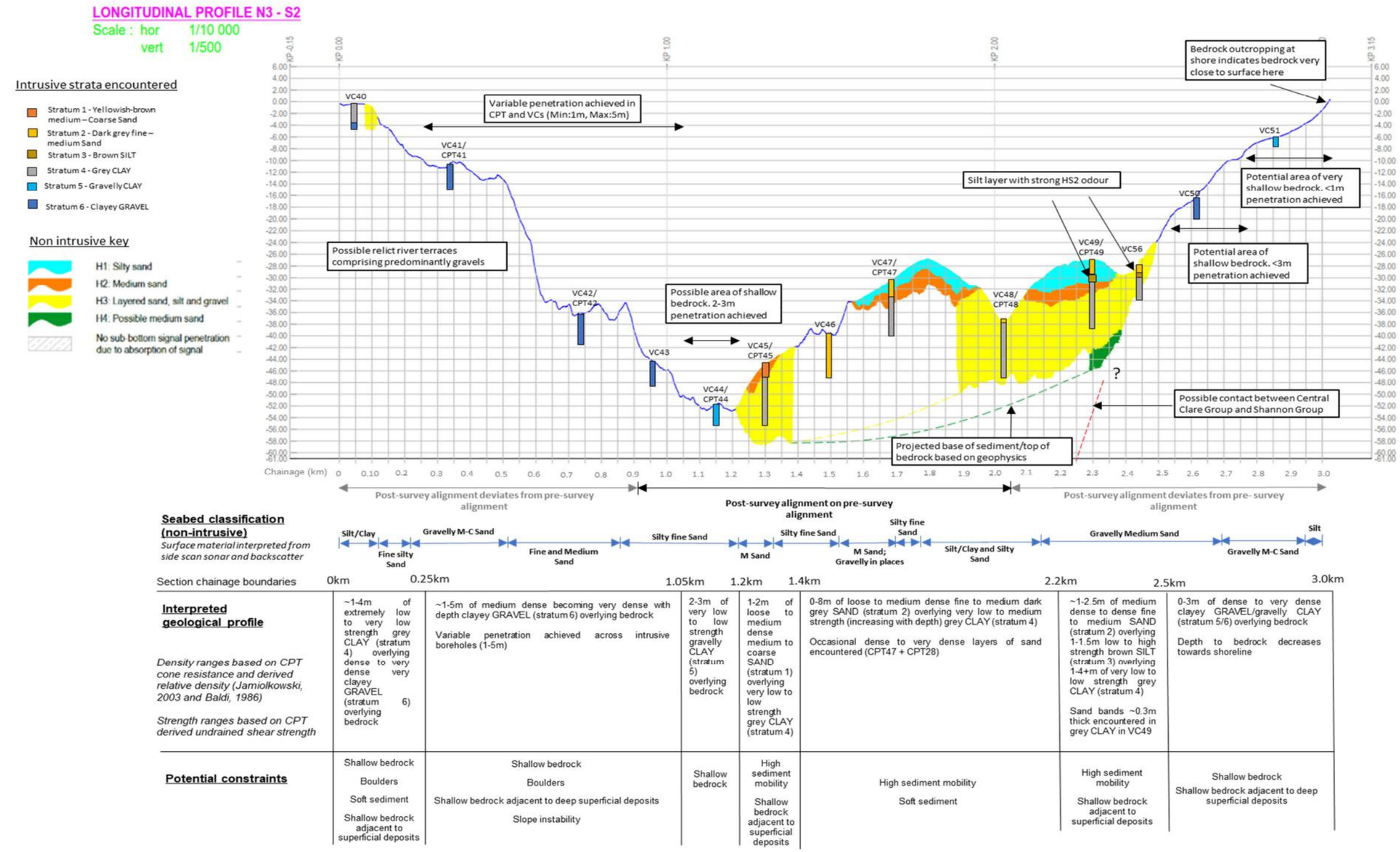
- **Route chainage KP 1.4 to 1.6:** Mobile sediments:
  - An area of high sediment mobility was identified following analysis of the survey results, approximately 100 m west of the proposed cable centreline (west of KP 1.5). Sand waves with an amplitude of up 0.5 to 0.75 m and wavelengths up to 5 m have been measured. Based on analysis of historical bathymetry data, larger scale seabed features have been identified that may be moving over longer timescales (years) than the relatively small sand waves (days / weeks). The height of these features are up to 3 to 4 m and 50 m wide. The proposed cable route centreline has been routed to avoid this area.
- Route chainage KP 2.95 to 3.2: Shallow and/or exposed bedrock:
- Shallow and exposed bedrock has been identified for the last 200 m of the cable route at landfall S02. Bedrock is observed at the landfall at low tide up to the high-water mark. Additional cable protection is proposed along the last 250 m of this route due to the shallow and exposed bedrock

Figure 7.6: Target Burial Depth for Option 1 – N03 to S02. [This shows the route centreline chainage (x-axis), target burial depth (y-axis), sediment type (colour polygons) and additional cable protection (red line)]



Source: Mott MacDonald

Figure 7.7: Geological long section along N03-S02 pre-survey cable route



Interpreted geological profile *Density ranges based on CPT cone resistance and derived relative density (Jamiolkowski, 2003 and Baldi, 1986)* *Strength ranges based on CPT derived undrained shear strength*	~1-4m of extremely low to very low strength grey CLAY (stratum 4) overlying dense to very dense very clayey GRAVEL (stratum 6) overlying bedrock	~1-5m of medium dense becoming very dense with depth clayey GRAVEL (stratum 6) overlying bedrock Variable penetration achieved across intrusive boreholes (1-5m)	2-3m of very low to low strength gravelly CLAY (stratum 5) overlying bedrock	1-2m of loose to medium dense medium to coarse SAND (stratum 1) overlying very low to low strength grey CLAY (stratum 4)	0-8m of loose to medium dense fine to medium dark grey SAND (stratum 2) overlying very low to medium strength (increasing with depth) grey CLAY (stratum 4) Occasional dense to very dense layers of sand encountered (CPT47 + CPT28)	~1-2.5m of medium dense to dense fine to medium SAND (stratum 2) overlying 1-1.5m low to high strength brown SILT (stratum 3) overlying 1-4+m of very low to low strength grey CLAY (stratum 4) Sand bands ~0.3m thick encountered in grey CLAY in VC49	0-3m of dense to very dense clayey GRAVEL/gravelly CLAY (stratum 5/6) overlying bedrock Depth to bedrock decreases towards shoreline
Potential constraints	Shallow bedrock Boulders Soft sediment Shallow bedrock adjacent to superficial deposits	Shallow bedrock Boulders Shallow bedrock adjacent to deep superficial deposits Slope instability	Shallow bedrock	High sediment mobility Shallow bedrock adjacent to superficial deposits	High sediment mobility Soft sediment	High sediment mobility Shallow bedrock adjacent to superficial deposits	Shallow bedrock Shallow bedrock adjacent to deep superficial deposits

NB: Intrusive positions projected onto pre-survey alignment. See Figure 6 for where pre and post survey route alignments differ.

Table 7.3: Interpreted Geological Profile and Constraints along the N03-S02 route

Start Chainage (m)	End Chainage (m)	Expected Geological Profile	Potential Constraints
0	0.25	~1-4m of extremely low to very low strength grey CLAY (stratum 4) overlying dense to very dense very clayey GRAVEL (stratum 6) overlying bedrock.	Shallow bedrock Boulders Soft sediment Shallow bedrock adjacent to deep superficial deposits
0.25	1.05	~1-5m of medium dense becoming very dense with depth clayey GRAVEL (stratum 6) overlying bedrock. Variable penetration achieved across intrusive boreholes (1-5m).	Shallow bedrock Boulders Shallow bedrock adjacent to deep superficial deposits Slope instability
1.05	1.2	2-3m of very low to low strength gravelly CLAY (stratum 5) overlying bedrock.	Shallow bedrock
1.2	1.4	1-2m of loose to medium dense medium to coarse SAND (stratum 1) overlying very low to low strength grey CLAY (stratum 4).	High sediment mobility Shallow bedrock adjacent to deep superficial deposits
1.4	2.2	0-8m of loose to medium dense fine to medium dark grey SAND (stratum 2) overlying very low to medium strength (increasing with depth) grey CLAY (stratum 4). Occasional dense to very dense layers of sand encountered (CPT47 + CPT28).	High sediment mobility Soft sediment
2.2	2.5	~1-2.5m of medium dense to dense fine to medium SAND (stratum 2) overlying 1-1.5m low to high strength brown SILT (stratum 3) overlying 1-4+m of very low to low strength grey CLAY (stratum 4). Sand bands ~0.3m thick encountered in grey CLAY in VC49.	High sediment mobility Shallow bedrock adjacent to deep superficial deposits
2.5	3.0	0-3m of dense to very dense clayey GRAVEL/gravelly CLAY (stratum 5/6) overlying bedrock.	Shallow bedrock Shallow bedrock adjacent to deep superficial deposits

Start Chainage (m)	End Chainage (m)	Expected Geological Profile	Potential Constraints
		Depth to bedrock decreases towards shoreline.	

NB: Chainage begins at N03

7.4 Works at Kilpaddoge 220 kV GIS Substation

7.4.1 General

The proposed new 400 kV cable across the Shannon Estuary will connect Kilpaddoge and Moneypoint substations. There are two proposed landfall locations at the south/Moneypoint side of the estuary. These landfalls are designated as S01 and S02. Landfall S01 is approximately 1km west and S02 is approximately 250m northeast of Kilpaddoge substation. The landfall at S01 is the proposed landing point for the route option 1 from N01 or the northern side of the estuary. The landfall at S02 is the proposed location for both route options 2 & 3 from N02 & N03 on the northern side.

Two cable route options associated with these landfalls have been brought forward:

- Land Cable Route from S01 through Private Land; and
- Land Cable Route from S02 through ESB Land.

7.4.2 Land Cable Route from S01 through Private Land

This option considers the 400 kV cable circuit running from landfall location S01 to the existing Kilpaddoge 220 kV GIS substation via a 400 kV AIS bay and a 400/220 kV power transformer. Landfall S01 is located about 1km west of the substation. The alignment of this route option can be seen on drawing 229379408-MMD-XX-GIS-Y-108 (Feasible Cable Route Options General) included in *Appendix A Drawings*. The overall estimated land route length is approximately 1km.

The transition joint pit would be installed in the private land off the beach area where there appears to be available space for its installation.

The cable route would then follow the coastline heading east through private land for 675m before turning towards the southeast and running either along the existing 220 kV joint bay access road or within the ESB property boundary for 65m. At this point the cable route would turn east towards the substation where it would pass straight through a joint bay (2.5m x 10m). This joint bay would be installed below ground and would serve as an interface point to access the 400 kV circuit should any future 400 kV development occur in the vicinity. There would appear to be available space for the installation of the joint bay in this area.

The cable route would then run along the northern side of the existing substation for approximately 180m. For this section the 400 kV cable circuit would have to cross the existing Kilpaddoge-Moneypoint 2 and Kilpaddoge-Moneypoint 1 220 kV cable circuits. The cable route would then turn to run northeast towards the 400 kV AIS bay. The surrounding land is elevated , and as a result in these sections of the route, the cable would run through embankments . These areas may need to be graded off to provide a gradual incline for the construction of the cable trench.

The 400 kV AIS bay and transformer would be situated to the northeast of Kilpaddoge substation within ESB property. The substation fence would be extended to encompass this equipment. Since the substation is elevated, this area is sloped, so civil works would be required to fill and either level or grade off for installation of the equipment.

From the 220 kV side of the transformer the 220 kV cable would run south, cross the Kilpaddoge – Tarbert 1 & 2 220 kV circuits and then turn west and finally north towards the 220 kV substation. The 220 kV cable route would cross an existing 110 kV cable circuit and existing buried ducts at the front of the substation building. Adequate space between these circuits would to be achieved to mitigate any derating effects on the circuits.

7.4.3 Land Cable Route from S02 through ESB Land

This option considers the 400 kV cable circuit running from landfall location S02 to the existing Kilpaddoge 220 kV GIS substation via a 400 kV AIS bay and a 400/220 kV power transformer. Landfall S02 is located about 250m northeast of the substation. The alignment of this route option can be seen on drawing 229379408-MMD-XX-GIS-Y-108 (Feasible Cable Route Options General).

The transition joint pit would be installed within ESB land off the beach area where there appears to be available space for its installation (It may be possible to eliminate the transition joint pit and connect the submarine cable directly to the AIS cable sealing ends but this will be investigated at a further design stage).

The cable route would then run south towards the substation for approximately 40m where it would connect into the 400 kV AIS bay. The 400 kV AIS bay and transformer would be situated to the northeast of Kilpaddoge substation within ESB property. The substation fence would be extended to encompass this equipment. Since the substation is elevated, this area is sloped, so civil works would be required to fill and either level or grade off for installation of the equipment.

From the 220 kV side of the transformer the 220 kV cable would run south, cross the Kilpaddoge – Tarbert 1 & 2 220 kV circuits and then turn west and finally north towards the 220 kV substation. The 220 kV cable route would cross an existing 110 kV cable circuit and existing buried ducts at the front of the substation building. Adequate space between these circuits would to be achieved to mitigate any derating effects on the circuits.

8 Criteria to Identify the Best Performing Option

8.1 Introduction

The section also provides a description of the proposed approach to be used to evaluate each option (Step 4B). The evaluation of the options uses a multi-criteria comparison against five main criteria:

- Technical;
- Economic;
- Environmental;
- Socio Economic; and
- Deliverability.

Each of these five criteria is divided again into sub-criteria listed below in Section 8.2.

The project team have evaluated each option presented based on each of the sub criteria listed below. The evaluation for each option is then classified in terms of level of constraints identified from "*More significant/difficult risk*" to "*Less Significant /difficult /risk*". For the purpose of this evaluation this is displayed using a simple colour coding such as

The·sub-criteria·within·each·of·the·main·criteria·are·considered·to·present·differing·levels·of·risk·for·particular·criterion.·¶

8.2 Criteria used for Comparison of Each Option

8.2.1.1 Technical performance

- **Safety Standards Compliance**: All options will comply with relevant safety standards such as those from the European Committee for Electrotechnical Standardisation (CENELEC). Materials should comply with IEC or CENELEC. All options must meet the Minimum Required Rating criteria in order to be considered in this evaluation and as a result are not described further.
- **Security Standards Compliance**: All options will comply with the reliability and security standard defined in the Transmission System Security and Planning Standards and the Operation Security Standards.
- **System Reliability**: the average failure rates for the OHL and UGC can be calculated using, for example, estimated availability figures (unplanned outage/100km/year), Meant Time to Repair (MTTR) and the length of the line or cable. This criterion also considers a number of different sub-aspects to determine magnitude of potential impacts including;
  - Risk of unmanageable third-party damage such as emergency anchor from large vessel or periodic dredging. Risk zones will be identified and used to inform selection of preferred corridor.

- Potential for future developments in close proximity which could introduce additional risk to the project.
- Technology risk associated with unproven jointing, field jointing or associated HDD risks.

- **Headroom**: Headroom describes the amount of additional generation/demand capacity that the transmission network is able to facilitate in the future without upgrades. This criterion also considers a number of different sub-aspects to determine magnitude of potential impacts including;
  - Risk of achieving ratings in the main submarine cable.
  - Risk of achieving ratings at the shore approaches.
  - Risk of achieving ratings on the land cable.

8.2.1.2 Economic Assessment

- **Project Implementation Costs:** Costs associated with the procurement, installation and commissioning of the grid development and therefore includes all the transmission equipment that forms part of the project scope.

8.2.1.3 Environmental Assessment

- **Biodiversity/Natural Heritage**

  This criterion considers a number of different sub-aspects to determine magnitude of potential impacts including;

  (i) The potential for the option to have an impact on a legally designation site of conservation importance (international/national/site of nature conservation) with specific reference to Lower River Shannon Special Area of Conservation and the River Shannon and River Fergus Special Protection Area, the Habitats Directive and the Birds Directive;
  (ii) The potential for the option to present a risk to the status of the Lower Shannon Estuary as defined by the Water Framework Directive and associated river basin management plan;
  (iii) The potential to impact on specific protected habitats and species during the construction or operational phases of the Project;
  (iv) The potential to impact or disperse invasive species during the construction or operational phases of the Project.

- **Landscape and Visual**

This criterion considers a number of different sub-aspects to determine magnitude of potential impacts including;

(i) The potential for the option to have an impact on highly sensitive landscapes;
(ii) The potential for the option to impact on rare or distinctive landscape elements/patterns (rock outcrops, water bodies, treeline hedgerows etc);
(iii) The potential for the option to alter the prevailing landscape character;
(iv) The potential for the option to impact on designated scenic routes / views;
(v) The potential for the option impact on views from settlements/houses;
(vi) The potential for the option to impact on views from amenity/recreational and heritage views.

