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Shannon Technology and Energy Park

Environmental Impact Assessment Report

VOLUME 2 | Main Text

CHAPTER 01
Introduction

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park

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1. Introduction

1.1 General

Shannon LNG Limited (hereafter referred to as the 'Applicant') proposes to develop a combined cycle gas turbine plant (CCGT) with three combustion turbines, a 120 MWh battery energy storage system and a liquified natural gas (LNG) Terminal, which will be known collectively as the Shannon Technology and Energy Park (STEP, hereafter referred to as the 'Proposed Development'). It will be located on the Shannon Estuary between Tarbert and Ballylongford in Co. Kerry (hereafter referred to as the 'Proposed Development site').

This Environmental Impact Assessment Report (EIAR) has been prepared by AECOM Ireland Limited (AECOM) on behalf of the Applicant, an Irish owned subsisiary of New Fortress Energy Inc.

The EIAR is presented in four volumes as outlined below.

- Volume 1: Non – Technical Summary (NTS);
- Volume 2: Main Text;
- Volume 3: Figures; and
- Volume 4: Appendices.

This chapter of the EIAR provides an overview of the Proposed Development, the Environmental Impact Assessment (EIA) methodology, structure of the EIAR, consultation undertaken and the names and qualifications of the lead contributors to the EIAR. When referring to the construction and operation of the Proposed Development throughout the EIAR, the future tense has been used; for example, 'the Proposed Development will be located…, will consist of ….' etc., this is with the understanding that all aspects of the development are subject to the necessary statutory permits and consents and does not in any way presume approval.

This EIAR includes a consideration of alternatives and identifies the potential significant environmental effects arising from both the construction and operational phases of the Proposed Development. Where potential significant environmental effects have been identified, mitigation and monitoring measures have been proposed to avoid, prevent, reduce or offset the effects. In addition, cumulative environmental impacts of the Proposed Development have been assessed, where appropriate.

Pre-application consultation with An Bord Pleanála (ABP), entered into on 20th March 2019, has determined that the Proposed Development is strategic infrastructure within the meaning of section 37A of the Planning and Development Act 2000. The notice served on 2nd June 2021 requires an application to be made directly to ABP under section 37E of the Act. This EIAR should be read in conjunction with all the particulars of the planning application (see Section 1.4.1).

1.2 Key Objectives

The main objectives of the Proposed Development are to:

1. Provide 600 MW of fast acting flexible thermal generation capacity to the Irish electricity market;
2. Provide a 120 MWh battery energy storage system (BESS) to participate in the electricity ancillary services market; and
3. Provide an LNG Terminal capable of offering up to 180,000 m^3 of LNG storage capacity and regasification capacity of up to 22.6 million Sm^3/d.

1.3 Proposed Development Overview

The Proposed Development site is located 4.5 km from Tarbert and 3.5 km Ballylongford in Co. Kerry. The area to be developed within the Proposed Development site is 52 ha (including both onshore and offshore elements) and is characterised by predominantly improved grassland in an agricultural setting. Field boundaries predominantly consist of hedgerows with small drainage ditches. A small section of the Ralappane Stream is located in the southernmost part of the Proposed Development site. The

Proposed Development site is zoned for marine-related industry in the Kerry County Development Plan 2015-2021, and has been identified as a Strategic Development location in the Shannon Integrated Framework Plan 2014-2020, the Regional Spatial and Economic Strategy (RSES) for the Southern Region 2020, the Kerry County Development Plan 2015-2021, and the Listowel Municipal District Local Area Plan 2020. See Chapter 04 – Policy (Energy and Planning) for further detail.

The Shannon Estuary comprises 500 km^2 of navigable water extending from Loop Head, in Co. Clare, and Kerry Head, in Co. Kerry, eastwards to the city of Limerick, a distance of 100 km. The naturally occurring deep and sheltered waters of the estuary are connected to the Atlantic Ocean and are accessible to large ocean-going vessels of varying types and sizes of up to 185,000 deadweight tonnes (dwt).