- **Archaeology, Architectural Heritage and Cultural Heritage**

This criterion considers a number of different sub-aspects to determine magnitude of potential impacts including;

(i) The potential for the option to have an impact on a World Heritage Site, National Monument or feature included on the Register of Historic Monuments;
(ii) The potential for the option to have an impact on a Record of Monuments and Places (RMP) or Sites and Monuments Records (SMR) site;
(iii) The potential for the option to have an impact on a site included in the Record of Protected Structures (RPS);
(iv) The potential for the option to have an impact on an Architectural Conservation Area (ACA);
(v) The potential for the option to have an impact on undesignated features of archaeological/architectural/cultural heritage merit.

- **Water Resources and Flood Risk;**

This criterion considers a number of different sub-aspects to determine magnitude of potential impacts including;

(i) The potential for the option to have an impact on fishery or aquaculture resources during either the construction or the operational phases of the development;
(ii) The potential for the option to be impacted by flooding during construction or maintenance activities.

- **Soils, Geology and Hydrogeology;**

This criterion considers a number of different sub-aspects to determine magnitude of potential impacts including;

(i) The potential for the option to encounter difficult ground conditions, restricting the installation technique or requiring more extensive or more intrusive groundworks;
(ii) The potential for the option to permanently affect prevailing soils, geology or groundwater conditions.

- **Noise and Air;**

'This criterion considers the potential for the option to result in significant nuisance impacts during the during construction (noise, traffic, dust) or operational phases of the development.

8.2.1.4 Socio Economic Assessment

Socio economic performance sub criteria are:

- **Landuse and Communities**-

This criterion considers the potential for the option to impact on existing land-use practices (agricultural/aquaculture/industrial).

- **Recreation & Tourism;**

This criterion considers the potential for the option to potential impact on recreational activities and tourism and that are not included in other sub criteria.

8.2.1.5 Deliverability

Deliverability sub-criteria are:

- **Implementation Timelines:** Relative length of time until energisation (assess significant differences) and outage requirements; This criterion also considers a further sub-aspect to determine magnitude of potential impacts including;
  - Risks to the programme for the project arising from particular procurement or construction challenges when compared against the route alternatives.

- **Project Plan Flexibility:** Does the project plan allow for some flexibility if issues arise during design and construction; This criterion also considers a further sub-aspect to determine magnitude of potential impacts including;
  - Potential value added or flexibility for future transmission projects when compared with the route alternatives.

- **Permits & Wayleaves**: Various permissions and wayleaves required to proceed to construction (i.e. number or level). This criterion also considers a further sub-aspect to determine magnitude of potential impacts including;
  - Increased complexity/programme risk due to a requirement to secure additional consents when compared with the route alternatives.

- **Construction Related Impacts:**
  - Water Impact during construction. Ease/difficulty of mitigation measures that may be required to prevent impacts on river crossings, lakes, and groundwater;
  - Air Quality Impact during construction. Ease/difficulty of mitigation measures that may be required to reduce impacts from construction-related dust and traffic; and
  - Traffic & Noise Impact during construction: Noise and traffic disturbance and impacts that may occur during the construction phase and mitigation measures to reduce impacts.
  - Increased complexity of construction due to locational specific constraints.

9 Options Evaluation

9.1 Introduction

This section of the report examines the constraints affecting each of the feasible options identified in *Section 7 Identification of Feasible Options* of this report.

Each option is evaluated in accordance with EirGrid's Performance Matrix as presented in Section 8 of this report. A copy of the Performance Matrix of each option is set out in *Appendix B Performance Evaluation Matrix*. A recommendation for the Best Performing Option (BPO) is provided at the end of this report.

9.2 Option 1 (incorporating Submarine Option N01-S01)

9.2.1.1 Technical Performance

All options must meet the Safety and the Minimum Required Rating criteria in order to be considered in this evaluation and as a result are not described further in this section.

System Reliability

An underground cable system can suffer from failures due to strikes from third parties excavating near the cable installation and from problems with accessories such as cable sealing end terminations and joints. This option comprises a standard 400 kV trench arrangement from Moneypoint 400 kV Substation to the landfall N01 with approximately 400m in public road and 1km within the power station. At the Kilpaddoge side, S01, the cable would run through private land and cross both the Moneypoint-Kilpaddoge 220 kV circuits. This represents a mid-level risk and in terms of system reliability Option 1 has a Moderate impact.

Submarine cables can suffer from failure due to third-party activity such as emergency anchor strike from large vessel or periodic dredging. Consultation with Shannon Foynes Port Company (SFPC) has not identified any past, on-going or future plans for capital or maintenance dredging within 1 km of this cable route option. The likelihood of an occurrence of an anchor strike is less likely for Option 1 (N01-S01) than Option 2 (N02-S02), but more likely than Option 3 (N03-S02). The submarine cable route centreline for Option 1 is located significantly further away from Moneypoint jetty, however is downstream of the jetty therefore vessel traffic to and from Moneypoint will still pass over the cables. The cable route is located closer to active vessel anchorage areas however is >3 km west of the defined area. Approximately 1 km of the submarine cable route is in the primary navigational area of the Shannon Estuary (this is 200 more than both Option 2 and 3). There are no known occurrences of emergency anchor deployments in within the project study area. A proposed terminal on the south shore, part of the proposed Shannon LNG terminal project, is located 400 m south west of the cable route centreline. A new terminal would increase vessel traffic in the Shannon Estuary, but predominately west of the proposed location. Dredging and additional vessel traffic increases the likelihood of anchor strike, however the distance from the cable centreline is not considered as significant risk. A preliminary submarine cable burial risk assessment has identified a target burial depth for the option, therefore whilst the severity of anchor strike is high, the overall risk rating is considered to be Low.

On balance it is considered that from a system reliability perspective that the overall impact is considered to be Moderate (Dark Green) due to the residual system reliability risks on the land-side of the proposed cable installation.

Headroom

There is a risk of derating where the cable route crosses the existing three 400 kV generator cable circuits. However, there is an option to avoid this crossing by bringing the cables into the substation into the western side of the 400 kV substation building instead of in through the southern end. There is also a risk of derating where the cable route crosses the existing two Moneypoint-Kilpaddoge 220 kV cable circuits at the Kilpaddoge side. This represents a mid-level risk and in terms of headroom Option 1 has a Moderate impact (Dark Green).

Combined Technical Performance

The combined technical performance of moderate (Dark Green) is representative of and aligns with both the system reliability and headroom sub-criteria evaluation to reflect the routing through third party land and HV cable crossings associated with this option.

Option 1	System Reliability	Headroom	Combined Technical Performance
Technical Performance			

9.2.1.2 Economic Performance

Project Implementation Costs

The overall estimated capital cost for this option is 30% greater when considered against the most cost-effective option – Option 2.

Since the estimated capital cost of this option is greater than €40m, this yields an assessment of moderate level impact (Dark Green).

Option 1	Project Implementation Costs	Economic Performance
Economic		

9.2.1.3 Environmental Performance

Biodiversity/Flora and Fauna

Option 1 involves a cable installation within a designated NATURA 2000 site (Lower River Shannon Special Area of Conservation and the River Shannon and River Fergus Special Protection Area. There is no impact on Annex I or priority habitat anticipated however there is potential for disturbance to benthic habitats and marine mammals during the construction stage of the Cross Shannon 400 kV Project. This impact is considered to be Moderate-High.

The proposed option involves a cable installation in the Lower Shannon Estuary waterbody which is at 'Moderate' Status. However, whilst there may be localised suspension of sediment during the construction stage of the Project it is considered to be a Low-Moderate impact.

The northern extent of this option will result in minimal habitat loss as the cable will be installed within made ground (the existing road). The installation of the cable within the road may require

the loss of areas of grassy verge adjacent to the road. These grassy verges are likely of negligible ecological importance given their highly managed nature. The southern extent of the route for this option has the potential to result in a loss of scrub habitat where the route leaves existing roadways to enter into the substation. The scrub habitat is likely of Local Importance (lower value) as it may provide nesting habitat for bird species in the locality. The southern extent of Option 1 runs adjacent to the SAC and SPA for 400m, this increases slightly the risk of adverse impacts to the designated sites across the distance. The impact is considered to be Low-Moderate.

It is an offence under the European Communities (Birds and Natural Habitat) Regulations 2011 to knowingly disperse or spread invasive plant species. Invasive species have previously been recorded within the study area which include Fallow deer (*Dama dama*), Sika deer (*Cervus nippon*), and Spanish bluebell (*Hyacinthoides hispanica*). There is therefore a risk that invasive species may be disturbed during the construction phase. The impact is considered to be Low-Moderate.

Overall from a Biodiversity/Flora and Fauna perspective, due to the potential for this option to have an impact on some of the qualifying interests of a European (NATURA 2000) protected site it is considered that this is the most significant sub-criteria and therefore the overall impact is considered to be Moderate-High (Blue).

Landscape and Visual

The proposed option will be constructed within a 'working landscape' (County Clare) and an industrially zoned landscape (County Kerry). The impact is considered to be Low.

The proposed option is not considered to have a potential to impact on rare or distinctive landscape elements/patterns. The impact is considered to be Low.

The proposed option is not considered likely to alter the prevailing landscape. The impact is considered to be Low.

The proposed option will be installed in a beach which is adjacent to a scenic view in County Clare. Whilst the impact would only be temporary during the construction stage it has the potential to generate a nuisance. The impact is considered to be Low-Moderate.

There is very limited potential for the proposed option to be visible from settlements/houses. The impact is considered to be Low.

There is very limited potential for the proposed option to be visible from the River Shannon with the exception of the proposed works at Kilpaddoge 220/110 kV substation. The impact is considered to be Low-Moderate.

Overall from a Landscape and Visual perspective, due to the potential for this option to have an impact on scenic view in County Clare (albeit during the construction stage) the impact is considered to be Low-Moderate (Green).

Archaeology, Architecture & Cultural Heritage

For the assessment of archaeological, architectural and cultural heritage impact it is sub-divided into the submarine and land-based aspects.

Submarine and Inter-Tidal Aspects

The submarine route between N01 and S01 is the longest submarine cable route of the options under consideration. The following archaeological features and potential features lie within the 250m-wide buffer either side of the centreline.

Table 9.1: Cultural Heritage Features Option 1 (Submarine and Inter-Tidal)

Classification	Occurrences	Events
Intertidal features, southern shore	2	F05 building, F06 slipway (site of)
Historic Mapped features, southern shore	1	Weir
Recorded marine archaeology features, southern shore	3	Collection of four wooden stakes associated with former 19th-c. fish weir
Side-scan sonar anomalies, southern shore	1	ss18 rock alignment
Magnetometry anomalies, southern shore	1	mg6, close to Weir
Recorded marine archaeology features, main sea area	0	
Side-scan sonar anomalies, main sea area	1	ss10 rock
Magnetometry anomalies, main sea area	4	mg1, mg2, mg3, mg4 natural
Intertidal features, northern shore	0	
Historic Mapped features, northern shore	0	
Recorded marine archaeology features, northern shore	0	
Side-scan sonar anomalies, northern shore	0	
Magnetometry anomalies, northern shore	0	
Total	13	

Source: ADCO, 2019

A total of 13 features of known and potential archaeology occur on this route, with the majority lying at the southern shoreline area. They include a series of four wooden stakes recovered from an excavator bucket during the archaeological monitoring of the previous cable lay project, conducted under archaeological licence 15E0477. The collection of stakes was considered to be part of a previously unrecorded fish weir dating to the nineteenth century. A second collection of stakes that were dated to the Bronze Age were recovered slightly to the east but lie 40m outside the buffer area for this route option. The proximity of the Bronze Age-dated pieces to the buffer area focuses attention, while the collection of intertidal and related marine features within the buffer area indicates this as a zone of high archaeological potential. This impact is considered to be Moderate-High .

Land-Based Aspects

The land-based aspects of the project extends westwards from the existing Kilpaddoge Substation to the southern landfalls.

Table 9.2: Cultural Heritage Features Option 1 (Land)

Classification	Occurrences	Events
Intertidal features	3	F06 slipway, F07 lime kiln, F08 souterrain (possible)
Historic Mapped features	0	
Recorded marine archaeology features	0	
Side-scan sonar anomalies	0	
Magnetometry anomalies	0	
Total	3	

Source: ADCO, 2019

This route retains 3 known features, of which the possible souterrain (F08) suggests the potential for the discovery of an associated early medieval-period settlement area. The overall impact is considered to be Low-Moderate.

Overall from a Cultural Heritage perspective, due to the recognised cultural heritage value of the River Shannon and riparian lands and the fact that the majority of the development is in the submarine environment, the overall impact is considered to be Moderate-High (Blue).

Water Resources and Flooding

This option will be routed through the site of an existing Shell-fishery Order. On this basis the impact is considered to be Moderate-High.

It is considered that the proposed cable route installation is not considered to be influenced by the presence of flood risk due to the nature of the cable being submarine. The land cable will be located adjacent the shoreline in an area identified as being at significant flood risk with reference to the Irish Coastal Protection Strategy Study. The cable and associated transmission infrastructure is not considered to present a risk to other lands or third parties through flood risk displacement. Overall the impact is considered to have a Low-Moderate Impact.

Overall from a Water Resources/Flooding perspective, due to the legal entitlement with a third party associated with the Shell-Fishery Order, this is considered to be the dominant sub-criterion and therefore the overall impact is considered to be Moderate-High (Blue).

Soil, Geology and Hydrogeology

This option can be routed directly in the public road or in the verge to the side. The make-up of the ground here is sandy and gravelly clay with low cobble and boulder content which should not pose a challenge for the installation of the cable. For the route within the power station, the make-up of the ground consists of a higher cobble and boulder content, however, this is not considered a significant challenge in terms of installing the cable. The impact is considered to be Low-Moderate.

A preliminary submarine cable burial risk assessment has identified the target burial depth for the option. Shallow bedrock (0 - 1 m below seabed) has not been identified along the marine cable route length. The majority of the sediment down to the burial depth has been interpreted as sand and gravels which are not considered to be a significant installation challenge. The likely length of cable protection is the lowest of all the alternative options (~60 m at the S1 landfall). The interpretation of available geotechnical information suggests the variability is low across Option 1. The overall risk rating is considered Low.

Overall this criterion is considered to present a Low-Moderate (Green) impact to reflect the highest risk of both of the sub-criteria.

Noise and Air

This option is located away from residential receptors and whilst the cable on the north-side (N67) has the potential to result in some localised traffic disruption during the construction stage, the overall impact is considered to be Low-Moderate (Green**).**

Combined Environmental Performance

Option 1 has a combined environmental performance of Moderate-High impact (Blue). The key driver for this overall score is associated with the potential for impacts under the heading Biodiversity, Archaeology, Architectural and Cultural Heritage, and Water Resources and Flood Risk.

Option 1	Biodiversity	Landscape & Visual	Archaeology, Architecture & Cultural Heritage	Water Resources & Flood Risk	Soils, Geology & Hydrogeology	Noise and Air	Combined Environmental Performance
Environmental							

9.2.1.4 Socio-Economic Performance

Population, Landuse and Communities

This option has the potential to disrupt aquaculture activities within the site of an existing Shell-Fishery Order and is a Moderate Impact.

It has the potential to impact on traffic on the N67 (County Clare) during the construction stage. The impact is considered to be relatively low due to the comparably short length of cable in the public road. No significant construction or operational phase impact on marine traffic in general or the existing ferry route between Tarbert and Killimer is anticipated to occur. Overall on the basis that the most significant impact is likely to occur due to potential disruption of aquaculture activities the overall impact is considered to be Moderate (Dark Green).

Recreation and Tourism

This option has the potential to impact on traffic on the N67 (County Clare) during the construction stage which is part of the Wild Atlantic Way. The impacts on amenity enjoyment of the River Shannon are considered to be equivalent for all options and in general are considered to be very low due to the temporary nature of the works. Based on the temporary disruption to traffic which may occur during the construction stage the overall impact is considered to be Low-Moderate (Green).

Combined Socio-Economic Performance

From a socio economic perspective Option 1 was considered to be the most constrained grid connection option largely due to the potential for disruption of aquaculture activities This option has a combined performance of Moderate (Dark Green).

Option 1	Population, Landuse,& Communities	Recreation & Tourism	Combined Socio-Economic Performance
Socio-Economic			

9.2.1.5 Deliverability

Implementation Timelines

The technology used for all options is the same, and the installation techniques used will be the same. The lead time for the submarine cable will be approximately 18 months. We would expect that the civil works would be completed within this timeline making all options equal. The submarine cable route is significantly longer than the alternative options. The route is more exposed to waves and wind (weather risk). In terms of implementation timelines Option 1 has a Low-Moderate impact (Green).

Project Plan Flexibility

There is some flexibility for this option in terms of additional space being available in some sections of the roadway. However, there is a level of residual risk as some sections of the route are constrained by existing services. Overall there is only one route option available from N01 to Moneypoint 400 kV Substation.

The submarine route for Option 1 (N01-S01) has flexibility in the micro-routing of the cables. There are limited seabed obstructions. The Bridge feature and high sediment mobility area identified present a pinch point along the route, although this can be mitigated by routing cables around the features. This increases the likelihood of a wider cable corridor to micro-route the cables around this area or locally reduce the cable separation to maintain a single corridor. There is inherently greater risk for a cable route that is located further away from geotechnical investigation locations. The interpretation of available geotechnical information suggests the variability is low across for this submarine route.

In terms of project plan flexibility Option 1 has a Moderate impact (Dark Green).

Permits and Wayleaves

Cables will be mainly laid in the public roadway on the Moneypoint side. Appropriate consent and associated road opening licenses will be required from the local council prior to works commencing and this will need to be accompanied by a traffic management plan. Wayleaves/easements will be required for the section of cable route through private lands on the Kilpaddoge side.

Submarine cables will be installed in or on the seabed. Some additional cable protection is anticipated below Mean High Water (MHW) mark. A Foreshore Licence will be required from the Department for Housing, Planning and Local Government under the Foreshore Act, 1933.

In terms of permits and wayleaves Option 1 has a Moderate-High impact (Blue).

Construction Related Impacts

There will be construction traffic in the public road and as such traffic management will be required for the installation of the ducting and joint bays. However, this route runs in the road for approximately 400m and as such the impact on traffic is reduced as less time will be spent in the public road in comparison to some of the other options. Depending on the final design it may be possible to install a joint bay in the section of the route within the power station property boundary.

Submarine installation is considered to be the least complex for N01-S01. Although the cable route is significantly longer (1.8 km), the interpretation of available geotechnical information suggests the variability is low. Therefore, it is more likely that each cable could be installed in a single run by a single installation technique, such as ploughing. The slopes are shallower than Option 2 (N02-S2) and Option 3 (N03-S02). The tidal currents are anticipated to be less extreme.

In terms of construction related impacts Option 1 has a Low-Moderate impact (Green).

Combined Deliverability Performance

The combined deliverability evaluation aligns with the individual sub-criteria and represents a Moderate risk (Green) for the deliverability of this option.

Option 1	Implementation Timelines	Project Plan Flexibility	Permits & Wayleaves	Construction related impacts	Combined Deliverability Performance
Deliverability					

Overall Performance for Option 1

Overall Performance	Option 1-
Technical	
Economic	
Environmental	
Socio-Economic	
Deliverability	

9.3 Option 2 (incorporating Submarine Option N02-S02)

9.3.1 Technical Performance

All options must meet the Safety and the Minimum Required Rating criteria in order to be considered in this evaluation and as a result are not described further in this section.

System Reliability

An underground cable system can suffer from failures due to strikes from third parties excavating near the cable installation and from problems with accessories such as cable sealing end terminations and joints. This option comprises a standard 400 kV trench arrangement from Moneypoint 400 kV Substation to the landfall N02 with approximately 1.8km within the power station property boundary.

This represents a low risk and in terms of system reliability option 2 has a Low-Moderate impact.

Submarine cables can suffer from failure due to third-party activity such as emergency anchor strike from large vessel or periodic dredging. Consultation with SFPC has not identified any past, on-going or future plans for capital or maintenance dredging within 1 km of this cable route option. The likelihood of an occurrence of an anchor strike is more likely for Option 2 (N02-S02) than alternative submarine cable route options. The cable route centreline is approximately 250 m east of the Moneypoint jetty and approximately 1 km of the cable route is in the primary navigational area of the Shannon Estuary (this is 200 m less than both Option 1 and 3). Whilst there are no known occurrences of emergency anchor deployments in the project study area, anchor deployment under an emergency situation is more likely closer to an operational jetty. The size of vessels using Moneypoint jetty slightly increases the risk. A preliminary submarine cable burial risk assessment has identified the target burial depth for the option, therefore whilst the severity of anchor strike is high the overall risk rating is considered Low.

On balance it is considered that from a system reliability perspective that the overall impact is considered to be Low-Moderate (Green) due to the residual system reliability risks and the fact that the land-based infrastructure is predominantly under the control of the ESB.

Headroom

There is a risk of derating where the cable route crosses the existing two Moneypoint-Kilpaddoge 220 kV cable circuits. However, there may be an option to avoid this crossing by bridging the cables within the substation compound.

This represents a Low-Moderate risk for Option 2 (Green).

Combined Technical Performance

The combined technical performance of Low- Moderate (Green) is representative of the individual sub-criteria assessments.

Option 2	System Reliability	Headroom	Combined Technical Performance
Technical Performance			

9.3.2 Economic Performance

Project Implementation Costs

Option 2 is the most cost-effective option (Green) and has been taken as the baseline capital cost for the economic evaluation of the project.

Since the estimated capital cost of this option is less than €40m, this yields an assessment of low-moderate impact (Green).

Option 2	Project Implementation Costs	Economic Performance
Economic		

9.3.3 Environmental Performance

Biodiversity/Flora and Fauna

Option 2 involves a cable installation within a designated NATURA 2000 site (Lower River Shannon Special Area of Conservation and the River Shannon and River Fergus Special Protection Area. There is no impact on Annex I or priority habitat anticipated however there is potential for disturbance to benthic habitats and marine mammals during the construction stage of the Cross Shannon 400 kV Project. This impact is considered to be Moderate-High (Blue). However when compared to the other options this option is the preferred due to (i) there being a lower number of benthic sub-tidal community types (4 when compared with 5) present along the route (ii) the close proximity of the landfall at N02 to the operational electricity generation station and jetty (when compared with N01 and N03) from an inter-tidal ecology perspective and (iii) the close proximity of the landfall at N02 to the operational electricity generation station and jetty from a bird disturbance potential perspective. This impact is considered to be Moderate-High.

The proposed option involves a cable installation in the Lower Shannon Estuary waterbody which is at 'Moderate' Status. However whilst there may be localised suspension of sediment during the construction stage of the Cross Shannon 400 kV Project it is considered to be a Low-Moderate impact.

The northern extent of this option will result in minimal habitat loss as the cable will be installed within an existing access road within the ESB Moneypoint electricity generation station

landholding. Access to the landfall will also be routed in part through 3rd party landholding, the proposed access will be routed where possible through existing farm access tracks. The route will potentially result in the loss of a small area of scrub where the route leaves the coastal habitat and enters the track. The southerly extent of the route crosses an area which likely contains small patches of scrub within what would previously have been an agricultural field. The scrub habitat is likely of Local Importance (lower value) as it may provide nesting habitat for bird species in the locality. The impact is considered to be Low.

It is an offence under the European Communities (Birds and Natural Habitat) Regulations 2011 to knowingly disperse or spread invasive plant species. Invasive species have previously been recorded within the study area which include Fallow deer (*Dama dama*), Sika deer (*Cervus nippon*), and Spanish bluebell (*Hyacinthoides hispanica*). There is therefore a risk that invasive species may be disturbed during the construction phase. The impact is considered to be Low-Moderate.

Overall from a Biodiversity/Flora and Fauna perspective, due to the potential for this option to have an impact on some of the qualifying interests of a European (NATURA 2000) protected site it is considered that this is the most significant sub-criteria and therefore the overall impact is considered to be Moderate-High (Blue).

Landscape and Visual

The proposed option will be constructed within a 'working landscape' (County Clare) and an industrially zoned landscape (County Kerry). The impact is considered to be Low. There is very limited potential for the proposed option to be visible from the River Shannon with the exception being the proposed works at Kilpaddoge 220/110 kV Substation and the landfall adjacent to the existing 220 kV cable installation landfall at Moneypoint.

There is very limited potential for the proposed option to be visible from settlements/houses. The impact is considered to be Low.

Depending on the nature of proposed landfall installation there is a potential that a new structure will need to be constructed in a natural cove adjacent to the existing 220 kV landfall installation. This will have a local impact on the prevailing landscape permanently and therefore is considered to be Low-Moderate.

The proposed option will not impact on designated scenic routes/view. The impact is considered to be Low.

There is very limited potential for the proposed option to be visible from the River Shannon with the exception of the proposed works at Kilpaddoge 220/110 kV Substation. The impact is considered to be Low-Moderate.

On balance due to the absence of potential impacts on protected landscapes or sensitive views, the overall impact is considered to be Low (Yellow).

Archaeology, Architecture & Cultural Heritage

For the assessment of archaeological, architectural and cultural heritage impact it is sub-divided into the submarine/inter-tidal and land-based aspects.

Submarine and Inter-Tidal Aspects

The submarine route N02-S02 is the shortest submarine route of all of the options under consideration. The following archaeological features and potential features lie within the 250m-wide buffer either side of the centreline.

Table 9.3: Cultural Heritage Features Option 2(Submarine and Inter-Tidal)

Classification	Occurrences	Events
Intertidal features, southern shore	0	
Historic Mapped features, southern shore	0	
Recorded marine archaeology features, southern shore	0	
Side-scan sonar anomalies, southern shore	0	
Magnetometry anomalies, southern shore	0	
Recorded marine archaeology features, main sea area	0	
Side-scan sonar anomalies, main sea area	2	ss12 v-shaped formation, ss6 (2008 report)
Magnetometry anomalies, main sea area	0	
Intertidal features, northern shore	1	AP1
Historic Mapped features, northern shore	1	Slipway
Recorded marine archaeology features, northern shore	0	
Side-scan sonar anomalies, northern shore	1	ss24 metal object, possibly
Magnetometry anomalies, northern shore	1	mg10
Total	6	

Source: ADCO, 2019

The 13 features of known and potential archaeology are focussed on the landfall at the northern end of this route, and indicate the presence of a former slipway and a mound of quarried rock beside it. The overall impact is considered to be Low-Moderate.

Land-based Aspects

The land-based elements of the project involve works on the site of the existing Kilpaddoge 220 kV substation, a cable installation which extends northwards to the foreshore (County Kerry). On the other side of the Shannon Estuary the cable installation crosses existing lands at ESB Moneypoint electricity generation station prior to connection at the existing Moneypoint 400 kV substation.

Table 9.4: Cultural Heritage Features Option 2 (Land)

Classification	Occurrences	Events
Intertidal features, south side	0	
Historic Mapped features, south side	0	
Recorded archaeological features, south side	0	
Side-scan sonar anomalies, south side	0	
Magnetometry anomalies, south side	0	

Classification	Occurrences	Events
Intertidal features, north side	1	AP1 quarried cut rock on site of former quay/slipway
Historic Mapped features, north side	1	Slipway
Recorded archaeological features, north side	0	
Side-scan sonar anomalies, north side	0	
Magnetometry anomalies, north side	0	
Total	2	

Source: ADCO, 2019

As described in submarine/inter-tidal aspects section, the northern landfall area indicates the presence of a former slipway and a mound of quarried rock beside it. The overall impact is considered to be Low-Moderate .

Having regard to the equal impact rating for both the land and submarine aspects the overall impact rating is considered to be Low-Moderate (Green).

Water Resources and Flooding

This option will be routed through the edge of a site of an existing Shell-fishery Order adjacent to an operational jetty associated with the Moneypoint electricity generation station. On this basis the impact is considered to be Low.

It is considered that the proposed cable route installation is not considered to be influenced by the presence of flood risk due to the nature of the cable being submarine. The land cable will not be located in areas of significant flood risk. The cable and associated transmission infrastructure is not considered to present a risk to other lands or third parties through flood risk displacement. Overall the impact is considered to have a Low impact.

Having regard to the equal impact rating for both the water resources and flooding aspects the overall impact rating is considered to be Low (Yellow).

Soil, Geology and Hydrogeology

This option follows the elevated access road which passes the easterly perimeter of the coal yard within the power station. This road is predominantly made up of fill material, consisting of gravel with a high cobble and boulder content which shouldn't be too challenging in terms of cable installation. Investigations encountered larger boulders in the ground closer to the landfall which may need rock breaking equipment to remove. However, this was only noticed in one location where standard techniques could be used for installation. The impact is considered to be Low-Moderate.

A preliminary submarine cable burial risk assessment has identified the target burial depth for the option. Shallow bedrock (0 - 1 m below seabed) has been identified for ~480 m of the submarine cable route length. The majority of the sediment down to the burial depth has been interpreted as clay, sand or gravels which are not considered to be a significant installation challenge. Up to 1000 m of additional cable protection is likely at approaches to landfall N01 and S02 and in the deepest part of the Shannon Estuary. This is 17 and 4 times the length required for Option 1 and 3 respectively. The overall risk rating is considered Moderate.

Overall this criterion is considered to present a Moderate (Dark Green) impact to reflect the highest risk of both of the sub-criteria.

Noise and Air

This option is located away from residential receptors and whilst the cable on the north-side (N67) has the potential to result in some localised traffic disruption during the construction stage, the overall impact is considered to be Low-Moderate (Green).

Combined Environmental Performance

Option 2 has a combined environmental performance of Moderate-High impact (Blue). The key driver for this overall score is associated with the potential for impacts under the heading Biodiversity, Flora and Fauna.

Option 2	Biodiversity	Landscape & Visual	Archaeology, Architecture & Cultural Heritage	Water Resources & Flood Risk	Soils, Geology & Hydrogeology	Noise and Air	Combined Environmental Performance
Environmental							

9.3.4 Socio-Economic Performance

Population, Landuse and Communities

This option is considered unlikely to have a significant effect on existing land-use practices as the land-side works are wholly within ESB lands and the submarine works are not located within or immediately adjacent to an area of existing or potential aquaculture activities. A minor temporary construction impact on marine traffic is anticipated, but this is locally to Moneypoint jetty only. No significant construction or operational phase impact on marine traffic elsewhere or to the existing ferry route between Tarbert and Killimer is anticipated to occur. The overall impact is considered to be Low (Yellow).

Recreation and Tourism

The impacts on amenity enjoyment of the River Shannon are considered to be equivalent for all options and in general are considered to be very low due to the temporary nature of the works. Based on the temporary disruption to traffic which may occur during the construction stage the overall impact is considered to be Low (Yellow).

Combined Socio-Economic Performance

From a socio economic perspective Option 2 was considered to be the least constrained grid connection option largely due to fact that this option is mostly located within ESB lands. This option has a combined performance of Low impact (Yellow) which is consistent with each of the scores of the individual sub-criteria.

Option 2	Population, Landuse,& Communities	Recreation & Tourism	Combined Socio-Economic Performance
Socio-Economic			

9.3.5 Deliverability

Implementation Timelines

The technology used for all options is the same, and the installation techniques used will be the same. The lead time for the submarine cable will be approximately 18 months. We would expect that the civil works would be completed within this timeline making all options equal. The submarine cable route is the shortest of all the route options. The marine installation is anticipated to require multiple burial tools / techniques due to variable ground conditions and preliminary cable burial risk assessment conclusions. Strong tidal currents may impact the construction programme, although this is not expected to be significant.

Therefore, the overall risk rating is considered Low-Moderate (Green).

Project Plan Flexibility

There is some flexibility for this option in terms of their being space available in the elevated access road internal to the power station. Where the cable route, in the elevated road, approaches the substation, there may be a need for some additional civil works, in the form of fill, to install a joint bay. Overall there is only one route option available from N02 to Moneypoint 400 kV substation.

The submarine route for Option 1 (N01-S01) has limited flexibility in the micro-routing of the cables. The interpretation of available geotechnical information suggests the variability is relatively high across for this submarine route. Very steep slopes, areas anticipated to have significant sediment mobility and existing infrastructure (220 kV cables) mean this submarine route is the least flexible of the submarine cable routes.

In terms of project plan flexibility Option 2 has a Moderate impact (Dark Green).

Permits and Wayleaves

The vast majority of works will be contained within ESB owned electricity generation station property on the Moneypoint side (with the exception potentially of localised works at landfall N02) and within ESB owned property on the Kilpaddoge side. In terms of permits and wayleaves Option 2 has a Low-Moderate impact (Green).

Submarine cables will be installed in or on the seabed. Some additional cable protection is anticipated below Mean High Water (MHW) mark. A Foreshore Licence will be required from the Department for Housing, Planning and Local Government under the Foreshore Act, 1933.

Construction Related Impacts

Based on previous experience in the construction of the 220 kV cable across the estuary indicated that the installation of the revetment and cable installation was challenging at the N02 location. In terms of construction related impacts Option 2 has a moderate-high impact (Blue).

The submarine installation is considered to be feasible, however, it should be noted that it is considered to be the most challenging of the three submarine routes. The key constraints that increase the complexity of this option are as follows:

- The preliminary submarine cable burial risk assessment has identified areas of burial exceeding 5 m, and up to 7.5 m. Trenching may be required. Trenching of the material identified from the marine survey data is not considered particularly challenging for an

experienced contractor, however, the other marine factors such as existing submarine cables and strong tidal currents will increase the risk and cost.

- Based on the likely encountered seabed geology, multiple installation techniques may be required. Whilst typical cable installation speeds are between 200 – 400 m/hr, the complexity of changing burial method/tool will increase the installation programme compared to a more homogeneous route geology.
- Very steep seabed slopes at the approach to landfall N01. Slopes that have been surveyed exceed 15 degrees in some locations. Cable installation with a plough across steep slopes will be very challenging. Furthermore, construction of additional cable protection installation (e.g. rock placement) adjacent to, and above, existing submarine circuits increases the risk of damage.
- Proximity to the existing 7no. 220 kV submarine circuits, in particular at the approach to the northern shoreline. In addition to the risk of third-party damage noted above, logistics of cable installation at N02 is considered to be challenging. This increases the further west the cables come ashore.
- Strong tidal currents. Tidal velocity measurements highlight strong currents at the surface and seabed occur at different states of the tide. The strongest tidal currents can reach 5-6 knots north of and in the deepest part of the channel. Strong currents will make accurate installation of multiple submarine cables challenging. This is enhanced in areas of steep slopes and adjacent to existing cables as identified above. For example, ploughing across steep slopes in high currents may not be feasible and a less efficient or more costly installation method may be better.

The overall risk rating is considered High (Blue).

Combined Deliverability Performance

The combined deliverability evaluation is considered to be dominated by the construction related risks associated with the installation of the cables (particularly in the northern half of the channel) and the construction of the landfall at N02.

Option 2	Implementation Timelines	Project Plan Flexibility	Permits & Wayleaves	Construction related impacts	Combined Deliverability Performance
Deliverability					

Overall Performance for Option 2

Overall Performance	Option 2
Technical	
Economic	
Environmental	
Socio-Economic	
Deliverability	

9.4 Option 3A (incorporating Submarine Option N03-S02)

9.4.1 Technical Performance

All options must meet the Safety and the Minimum Required Rating criteria in order to be considered in this evaluation and as a result are not described further in this section.

System Reliability

An underground cable system can suffer from failures due to strikes from third parties excavating near the cable installation and from problems with accessories such as cable sealing end terminations and joints. This option comprises a standard 400 kV trench arrangement from Moneypoint 400 kV Substation to the landfall N03A with approximately 1.2 km in public road, a 400m section through private land and 675m within the power station. There is a significant portion of the route within third party lands and along a narrow roadway which may increase the duration of any repair works. This represents a mid-level risk and in terms of system reliability Option 3 has a Moderate impact.

Submarine cables can suffer from failure due to third-party activity such as emergency anchor strike from large vessel or periodic dredging. Consultation with SFPC has not identified any past, on-going or future plans for capital or maintenance dredging within 1 km of this cable route option. Option 3 is considered to have the least likelihood of an occurrence of an anchor strike. At the nearest point, the cable route centreline is located 1.5 km east of Moneypoint jetty and is upstream of the jetty therefore this route is subject to less marine traffic than the alternative options. Approximately 1 km of the cable route is in the primary navigational area of the Shannon Estuary (this is 200 m less than Option 1, and the same as Option 2). The centreline is approximately 1 km west of the Shannon ferry crossing between Killimer terminal on the north to Tarbert on the south. The ferry route does not cross the proposed cable route. A preliminary submarine cable burial risk assessment has identified the target burial depth for the option, therefore whilst the severity of anchor strike is high the overall risk rating is considered to be Low.

On balance it is considered that from a system reliability perspective that the overall impact is considered to be Moderate (Dark Green) due to the residual system reliability risks on the land-side of the proposed cable installation.

Headroom

There is a risk of derating where the cable route crosses the existing two Moneypoint-Kilpaddoge 220 kV cable circuits. However, there may be an option to avoid this crossing by bridging the cables within the substation compound. Where a section of the cable crosses private land the cable will need to cross an existing drain. This represents a mid-level risk and in terms of headroom Option 3 has a Moderate impact (Dark Green).

Combined Technical Performance

The combined technical performance of moderate (Dark Green) is representative of the individual sub-criteria assessments to reflect the routing through third-party lands and crossings associated with this option.

Option 3A	System Reliability	Headroom	Combined Technical Performance
Technical Performance			

9.4.2 Economic Performance

Project Implementation Costs

The overall estimated capital cost for this option is less than 10% greater when considered against the most cost-effective option – Option 2.

Since the estimated capital cost of this option is less than €40m, this yields an assessment of low-Moderate impact (Green).

Option 3A	Project Implementation Costs	Economic Performance
Economic		

9.4.3 Environmental Performance

Biodiversity, Flora and Fauna

Option 3A involves a cable installation within a designated NATURA 2000 site (Lower River Shannon Special Area of Conservation and the River Shannon and River Fergus Special Protection Area. There is no impact on Annex I or priority habitat anticipated however there is potential for disturbance to benthic habitats and marine mammals during the construction stage of the Cross Shannon 400 kV Project. This impact is considered to be Moderate-High.

The proposed option involves a cable installation in the Lower Shannon Estuary waterbody which is at 'Moderate' Status. However, whilst there may be localised suspension of sediment during the construction stage of the Cross Shannon 400 kV Project it is considered to be a Low-Moderate impact.

The northern extent of Option 3A will result in minimal habitat loss as the cable will be installed largely within made ground (the existing road). A segment of the route will require crossing agricultural grassland, treelines and drainage ditches, before climbing the embankment to enter into the internal access track at Moneypoint. The drainage ditches likely have connectivity to the adjacent SAC and SPA. To facilitate the change in levels it is likely that permanent construction will be required. This has potential to result in a strip of woodland being fragmented. This area of woodland is of local importance (higher value) as it likely supports badger, which is protected under the Wildlife Act. The installation of the cable may require the loss of mature trees along the roadway. These trees are of local importance (lower value) as they may provide nesting habitat for birds. The southerly extent of the route crosses an area which likely contains small patches of scrub within what would previously have been an agricultural field. The scrub habitat is likely of Local Importance (lower value) as it may provide nesting habitat for bird species in the locality. The impact is considered to be Low-Moderate (Green). It is an offence under the European Communities (Birds and Natural Habitat) Regulations 2011 to knowingly disperse or spread invasive plant species. Invasive species have previously been recorded within the study area which include Fallow deer (*Dama dama*), Sika deer (*Cervus nippon*), and Spanish bluebell (*Hyacinthoides hispanica*). There is therefore a risk that invasive species may be disturbed during the construction phase. The impact is considered to be Low-Moderate.

Overall from a Biodiversity/Flora and Fauna perspective, due to the potential for this option to have an impact on some of the qualifying interests of a European (NATURA 2000) protected site it is considered that this is the most significant sub-criteria and therefore the overall impact is considered to be Moderate-High (Blue).

Landscape and Visual

The proposed option will be constructed within a 'working landscape' (County Clare) and an industrially zoned landscape (County Kerry). The impact is considered to be Low.

The proposed option is not considered to have a potential to impact on rare or distinctive landscape elements/patterns. The impact is considered to be Low (Yellow). The proposed option is not considered likely to alter the prevailing landscape. The impact is considered to be Low.

The proposed option will be installed in a beach which is adjacent to a scenic view in County Clare. Whilst the impact would only be temporary during the construction stage it has the potential to generate a nuisance. The impact is considered to be Low-Moderate.

There is very limited potential for the proposed option to be visible from settlements/houses. The impact is considered to be Low.

There is very limited potential for the proposed option to be visible from the River Shannon with the exception of the proposed works at Kilpaddoge 220/110 kV substation. The impact is considered to be Low-Moderate.

On balance due to the absence of potential impacts on protected landscapes or sensitive views, the overall impact is considered to be Low (Yellow).

Archaeology, Architecture & Cultural Heritage

For the assessment of archaeological, architectural and cultural heritage impact it is sub-divided into the submarine and land-based aspects.

Submarine Aspects

The submarine route between N03 and S02 is the most easterly route under consideration. The following archaeological features and potential features lie within the 250m-wide buffer either side of the centreline.

Table 9.5: Cultural Heritage Features Option 3A(Submarine and Inter-Tidal)

Classification	Occurrences	Events
Intertidal features, southern shore	0	
Historic Mapped features, southern shore	0	
Recorded marine archaeology features, southern shore	0	
Side-scan sonar anomalies, southern shore	0	
Magnetometry anomalies, southern shore	0	
Recorded marine archaeology features, main sea area	0	
Side-scan sonar anomalies, main sea area	5	ss26 rock, ss27 rock, ss30 debris, ss21 v-shaped feature, ss23 box-shaped feature
Magnetometry anomalies, main sea area	3	mg7, mg8, mg9
Intertidal features, northern shore	3	F02 stone alignment, F03 retaining wall, F04 submerged peat and woodland
Historic Mapped features, northern shore	4	Quay 1, Quay 2, Weir 1, Weir 2,
Recorded marine archaeology features, northern shore	0	None
Side-scan sonar anomalies, northern shore	2	ss22 metal possibly, ss29 debris
Magnetometry anomalies, northern shore	0	
Total	17	

Source: ADCO, 2019

The greatest number of known and potential archaeology features lie within this route option, and they occur in the main sea area and at the north side of the marine route and at its landfall. This is also a zone where there was extensive small-scale magnetic anomalies detected, highlighting further the suggestion of a large amount of debris in the shallow waters. The presence of nineteenth-century quays and fish weirs is in keeping with the sense to which the northern area of the route retains the remains of a busy coastal interface, while the presence of an area of submerged peat and woodland presents the possibility of uncovering ancient woodland and associated archaeological indicators of prehistoric date. This impact is considered to be Moderate-High.

Land-Based Aspects

The land-based elements of the project involve works on the site of the existing Kilpaddoge 220 kV Substation, a cable installation which extends northwards to the foreshore (County Kerry). On the other side of the Shannon Estuary the cable installation is in the public road and travels in a north-westerly direction prior to travelling across agricultural land-holding to reach the existing ESB Moneypoint electricity generation station lands. There are no known archaeological features associated with this route and therefore the impact is considered to be Low.

On balance from a Cultural Heritage perspective it is considered that due to the extensive anomalies identified during the marine survey along the submarine section of this option the overall impact is considered to be Moderate-High (Blue).

Water Resources and Flooding

This option will be routed adjacent to a licensed aquaculture activity. On this basis the impact is considered to be Moderate-High.

It is considered that the proposed cable route installation is not considered to be influenced by the presence of flood risk due to the nature of the cable being submarine. The land cable will not be located in areas of significant flood risk. The cable and associated transmission infrastructure is not considered to present a risk to other lands or third parties through flood risk displacement and is considered to have a low impact.

Overall on the basis of proximity to the licensed aquaculture activity it is considered that the impact is Moderate-High (Blue).

Soil, Geology and Hydrogeology

This route would follow the public road for approximately 1km before diverting into private land. The ground conditions through the private land is unknown. The route also runs on the elevated access road within the power station which is made up of fill material, consisting of gravel with a high cobble and boulder content which shouldn't be too challenging in terms of cable installation. The impact is considered to be Moderate.

A preliminary submarine cable burial risk assessment has identified the target burial depth for the option. Shallow bedrock (0 - 1 m below seabed) has been identified for ~210 m of the marine cable route length. The majority of the sediment down to the burial depth has been interpreted as clay, sand or gravels which are not considered to be a significant installation challenge. Up to 250 m of additional cable protection is likely at landfall S02. This is the less than Option 2 but more than Option 1. The overall risk rating is considered Low-Moderate (Green).

Noise and Air

This option is located away from residential receptors and whilst the cable on the north-side (N67) has the potential to result in some localised traffic disruption during the construction stage, the overall impact is considered to be Low-Moderate (Green).

Combined Environmental Performance

Option 3A has a combined environmental performance of Moderate-High impact (Blue). The key driver for this overall score is associated with the potential for impacts under the heading Biodiversity, Archaeology, Architectural and Cultural Heritage, and Water Resources and Flood Risk.

Option 3A	Biodiversity	Landscape & Visual	Archaeology, Architecture & Cultural Heritage	Water Resources & Flood Risk	Soils, Geology & Hydrogeology	Noise and Air	Combined Environmental Performance
Environmental							

9.4.4 Socio-Economic Performance

Population, Landuse and Communities

Compared with the other options it is considered that this option has the greatest potential to impact on existing land-practices. A section of this option (approximately 200 metres) would need to be routed through actively managed agricultural lands. It also has the potential to impact on traffic on a local road the construction stage. The impact is considered to be relatively low due to the comparably short length of cable in the public road. No significant construction or operational phase impact on marine traffic in general or the existing ferry route between Tarbert and Killimer is anticipated to occur. Due to the close proximity of the submarine aspects of this option to a licensed aquaculture site there is a potential for disturbance particularly during the construction stage. Overall on the basis that the most significant impact is likely to occur due to traffic disruption on the N67 in County Clare and it also has the potential to impact on existing agricultural/aquaculture activity it is rated Low-Moderate (Green).

Recreation and Tourism

This option has the potential to impact on traffic on the N67 (County Clare) during the construction stage which is part of the Wild Atlantic Way. The impacts on amenity enjoyment of the River Shannon are considered to be equivalent for all options and in general are considered to be very low due to the temporary nature of the works. Based on the temporary disruption to traffic which may occur during the construction stage the overall impact is considered to be Low-Moderate (Green).

Combined Socio-Economic Performance

From a socio economic perspective Option 3A due to the equivalent scores for the sub-criteria it is considered that this option has a combined performance of Low-Moderate (Green).

Option 3A	Population, Landuse,& Communities	Recreation & Tourism	Combined Socio-Economic Performance
Socio-Economic			

9.4.5 Deliverability

Implementation Timelines

The technology used for all options is the same, and the installation techniques used will be the same. The lead time for the submarine cable will be approximately 18 months. We would expect that the civil works would be completed within this timeline making all options equal. The submarine cable route is shorter than Option 1 (N01-S01), but longer than Option 2 (N02-S02). The route is considered to be the most sheltered in terms of waves and wind (weather risk). Strong tidal currents may impact the construction programme, although this is not expected to be significant.

The overall impact rating is considered Low-Moderate (Green).

Project Plan Flexibility

There is flexibility for this option in that two route options are available from the landfall N03.

The submarine route for Option 1 (N01-S01) has flexibility in the micro-routing of the cables. Some steep subsea slopes and high sediment mobility areas have been identified, and may present a pinch point along the route, although it is considered possible to micro-route the cables to avoid these constraints.

In terms of project plan flexibility Option 3A has a Low-Moderate impact (Green).

Permits and Wayleaves

Cables will be mainly laid in the public roadway on the Moneypoint side. Appropriate consent and associated road opening licenses will be required from the local council prior to works commencing and this will need to be accompanied by a traffic management plan. Wayleaves will be required for the section of cable route through private agricultural lands on the approach to the power station.

Submarine cables will be installed in or on the seabed. Some additional cable protection is anticipated below Mean High Water (MHW) mark. A Foreshore Licence will be required from the Department for Housing, Planning and Local Government under the Foreshore Act, 1933.

In terms of permits and wayleaves Option 3A has a Moderate-High impact (Blue).

Construction Related Impacts

There will be construction traffic in the public road and as such traffic management will be required for the installation of the ducting and joint bays. However, this route runs in the local road for approximately 1km with alternative access and fewer dwellings resulting in an impact on a smaller number of people should sections of it be closed for construction works. In terms of construction related impacts Option 3A has a Low-Moderate impact.

Submarine installation is considered to be less complex for N03-S02 than Option 2 (N02-S02) but more complex than Option 1 (N01-S01). Steeper subsea slopes, higher tidal currents, higher

likelihood of more significant mobile sediment areas as well as more shallow bedrock means this route is anticipated to be more challenging than Option 1.

The overall risk rating is considered Low-Moderate (Green).

Combined Deliverability Performance

The combined deliverability evaluation aligns with the individual sub-criteria and represents a mid-level risk for the deliverability of this option.

Option 3A	Implementation Timelines	Project Plan Flexibility	Permits & Wayleaves	Construction related impacts	Combined Deliverability Performance
Deliverability					

Overall Performance for Option 3A

Overall Performance	Option 3A
Technical	
Economic	
Environmental	
Socio-Economic	
Deliverability	

9.5 Option 3B (incorporating Submarine Option N03-S02)

9.5.1 Technical Performance

All options must meet the Safety and the Minimum Required Rating criteria in order to be considered in this evaluation and as a result are not described further in this section.

System Reliability

An underground cable system can suffer from failures due to strikes from third parties excavating near the cable installation and from problems with accessories such as cable sealing end terminations and joints. This option comprises a standard 400 kV trench arrangement from Moneypoint 400 kV Substation to the landfall N03B with approximately 900m in a narrow local road, 2km in a public road and 500m within the power station property. There is a significant portion of the route along a narrow roadway which may increase the duration of any repair works. This represents a mid-level risk and in terms of system reliability Option 4 has a Moderate impact (Dark Green).

Headroom

There is a risk of derating where the cable route crosses the existing 110 kV cable circuits. However, there may be an option to avoid this crossing by bringing the cables further down the public road and into the power station through its internal access roads and into the substation compound.

This represents a mid-level risk and in terms of headroom option 4 has a Moderate impact (Dark Green).

Combined Technical Performance

The combined technical performance of Moderate (Dark Green) is representative of the individual sub-criteria assessments but aligns closer with the headroom sub-criteria evaluation to reflect the relatively low ampacity rating associated with this option.

Option 3B	System Reliability	Headroom	Combined Technical Performance
Technical Performance			

9.5.2 Economic Performance

Project Implementation Costs

The overall estimated capital cost for this option is 20% greater when considered against the most cost-effective option – Option 2.

Since the estimated capital cost of this option is greater than €40m, this yields an assessment of mid-level impact (Dark Green).

Option 3B	Project Implementation Costs	Economic Performance
Economic		

9.5.3 Environmental Performance

Biodiversity Flora and Fauna

Option 3B involves a cable installation within a designated NATURA 2000 site (Lower River Shannon Special Area of Conservation and the River Shannon and River Fergus Special Protection Area. There is no impact on Annex I or priority habitat anticipated however there is potential for disturbance to benthic habitats and marine mammals during the construction stage of the Cross Shannon 400 kV Project. This impact is considered to be Moderate-High.

The proposed option involves a cable installation in the Lower Shannon Estuary waterbody which is at 'Moderate' Status. However, whilst there may be localised suspension of sediment during the construction stage of the Cross Shannon 400 kV Project it is considered to be a Low-Moderate impact.

The northern extent of Option 3B will result in minimal habitat loss as the cable will be installed largely within made ground (the existing road). The installation of the cable may require the loss of mature trees along the roadway. These trees are of local importance (lower value) as they may provide nesting habitat for birds. The southerly extent of the route crosses an area which likely contains small patches of scrub within what would previously have been an agricultural field. The scrub habitat is likely of Local Importance (lower value) as it may provide nesting habitat for bird species in the locality. The impact is considered to be Low.

It is an offence under the European Communities (Birds and Natural Habitat) Regulations 2011 to knowingly disperse or spread invasive plant species. Invasive species have previously been recorded within the study area which include Fallow deer (*Dama dama*), Sika deer (*Cervus nippon*), and Spanish bluebell (*Hyacinthoides hispanica*). There is therefore a risk that invasive

species may be disturbed during the construction phase. The impact is considered to be Low-Moderate.

Overall from a Biodiversity/Flora and Fauna perspective, due to the potential for this option to have an impact on some of the qualifying interests of a European (NATURA 2000) protected site it is considered that this is the most significant sub-criteria and therefore the overall impact is considered to be Moderate-High (Blue).

Landscape and Visual

The proposed option will be constructed within a 'working landscape' (County Clare) and an industrially zoned landscape (County Kerry). The impact is considered to be Low.

The proposed option is not considered to have a potential to impact on rare or distinctive landscape elements/patterns. The impact is considered to be Low. The proposed option is not considered likely to alter the prevailing landscape. The impact is considered to be Low.

The proposed option will be installed in a beach which is adjacent to a scenic view in County Clare. Whilst the impact would only be temporary during the construction stage it has the potential to generate a nuisance. The impact is considered to be Low-Moderate.

There is very limited potential for the proposed option to be visible from settlements/houses. The impact is considered to be Low.

There is very limited potential for the proposed option to be visible from the River Shannon with the exception of the proposed works at Kilpaddoge 220/110 kV Substation. The impact is considered to be Low-Moderate.

Due to the absence of potential impacts on protected landscapes or sensitive views, the overall impact is considered to be Low (Yellow).

Archaeology, Architecture & Cultural Heritage

For the assessment of archaeological, architectural and cultural heritage impact it is sub-divided into the submarine and land-based aspects.

Submarine Aspects

The submarine route between N03 and S02 is the most easterly route under consideration. The following archaeological features and potential features lie within the 250m-wide buffer either side of the centreline.

Table 9.6: Cultural Heritage Features Option 3B (Submarine and Inter-Tidal)

Classification	Occurrences	Events
Intertidal features, southern shore	0	
Historic Mapped features, southern shore	0	
Recorded marine archaeology features, southern shore	0	
Side-scan sonar anomalies, southern shore	0	
Magnetometry anomalies, southern shore	0	
Recorded marine archaeology features, main sea area	0	

Classification	Occurrences	Events
Side-scan sonar anomalies, main sea area	5	ss26 rock, ss27 rock, ss30 debris, ss21 v-shaped feature, ss23 box-shaped feature
Magnetometry anomalies, main sea area	3	mg7, mg8, mg9
Intertidal features, northern shore	3	F02 stone alignment, F03 retaining wall, F04 submerged peat and woodland
Historic Mapped features, northern shore	4	Quay 1, Quay 2, Weir 1, Weir 2,
Recorded marine archaeology features, northern shore	0	None
Side-scan sonar anomalies, northern shore	2	ss22 metal possibly, ss29 debris
Magnetometry anomalies, northern shore	0	
Total	17	

Source: ADCO, 2019

The greatest number of known and potential archaeology features lie within this route option, and they occur in the main sea area and at the north side of the marine route and at its landfall. This is also a zone where there was extensive small-scale magnetic anomalies detected, highlighting further the suggestion of a large amount of debris in the shallow waters. The presence of nineteenth-century quays and fish weirs is in keeping with the sense to which the northern area of the route retains the remains of a busy coastal interface, while the presence of an area of submerged peat and woodland presents the possibility of uncovering ancient woodland and associated archaeological indicators of prehistoric date. This impact is considered to be Moderate-High.

Land-Based Aspects

The land-based elements of the project involve works on the site of the existing Kilpaddoge 220 kV Substation, a cable installation which extends northwards to the foreshore (County Kerry). On the other side of the Shannon Estuary the cable installation is in the public road and travels in a northerly direction along a local road to its junction with the N67. It then travels in a westerly direction along the N67 for approximately 2.4 kilometres prior to entering ESB lands at ESB Moneypoint electricity generation station.

Table 9.7: Cultural Heritage Features Option 3B (Land)

Classification	Occurrences	Events
Intertidal features	0	
Historic Mapped features	0	
Recorded archaeological features	1	CL067-45, ringfort
Side-scan sonar anomalies	0	
Magnetometry anomalies	0	
Total	1	

Source: ADCO, 2019

The route option along an existing roadway crosses a landscape that has several recorded archaeological monuments in it, one of which lies close to the roadway: a ringfort, CL067-45, which indicates the presence of a settlement area most probably associated with the early medieval period. The overall impact is considered to be Low-Moderate.

Overall from a Cultural Heritage perspective it is considered that due to the extensive anomalies identified during the marine survey along the submarine section of this option the overall impact is considered to be Moderate-High (Blue).

Water Resources and Flooding

This option will be routed adjacent to a licensed aquaculture activity. On this basis the impact is considered to be Moderate-High.

It is considered that the proposed cable route installation is not considered to be influenced by the presence of flood risk due to the nature of the cable being submarine. The land cable will not be located in areas of significant flood risk. The cable and associated transmission infrastructure is not considered to present a risk to other lands or third parties through flood risk displacement and is considered to have a Low impact. Overall on the basis of proximity to the licensed aquaculture activity it is considered that the impact is Moderate-High (Blue).

Soil, Geology and Hydrogeology

This option follows the public road for approximately 3km where it then turns into the power station where the make-up of the ground is gravelly with cobble and boulder content which should not pose a significant challenge to the installation of the cable. The impact is considered to be Moderate (Dark Green).

Noise and Air

The long length of cable in the public road on the north-side (N67) has the potential to result in prolonged traffic disruption during the construction stage when compared with the other options (in addition to being closer to a greater number of dwellings), as such the overall impact is considered to be -Moderate (Dark Green).

Combined Environmental Performance

Option 3B has a combined environmental performance of Moderate-High impact (Blue). The key driver for this overall score is associated with the potential for impacts under the heading Biodiversity, Archaeology, Architectural and Cultural Heritage, and Water Resources and Flood Risk.

Option 3B	Biodiversity	Landscape & Visual	Archaeology, Architecture & Cultural Heritage	Water Resources & Flood Risk	Soils, Geology & Hydrogeology	Noise and Air	Combined Environmental Performance
Environmental							

9.5.4 Socio-Economic Performance

Population, Landuse and Communities

This option is considered unlikely to have a significant effect on existing land-use practices. It has to the potential to impact on traffic on the N67 (County Clare) during the construction stage. The impact is considered to be relatively low due to the comparably short length of cable in the public road. No significant construction or operational phase impact on marine traffic in general or the existing ferry route between Tarbert and Killimer is anticipated to occur. Due to the close proximity of the submarine aspects of this option to a licensed aquaculture site there is a potential for disturbance particularly during the construction stage. The overall impact is considered to be low-moderate (Green). Overall on the basis that the most significant impact is likely to occur due to

traffic disruption on the N67 in County Clare in addition to potential to impact on an existing aquaculture activity the overall impact is considered to be Low-Moderate (Green).

Recreation and Tourism

This option has the potential to impact on traffic on the N67 (County Clare) during the construction stage which is part of the Wild Atlantic Way. The impacts on amenity enjoyment of the River Shannon are considered to be equivalent for all options and in general are considered to be very low due to the temporary nature of the works. Based on the temporary disruption to traffic which may occur during the construction stage the overall impact is considered to be Low-Moderate (Green).

Combined Socio-Economic Performance

From a socio economic perspective Option 3A due to the equivalent scores for the sub-criteria it is considered that this option has a combined performance of Low-Moderate (Green).

Option 3B	Population, Landuse,& Communities	Recreation & Tourism	Combined Socio-Economic Performance
Socio-Economic			

9.5.5 Deliverability

Implementation Timelines

The technology used for all options is the same, and the installation techniques used will be the same. The lead time for the submarine cable will be approximately 18 months. We would expect that the civil works would be completed within this timeline making all options equal. Therefore, the overall risk rating is considered Low-Moderate (Green).

Project Plan Flexibility

There is flexibility for this option in that two route options are available from the landfall N03.

In terms of project plan flexibility Option 3B has a Low-Moderate impact (Green).

Permits and Wayleaves

Cables will be mainly laid in the public roadway for over 3km and in the power station/ESB owned property. Appropriate consent and associated road opening licenses will be required from the local council prior to works commencing and this will need to be accompanied by a traffic management plan. In terms of permits and wayleaves Option 3B has a Moderate impact (Dark Green).

Construction Related Impacts

Since this route runs in the public road for approximately 3km, which is longer than any other option, there will be more construction traffic in the public road and as such traffic management will be required for the installation of the ducting and joint bays. Given the hat this is the longest road route it would impact more people especially if sections of it would be closed for construction works. In terms of construction related impacts Option 3B has a Moderate impact (Dark Green).

Combined Deliverability Performance

The combined deliverability evaluation having due regard to the assessment of the individual sub-criteria and professional opinion is considered to be a Moderate Impact (Dark Green) for the deliverability of this option.

Option 3B	Implementation Timelines	Project Plan Flexibility	Permits & Wayleaves	Construction related impacts	Combined Deliverability Performance
Deliverability					

Overall Performance for Option 3B

Overall Performance	Option 3B
Technical	
Economic	
Environmental	
Socio-Economic	
Deliverability	

10 Description of the Best Performing Option

10.1 Summary Ratings for Individual Options

A summary table presenting the ratings for the main criteria for each of the options is presented in the table hereunder.

Overall Performance	Option 1	Option 2	Option 3A	Option 3B
Technical				
Economic				
Environmental				
Socio-Economic				
Deliverability				

Source: Mott MacDonald

10.2 Overview of Best Performing Option

The Best Performing Option is considered to be Option 2. The identified Best Performing Option forms the basis of the development that will enter the subsequent planning process (i.e. Step 5). Having regard to EirGird's six step approach described in Section 2, the solution will be refined and optimised further in Step 5 and consent will be sought from the consenting authority.

On the northern side of the Shannon Estuary this option includes a 400 kV cable circuit running from landfall location N02 to the existing Moneypoint 400 kV GIS substation. Landfall N02 is located to the south of the main coal yard within Moneypoint Electricity Generation Station. The transition joint pit would be installed to the east of the existing 220 kV cable transition joint bay. From a submarine perspective, the overall estimated submarine cable route length is approximately 2.8 km. Subsea cable preparation works will required to facilitate the installation and burial of the four 400 kV cables. Subsea trenches will be created resulting the temporary displacement of subsea material. The sediment that is removed is displaced directly next to the trenches that are created. These trenches are left to refill naturally through sedimentation and sediment movement processes. The proposed subsea cable installation does not require the deliberate disposal or dredging of material in a maritime area.

From the landfall at S02 the submarine cable would run for a short distance (approx.60m) before connection to the cable sealing ends on the 400 kV AIS bay. The 400/220 kV transformer is located at the Kilpaddoge end of the AIS bay and a 220 kV underground cable will connect the transformer to the existing 220 kV GIS substation.

10.2.1 Key Observations (Technical)

A preliminary cable burial risk assessment has been completed to identify the submarine target cable burial to reduce the risk of anchor strike and third-party damage. The average submarine cable burial depth is 2.75 m. Due to shallow or exposed bedrock, up to 1000 m of submarine cable protection is anticipated. This could be in the form of rock armouring or installation of concrete mattresses. This will make maintenance and inspection of the submarine cables more difficult during the design life of the cables.

The seabed geology along the Best Performing Option centreline is generally sands and gravels overlying clay. At the nearshore approaches, in water depths of 25 m or less, this changes to gravels overlying shallow bedrock or even areas of exposed bedrock. Mobile sediments have

been identified across the Shannon Estuary. A potential area for high sediment mobility has been identified on the southern slope of the main channel. If the submarine cables are installed above the base of these mobile seabed features there is a risk that one or more of the cables could become exposed, undermined or even damaged during the design life. Conversely, if the cables are buried below the base of these features and these features grow in amplitude (height) then there is the risk of de-rating the cable. Further surveys or empirical / numerical sediment studies as the project progresses from preliminary design and planning stages through to procurement and detailed design will be required to plan for these scenarios.

A conservative approach has been taken to identify the burial depth in areas of high sediment mobility. On this basis, approximately 500 m of the submarine burial is likely to exceed 5 m, with a maximum burial depth up to 7.5 m.

The preferred route option runs through the Moneypoint Electricity Generation Station property and therefore reduces the risk of third-party damage by avoiding private land and public roads. There is a risk of derating where the cable route crosses the existing two Moneypoint-Kilpaddoge 220 kV cable circuits. However, there may be an option to avoid this crossing by bridging the cables within the substation compound.

10.2.2 Key Observations (Economic)

The costs for Option 2 were based on supply and installation per km as a differentiator between options. In this regard, the Best Performing Option is the most cost effective. The risk associated with the additional civil works for the landfall at N02 and the challenges with installing the cable at this location may impact the cost of the option. However, at this stage it is not seen as a significant impact in comparison to the per kilometre costs of the other options.

10.2.3 Key Observations (Environmental)

Whilst the Best Performing Option continues to involve works in a NATURA 2000 site (Lower River Shannon SAC and River Shannon and River Fergus SPA) this cannot be avoided with any of the options. Overall when compared to the other options this option is the best performing due to (i) there being a lower number of benthic sub-tidal community types (four when compared with five) present along the route (ii) the close proximity of the landfall at N02 to the operational electricity generation station and jetty (when compared with N01 and N03) from an inter-tidal ecology perspective and (iii) the close proximity of the landfall at N02 to the operational electricity generation station and jetty from a bird disturbance potential perspective. The selection of Best Performing Option avoids the most significant areas of both known archaeological value and highest archaeological potential. Whilst the option does cross within the corner of an existing Shell Fishery Order site it substantially avoids it and is the option furthest removed from existing licensed aquaculture sites. The Best Performing Option avoids areas of potential flood risk. The Best Performing Option also involves works predominantly within lands which have been the subject of previous development of electrical generation and transmission infrastructure.

10.2.4 Key Observations (Socio-Economic)

The Best Performing Option avoids works in the public road and thereby avoids potential for traffic disruption, particularly on the important regional route – N67 national secondary road – and part of the Wild Atlantic Way route. The Best Performing Option is predominantly located with lands under the control of ESB however it will require the acquisition of land at the proposed northern landfall N02. It should be noted that Option 1 and 3A would equally require agreements for the installation of infrastructure in private land-holdings of a similar or more extensive scale. Option 3B is exclusively in public lands or lands under the control of ESB however this factor is not

significant enough to counterbalance the additional risks associated with this option, particularly from a cultural heritage perspective.

A minor temporary construction impact on marine traffic is anticipated, but this is locally to the ESB Moneypoint electricity generation station jetty only. No significant construction or operational phase impact on marine traffic elsewhere or to the existing ferry route between Tarbert and Killimer is anticipated to occur.

10.2.5 Key Observations (Deliverability)

The submarine cable route length for Option 2 is anticipated to be 2.8 km. This is 1.8 km and 0.4 km shorter than options 1 and 3 respectively. The marine installation is inherently riskier and more complex than the land installation. With four cables required to be installed in what is known to be a challenging marine environment, a shorter route on paper means the risk exposure is lower.

The submarine installation is considered to be feasible, however, it should be noted that it is considered to be the most challenging route of the three feasible options. A preliminary submarine cable burial risk assessment has been completed to identify the marine target cable burial to reduce the risk of anchor strike and third-party damage. Burial of multiple submarine cables to > 5 m is likely to require trenching operations.

Based on the likely encountered seabed geology, multiple installation techniques may be required. Three distinct areas of shallow or exposed bedrock have been identified along the centreline of the preferred marine cable route. Mechanical cutters may be feasible, however, it is more likely that the cable would be installed on the seabed and protected, similar to the installation method for the 220 kV cables between Moneypoint and Kilpaddoge. The other areas are likely to require a combination of ploughing (pulled by a cable lay vessel) and/or water jetting (ROV) due to the possibility of deep burial south of the main channel. The trenching would need to be graded in and out to facilitate transition to water jetting installation or another technique. Whilst typical cable installation speeds are quoted between 200 – 400 m/hr, the complexity of changing burial method/tool will increase the installation programme compared to installation by a single tool/technique.

Feedback from the team involved in the construction of the 220 kV cable across the estuary indicated that the installation of the revetment and cable installation was very challenging at the N02 location. The lead time for the submarine cable will be approximately 18 months. However, it would expect that the civil works for the revetment and slipway would be completed within the timeline for the submarine cable.

The land cable route will generally follow the elevated perimeter road around the coalfield. Where the cable route, in the elevated road, approaches the substation, there may be a need for some additional civil works, in the form of fill, to install a joint bay. However, other joint bays along the route may be accommodated in available areas just off the access road.

10.3 Screening for Environmental Impact Assessment

The EIA Directive 2011/92/EU on the assessment of the effect of certain public and private projects on the environment (codification), as amended by EIA Directive 2014/52/EU (the EIA Directive), sets out the process by which the anticipated effects of a project on the environment are assessed. The relevant requirements of the EIA Directive have been implemented into Irish law pursuant to the provisions of, inter alia, the Planning and Development Regulations 2001, as amended.

The provisions of Schedule 5 of the Planning and Development Regulations 2001, as amended, identify the requirements of EIA for different project types.

The determination of whether or not an EIA is required for a particular project may be carried out through a case by case examination or by setting thresholds and/or criteria.

Part 1 of Schedule 5 identifies projects of a class that will always have the potential for significant environmental effects and therefore will require an EIA. Part 2 of Schedule 5 identifies projects that may have an environmental impact and, therefore, thresholds or criteria have been set by member states for the requirements of EIA. It is considered that the potentially relevant classes of development include;

Paragraph 19 of Part 1 of Schedule 5

Refers to the "*Construction of overhead electrical power lines with a voltage of 220 kilovolts or more and a length of more than 15 kilometres*". The Cross Shannon 400 kV Project involves the installation of four new 400 kV underwater subsea cable installations across the River Shannon which will connect to the existing substation building at Moneypoint electricity generation station in County Clare. The connection in County Kerry will comprise construction of an extension to the existing Kilpaddoge substation on ESB lands. The Cross Shannon 400 kV Project does not involve the construction of new overhead electrical power lines with a voltage of 220 kilovolts or more and a length of more than 15 kilometres. The routing of the grid connection will be accommodated by using High Voltage (HV) underground cables which will be brought ashore at the proposed landfall locations on either side of the River Shannon.

Paragraph 2d of Part 2 of Schedule 5

Refers to the "*Extraction of stone, gravel, sand or clay, by marine dredging (other than maintenance dredging), where the area involved would be greater than 5 hectares or, in the case of fluvial dredging (other than maintenance dredging), where the length of river involved would be greater than 500 metres*". The Cross Shannon 400 kV Project will not require extraction of material. subsea preparation works including seabed profiling will be required for cable installation works, these works will not require dredging or extraction/disposal off site of marine sediment.

Paragraph 3 (b) of Part 2 of Schedule 5

Refers to "Industrial installations for carrying gas, steam and hot water with a potential heat output of 300 megawatts or more, or transmission of electrical energy by overhead cables not included in Part 1 of this Schedule, where the voltage would be 220 kilovolts or more'. The Cross Shannon 400 kV Project does not involve the transmission of electrical energy by overhead cables.

Paragraph 10 (dd) of Part 2 of Schedule 5

Refers to "*All private roads which would exceed 2000 metres in length"*

The Cross Shannon 400 kV Project will require vehicular access to the proposed joint bays for maintenance. Where possible access will utilise existing access roads and farm access tracks. However, the Cross Shannon 400 kV Project will provide internal access tracks to tie into the existing tracks comprising of granular stone less than 500 metres in length. This is well below the 2000 metres threshold.

Paragraph 13(a) of Part 2 of Schedule 5

Refers to '(a) Any change or extension of development already authorised, executed or in the process of being executed (not being a change or extension referred to in Part 1) which would:-

(i) result in the development being of a class listed in Part 1 or paragraphs 1 to 12 of Part 2 of this Schedule, and

(ii) result in an increase in size greater than –

- 25 per cent, or

- an amount equal to 50 per cent of the appropriate

threshold, whichever is the greater.

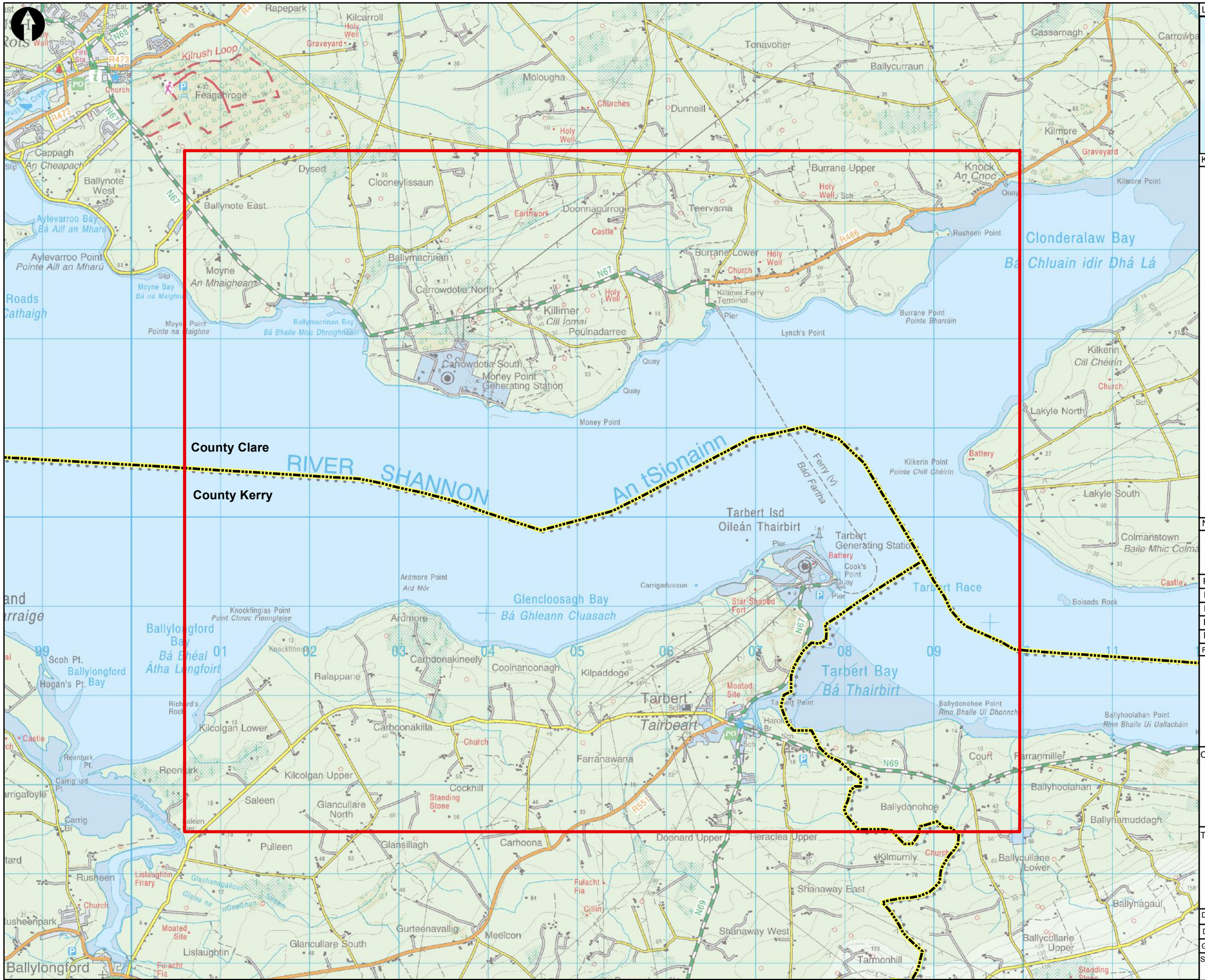
The Cross Shannon 400 kV Project will connect to the existing authorised substation building at Moneypoint electricity generation station in County Clare and the existing authorised GIS substation at Kilpaddoge Co. Kerry. The proposed connection in County Clare will terminate at Moneypoint 400 kV substation, where an existing spare bay has been allocated for this connection. The connection in County Kerry will need the construction of extension to the existing Kilpaddoge substation on ESB lands. This extension will include a substation control cabin and outdoor electrical equipment. It would not result in it being of a Class requiring environmental impact assessment under subsection (i). The proposed extension will comprise approximately 0.5 hectare on lands adjacent to the existing substation. Due to the nature of the change or extension being the construction it would not qualify under subsection (ii),

10.3.1 Conclusions

The Cross Shannon 400 kV Project does not constitute a ”project” identified in either Annex I or Annex II of the EIA Directive or within either Part 1 or Part 2 of Schedule 5 to the Planning and Development Regulations 2001, as amended. As such, there is no statutory requirement under the Directive for it to be subject to EIA

EirGrid is a responsible developer and is committed to demonstrating to An Bord Pleanála and other planning stakeholders that the project will not result in significant effects on the environment. As such, EirGrid will prepare a Planning and Environmental Considerations Report will accompany the planning application and foreshore licence application.

A. Drawings



Location Map

Key to Symbols

- Study Area
- County Boundary

Notes

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

Rev	Date	Drawn	Description	Ch'k'd	App'd
P5	23/04/19	[redacted]	Final Issue	[redacted]	[redacted]
P4	30/05/17	[redacted]	Final Issue	[redacted]	[redacted]
P3	21/04/17	[redacted]	Issue for review	[redacted]	[redacted]
P2	20/03/17	[redacted]	Issue for review	[redacted]	[redacted]
P1	15/03/17	[redacted]	Issue for review	[redacted]	[redacted]

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EIRGRID

Title

Cross Shannon 400 kV
Cable / Step 4 Report

Study Area (Discovery Series)

Designed	[redacted]	Eng Check	[redacted]
Drawn	[redacted]	Coordination	[redacted]
GIS Check	[redacted]	Approved	[redacted]

Scale at A3	Status	Rev	Security
1:40,000	APR	P5	STD

Drawing Number

379408-MMD-XX-00-GIS-Y-101

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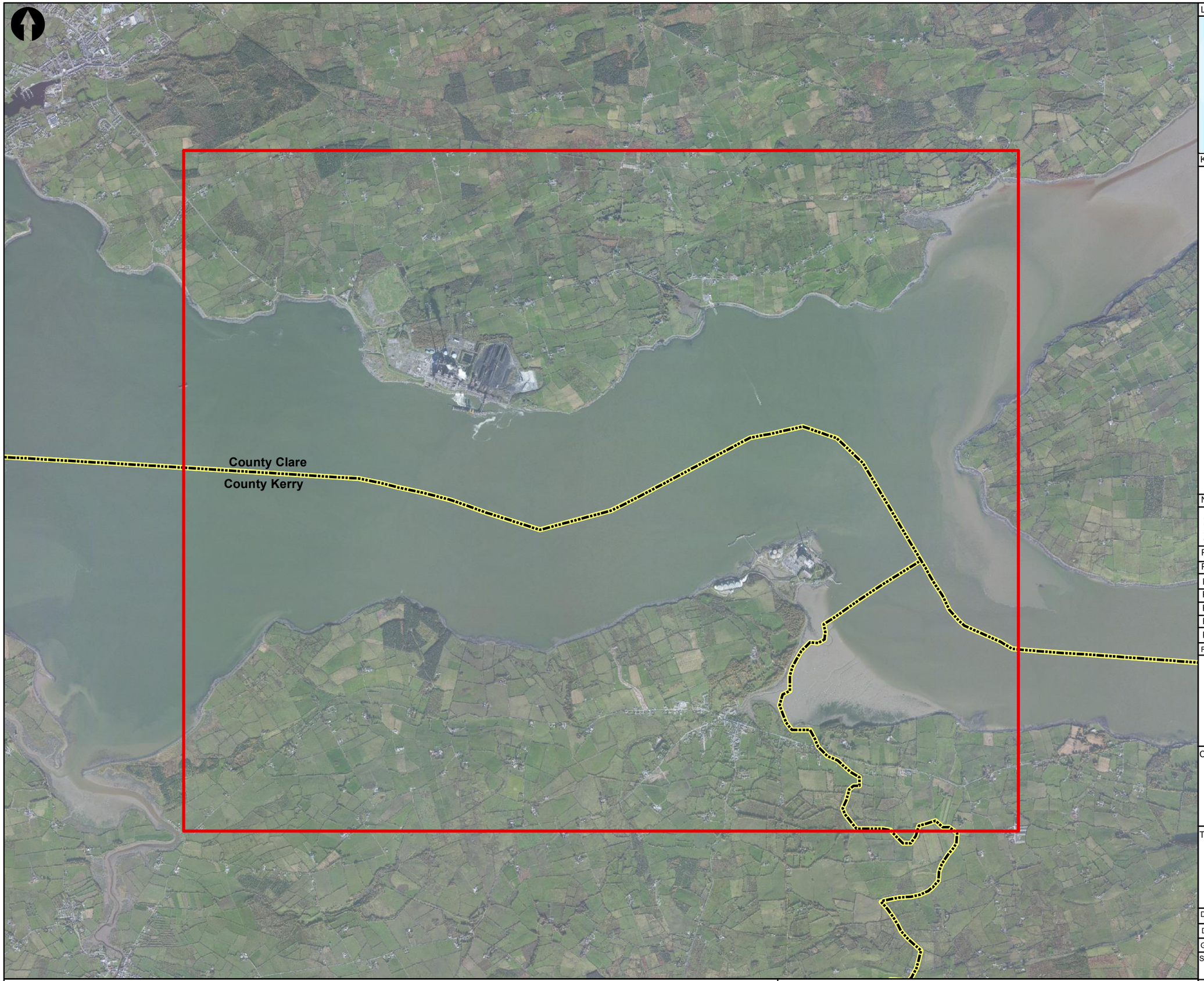

Location Map

Key to Symbols

Study Area

County Boundary

Notes

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Rev	Date	Drawn	Description	Ch'k'd	App'd
P7	23/04/19	[redacted]	Final Issue	[redacted]	[redacted]
P6	24/10/17	[redacted]	Issue for information	[redacted]	[redacted]
P5	06/10/17	[redacted]	Issue for information	[redacted]	[redacted]
P4	30/05/17	[redacted]	Final Issue	[redacted]	[redacted]
P3	21/04/17	[redacted]	Issue for review	[redacted]	[redacted]
P2	20/03/17	[redacted]	Issue for review	[redacted]	[redacted]
P1	15/03/17	[redacted]	Issue for review	[redacted]	[redacted]

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Cross Shannon 400 kV
Cable / Step 4 Report

Study Area (Aerial Photography)

Designed	[redacted]	Eng Check	[redacted]
Drawn	[redacted]	Coordination	[redacted]
GIS Check	[redacted]	Approved	[redacted]

Scale at A3	Status	Rev	Security
1:40,000	APR	P6	STD

Drawing Number

379408-MMD-XX-00-GIS-Y-102

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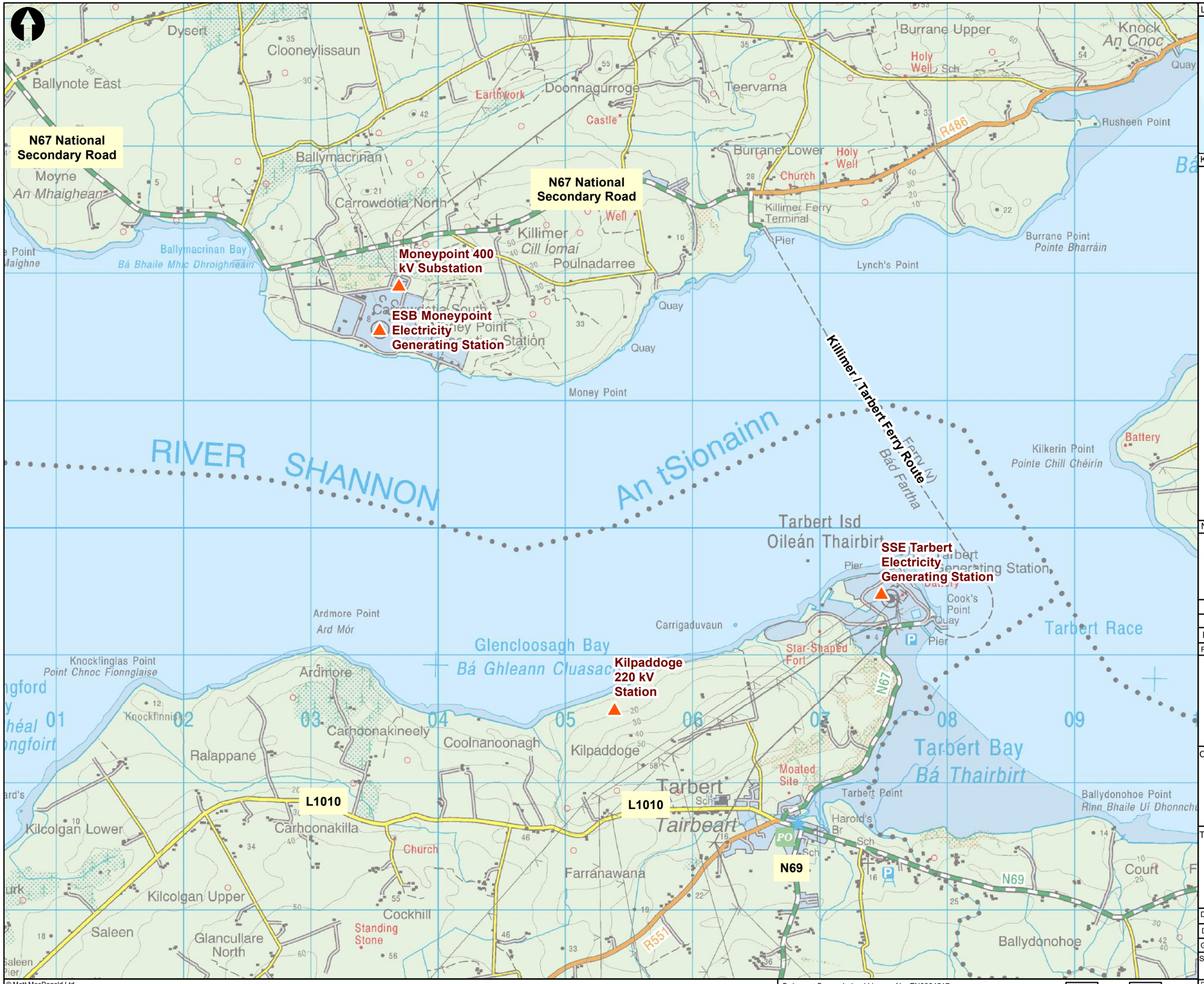

Location Map

Key to Symbols

▲ Station

Notes

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P1	23/04/19	[redacted]	Final Issue	[redacted]	[redacted]

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Cross Shannon 400 kV Cable / Step 4 Report

Transport and Industry

Designed	-		Eng Check	[redacted]	
Drawn	[redacted]		Coordination	[redacted]	
GIS Check	[redacted]		Approved	[redacted]	

Scale at A3	Status	Rev	Security
1:28,000	APR	P1	STD

Drawing Number

379408-MMD-XX-GIS-Y-103

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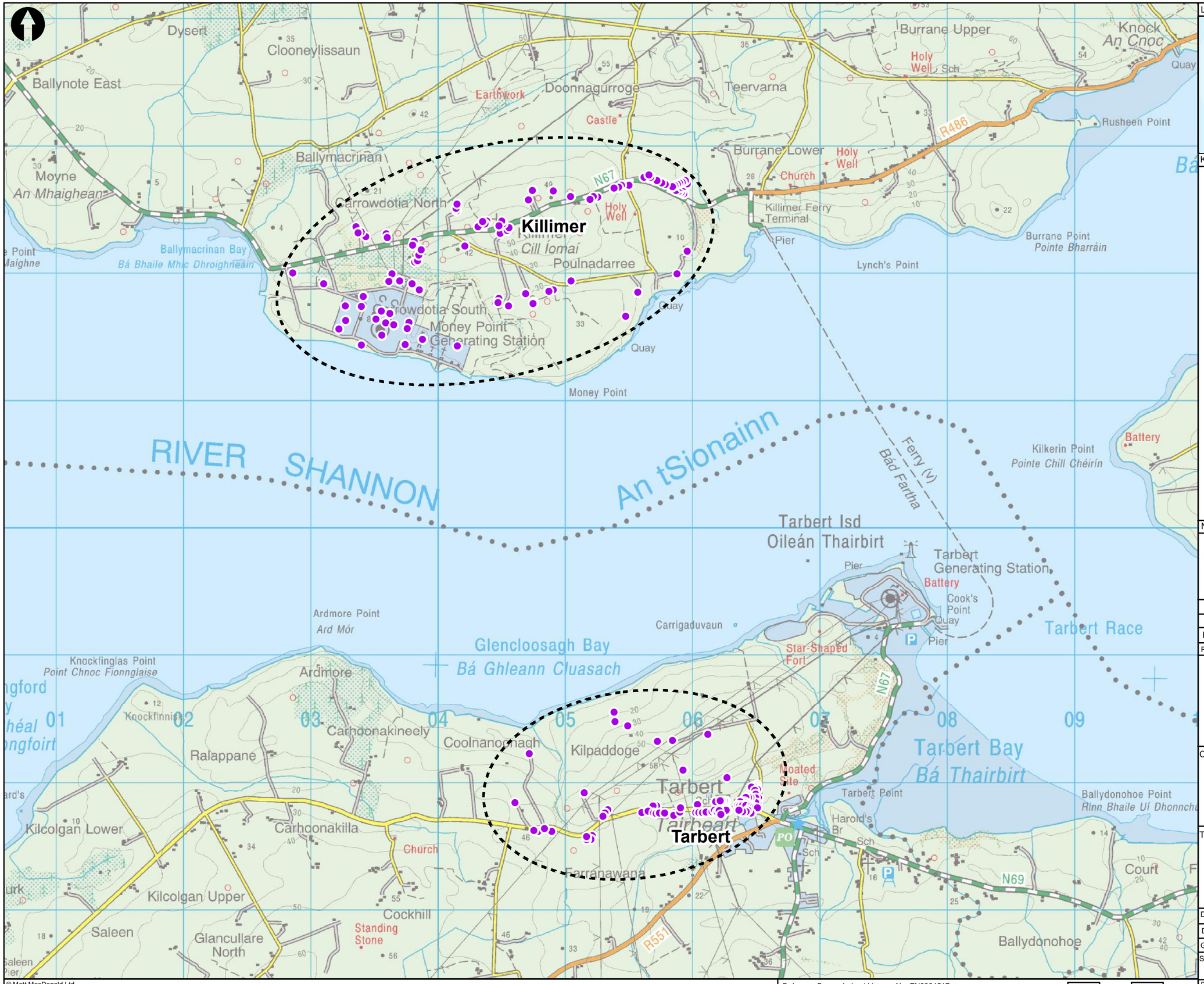

Location Map

Key to Symbols

- Structures
- Search Area for Structures

Notes

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

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P1	23/04/19	[redacted]	Final Issue	[redacted]	[redacted]

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Title

Cross Shannon 400 kV
Cable / Step 4 Report

Settlements, Dwellings and Structures

Designed	-		Eng Check	[redacted]	
Drawn	[redacted]		Coordination	[redacted]	
GIS Check	[redacted]		Approved	[redacted]	

Scale at A3	Status	Rev	Security
1:28,000	APR	P1	STD

Drawing Number

379408-MMD-XX-GIS-Y-104

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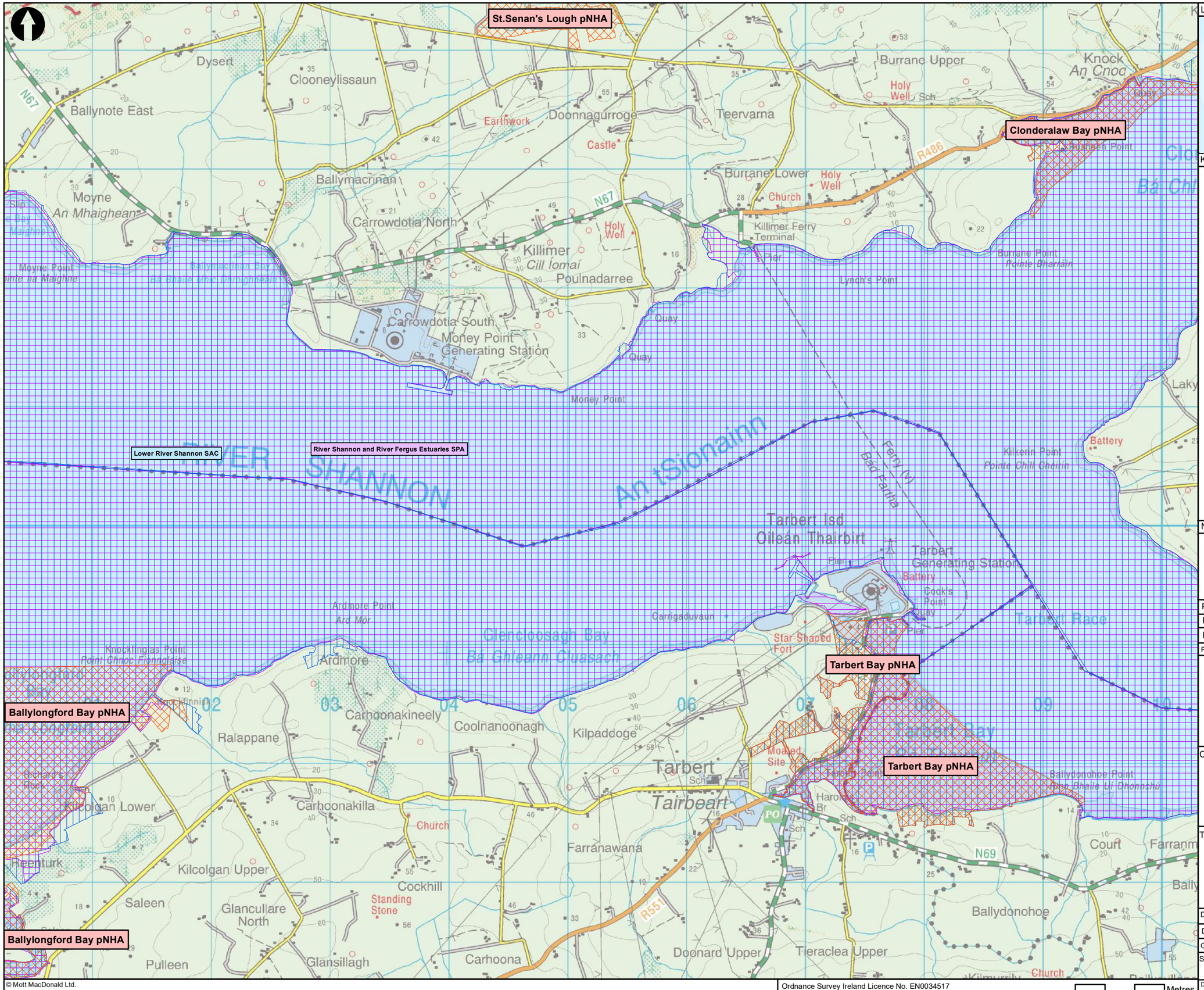

Location Map

Key to Symbols

- Proposed Natural Heritage Area
- Special Area of Conservation
- Special Protection Area

Notes

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

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P3	23/04/19	[redacted]	Final Issue	[redacted]	[redacted]
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P1	24/04/17	[redacted]	Issue for review	[redacted]	[redacted]

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Title

Cross Shannon 400 kV Cable / Step 4 Report

Designated Ecological Sites

Designed	[redacted]	Eng Check	[redacted]
Drawn	[redacted]	Coordination	[redacted]
GIS Check	[redacted]	Approved	[redacted]

Scale at A3	Status	Rev	Security
1:30,000	APR	P3	STD

Drawing Number: 379408-MMD-XX-00-GIS-Y-106

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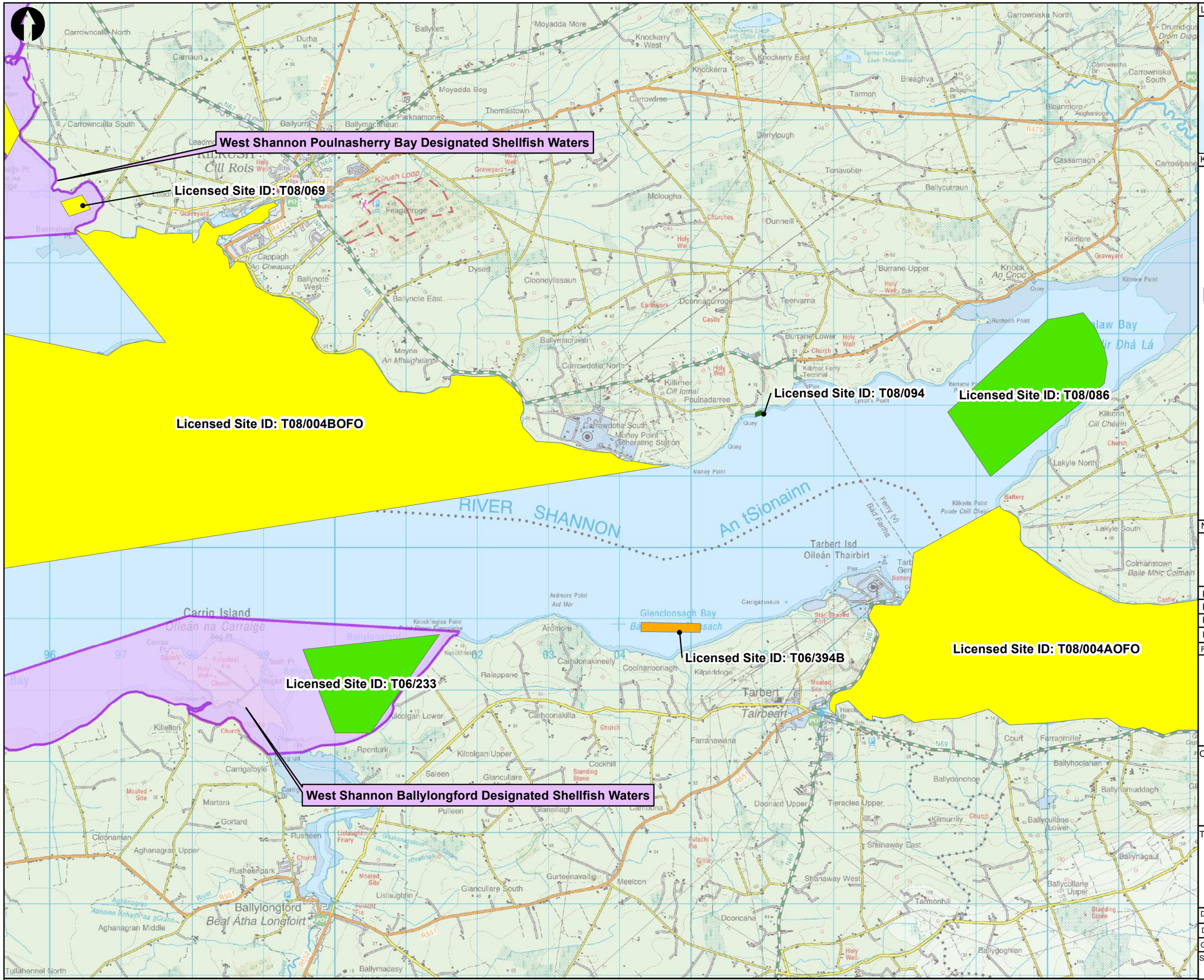

Location Map

Key to Symbols

Aquaculture Licence Application

- License Application and Progress
- License Approved

Aquaculture Licensed Sites

- Mussels
- Oysters
- Designated Shellfish Waters

Notes

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P4	17/04/19	[redacted]	Final Issue	[redacted]	[redacted]
P3	06/10/17	[redacted]	Issue for information	[redacted]	[redacted]
P2	30/05/17	[redacted]	Final Issue	[redacted]	[redacted]
P1	24/04/17	[redacted]	Issue for review	[redacted]	[redacted]

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Cross Shannon 400 kV
Cable / Step 4 Report

Aquaculture/Fishery Interests

Designed	[redacted]	Eng Check	[redacted]
Drawn	[redacted]	Coordination	[redacted]
GIS Check	[redacted]	Approved	[redacted]

Scale at A3	Status	Rev	Security
1:50,000	APR	P3	STD

Drawing Number

379408-MMD-XX-GIS-Y-105

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Location Map

Key to Symbols

- EPA River Waterbodies
- Ancient and Long Established Woodland Inventory

Notes

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Ecological Features

Designed	[redacted]		Eng Check	[redacted]	
Drawn	[redacted]		Coordination	[redacted]	
GIS Check	[redacted]		Approved	[redacted]	

Scale at A3	Status	Rev	Security
1:28,000	APR	P1	STD

Drawing Number

379408-MMD-XX-GIS-Y-107

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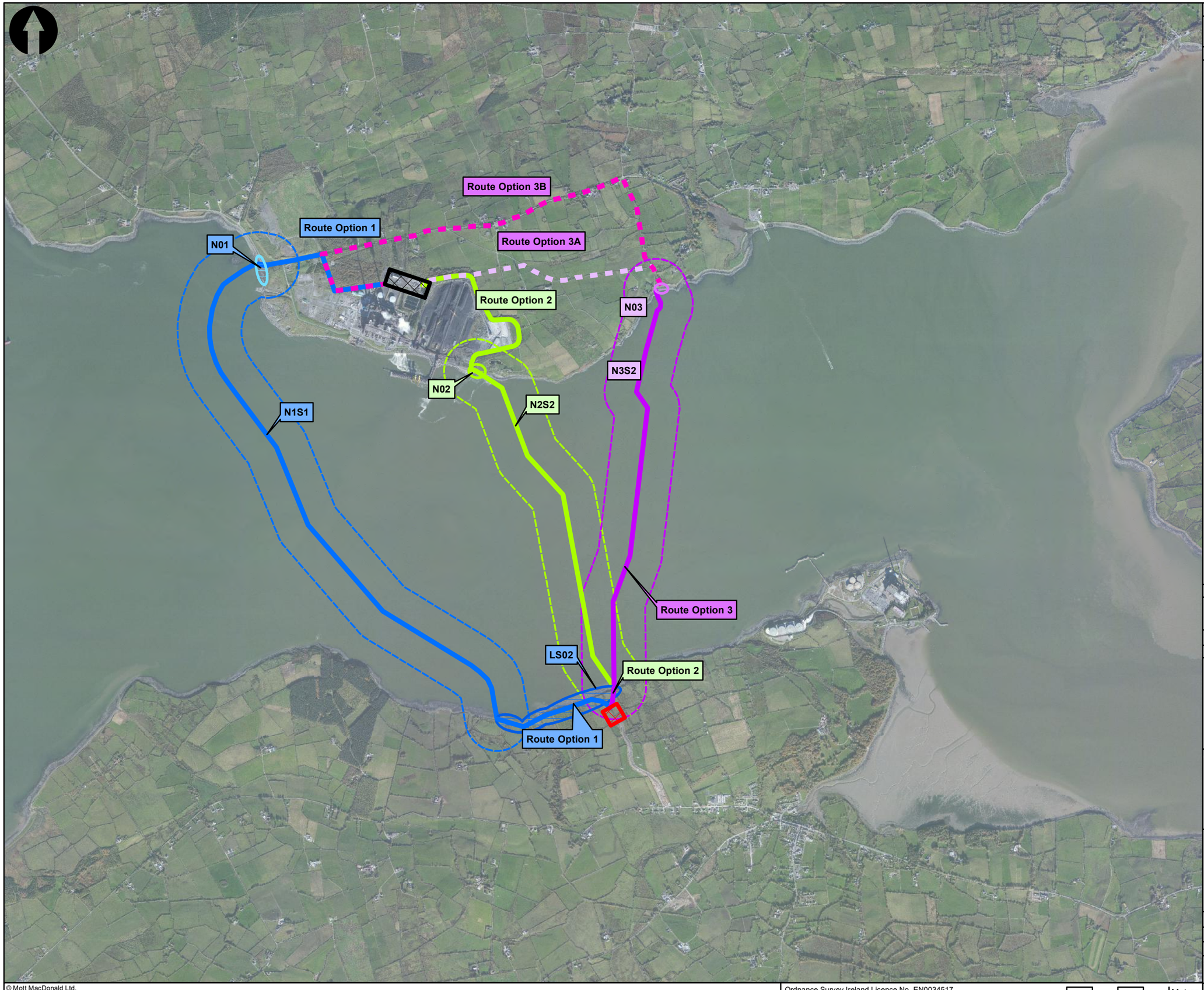

Location Map

Key to Symbols

- Kilpaddoge Substation
- Moneypoint Substation

Moneypoint Onshore Route Options

- Route Option 1
- Route Option 2
- Route Option 3B
- Route Option 3A

Kilpaddoge Onshore Cable Route Options

- S01
- S02

Offshore Route Options

- N1S1
- N2S2
- N3S2

Landfalls

- LN01
- LN02
- LN03
- LS01

Offshore Route Option (250m Buffers)

- N1S1
- N2S2
- N3S2

Notes

Rev	Date	Drawn	Description	Ch'k'd	App'd
01	23/04/19	[redacted]	Final Issue	[redacted]	[redacted]

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Title

Cross Shannon 400 kV Cable / Step 4 Report

Feasible Cable Route Options

Designed	[redacted]	Eng Check	[redacted]
Drawn	[redacted]	Coordination	[redacted]
GIS Check	[redacted]	Approved	[redacted]

Scale at A3	Status	Rev	Security
1:28,000	PRE	P1	STD

Drawing Number: 379408-MMD-XX-GIS-Y-108

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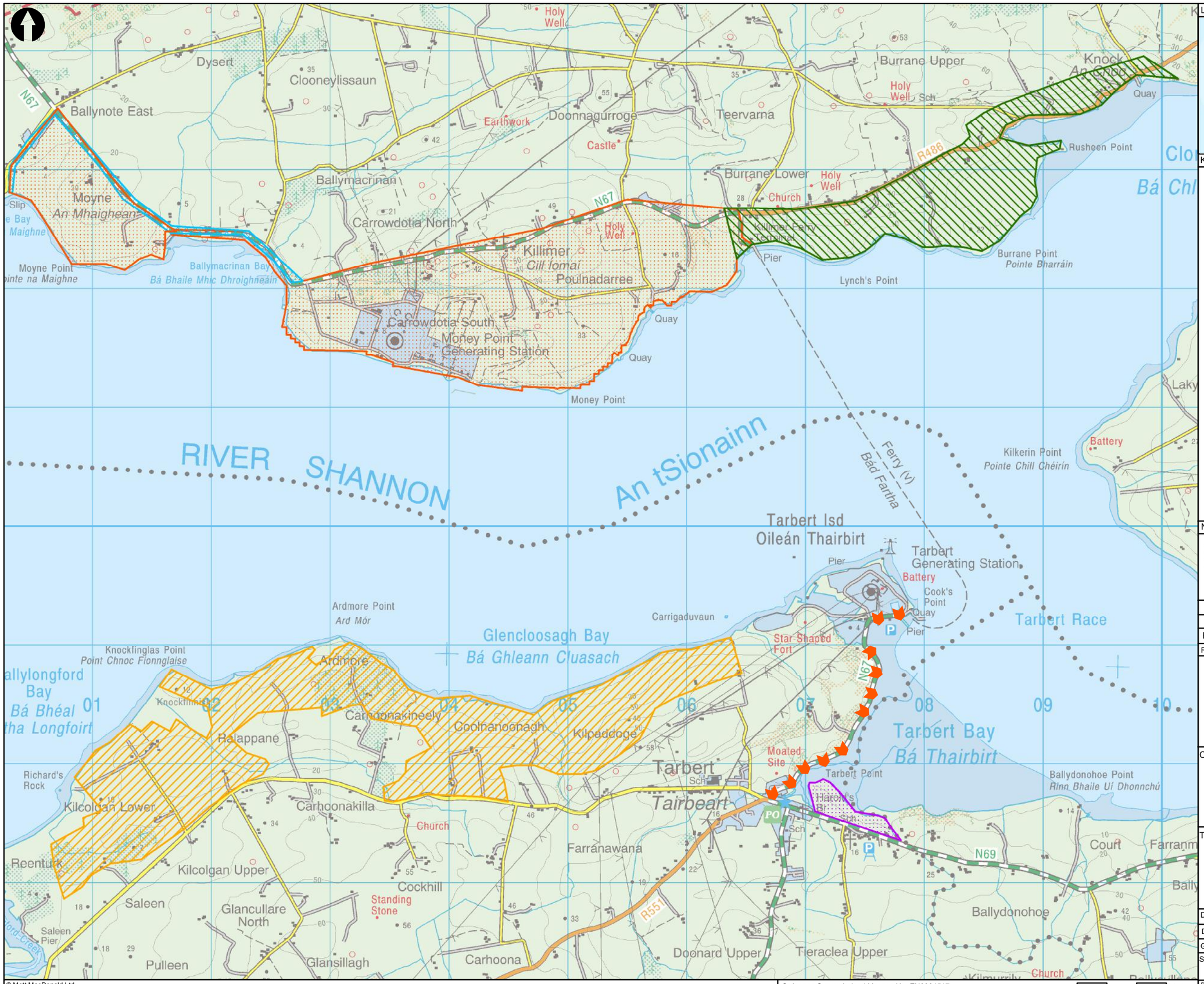

Location Map

Key to Symbols

- Views and Prospects
- Heritage Landscape
- Industry
- Scenic Route
- Secondary Special Amenity
- Working Landscape

Notes

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P1	23/04/19	[redacted]	Final Issue	[redacted]	[redacted]

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Title

Cross Shannon 400 kV Cable / Step 4 Report

Landscape

Designed	-		Eng Check	[redacted]	
Drawn	[redacted]		Coordination	[redacted]	
GIS Check	[redacted]		Approved	[redacted]	

Scale at A3	Status	Rev	Security
1:30,000	APR	P1	STD

Drawing Number: 379408-MMD-XX-GIS-Y-109

Metres: 0 250 500 750

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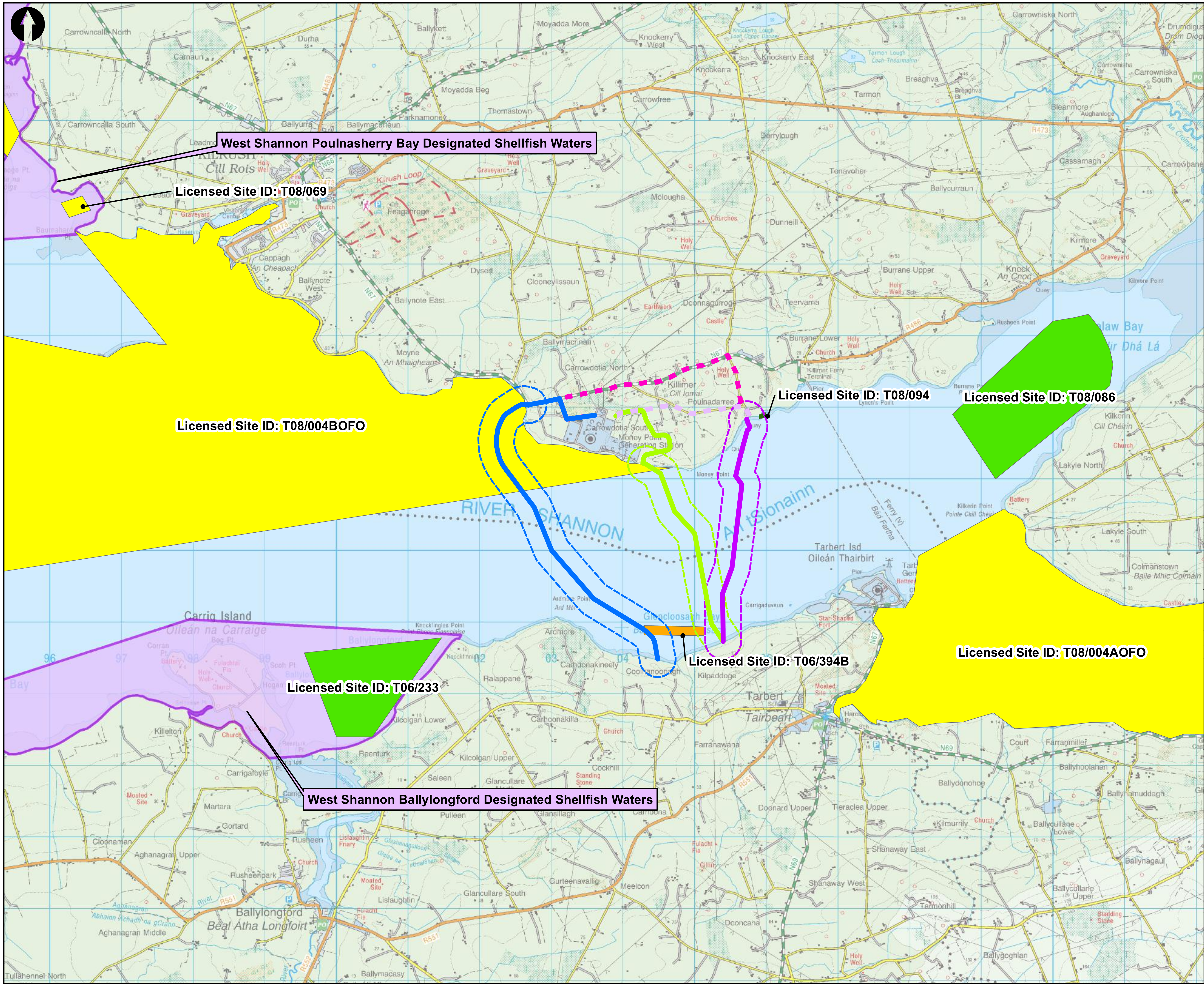

Location Map

Key to Symbols

Offshore Route Options
- N1S1
- N2S2
- N3S2

Moneypoint Onshore Route Options
- Route Option 1
- Route Option 2
- Route Option 3B
- Route Option 3A

Offshore Route Option (250m Buffers)
- N1S1
- N2S2
- N3S2

Aquaculture Licence Application
- License Application and Progress
- License Approved

Aquaculture Licensed Sites
- Mussels
- Oysters
- Designated Shellfish Waters

Notes

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P4	17/04/19	[redacted]	Final Issue	[redacted]	[redacted]
P3	06/10/17	[redacted]	Issue for information	[redacted]	[redacted]
P2	30/05/17	[redacted]	Final Issue	[redacted]	[redacted]
P1	24/04/17	[redacted]	Issue for review	[redacted]	[redacted]

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Client

EIRGRID

Title

Cross Shannon 400 kV
Cable / Step 4 Report

Aquaculture/Fishery Interests

Designed	[redacted]	Eng Check	[redacted]
Drawn	[redacted]	Coordination	[redacted]
GIS Check	[redacted]	Approved	[redacted]

Scale at A3	Status	Rev	Security
1:50,000	APR	P3	STD

Drawing Number
379408-MMD-XX-GIS-Y-110

0 500 1,000 1,500 Metres

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B. Performance Evaluation Matrix

Option 1	System Reliability	Headroom	Combined Technical Performance
Technical Performance			

Option 1	Project Implementation Costs	Economic Performance
Economic		

Option 1	Biodiversity	Landscape & Visual	Archaeology, Architecture & Cultural Heritage	Water Resources & Flood Risk	Soils, Geology & Hydrogeology	Noise and Air	Combined Environmental Performance
Environmental							

Option 1	Population, Landuse,& Communities	Recreation & Tourism	Combined Socio-Economic Performance
Socio-Economic			

Option 1	Implementation Timelines	Project Plan Flexibility	Permits & Wayleaves	Construction related impacts	Combined Deliverability Performance
Deliverability					

Overall Performa	Option 1-
Technical	
Economic	
Environmental	
Socio-Economic	
Deliverability	

Option 2	System Reliability	Headroom	Combined Technical Performance
Technical Performance			

Option 2	Project Implementation Costs	Economic Performance
Economic		

Option 2	Biodiversity	Landscape & Visual	Archaeology, Architecture & Cultural Heritage	Water Resources & Flood Risk	Soils, Geology & Hydrogeology	Noise and Air	Combined Environmental Performance
Environmental							

Option 2	Population, Landuse,& Communities	Recreation & Tourism	Combined Socio-Economic Performance
Socio-Economic			

Option 2	Implementation Timelines	Project Plan Flexibility	Permits & Wayleaves	Construction related impacts	Combined Deliverability Performance
Deliverability					

Overall Per	Option 2
Technical	
Economic	
Environmental	
Socio-Economic	
Deliverability	

Option 3A	System Reliability	Headroom	Combined Technical Performance
Technical Performance			

Option 3A	Project Implementation Costs	Economic Performance
Economic		

Option 3A	Biodiversity	Landscape & Visual	Archaeology, Architecture & Cultural Heritage	Water Resources & Flood Risk	Soils, Geology & Hydrogeology	Noise and Air	Combined Environmental Performance
Environmental							

Option 3A	Population, Landuse,& Communities	Recreation & Tourism	Combined Socio-Economic Performance
Socio-Economic			

Option 3A	Implementation Timelines	Project Plan Flexibility	Permits & Wayleaves	Construction related impacts	Combined Deliverability Performance
Deliverability					

Overall Pe	Option 3A
Technical	
Economic	
Environmental	
Socio-Economic	
Deliverability	

Option 3B	System Reliability	Headroom	Combined Technical Performance
Technical Performance			

Option 3B	Project Implementation Costs	Economic Performance
Economic		

Option 3B	Biodiversity	Landscape & Visual	Archaeology, Architecture & Cultural Heritage	Water Resources & Flood Risk	Soils, Geology & Hydrogeology	Noise and Air	Combined Environmental Performance
Environmental							

Option 3B	Population, Landuse,& Communities	Recreation & Tourism	Combined Socio-Economic Performance
Socio-Economic			

Option 3B	Implementation Timelines	Project Plan Flexibility	Permits & Wayleaves	Construction related impacts	Combined Deliverability Performance
Deliverability					

Overall Performance	**Option 3B**
Technical	
Economic	
Environmental	
Socio-Economic	
Deliverability	

Overall Performance	Option 1	Option 2	Option 3A	Option 3B
Technical				
Economic				
Environmental				
Socio-Economic				
Deliverability				