The Proposed Development will be comprised of two main components, as detailed in Chapter 02 – Project Description:

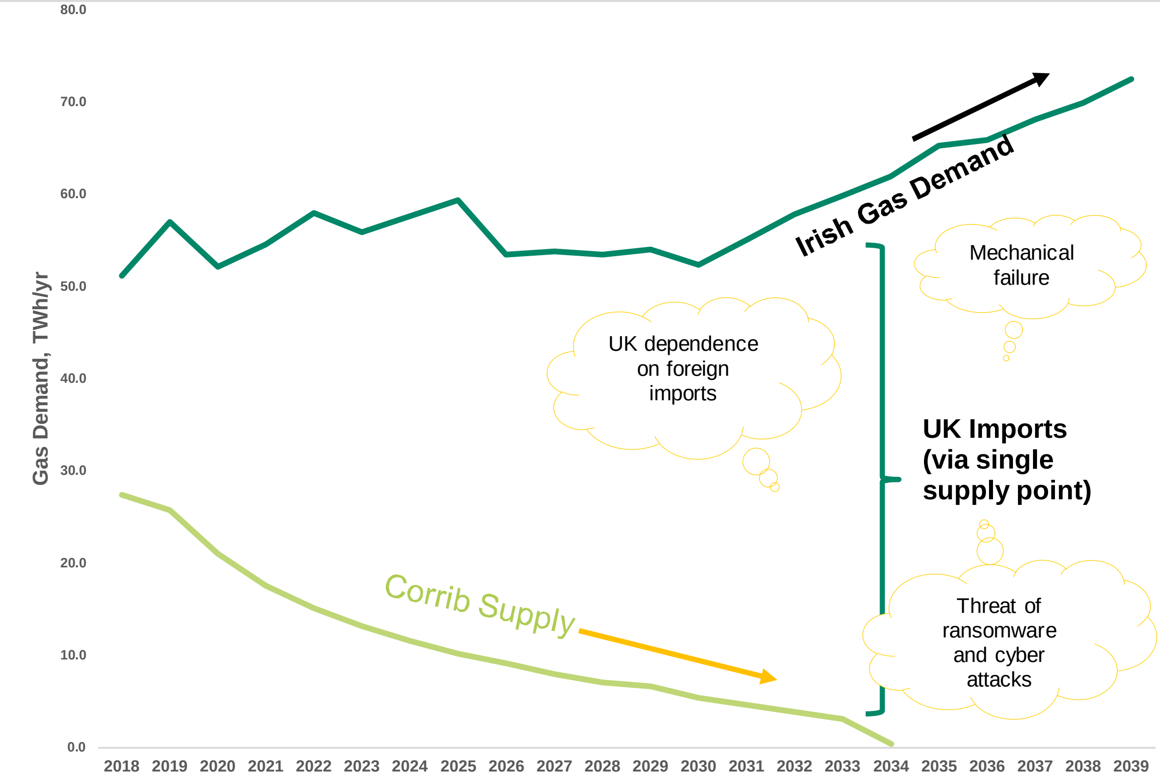
1. A Power Plant; and
2. An LNG Terminal.

The Power Plant will employ combined cycle natural gas technology and its design will comply with all relevant national and international codes. The Power Plant and 120 MWh battery energy storage system will be located directly adjacent to the LNG Terminal. The Proposed Development will have installed capacity to supply up to 22.6 million Sm^3/d of natural gas to the Irish gas transmission network via the already consented 30 inch Shannon Pipeline. The total installed capacity of the flexible modular Power Plant will be up to 600 MW.

The Power Plant will generate power for its own needs and for the LNG Terminal, and for sale to the market via the national electricity grid exported via a 220 kV connection, which will be subject to a separate planning application. The 220 kV connection is considered in the cumulative impact assessment within each technical chapter. An application to connect to the national electrical transmission network via this 220 kV connection was submitted to EirGrid in September 2020. An offer has yet to be received though Shannon LNG Limited made a successful high voltage grid application under Enduring Connection Policy (ECP2.1). Once the connection offer is made, this 220 kV connection will be subject to a separate planning application.

LNG is natural gas that has been cooled to approximately -160 degrees centigrade (˚C), at which point it becomes a liquid at atmospheric pressure. As a liquid, the volume of natural gas is approximately 600 times less than the volume of the equivalent amount in the gaseous stage, making it more manageable for storage and ocean transportation. LNG is stored and transported in insulated tanks operating at pressures slightly above normal atmospheric pressure.

LNG is produced primarily in locations with large gas reserves which are too distant from market areas to be transported economically by pipeline. The natural gas from these fields is gathered and brought by pipeline to liquefaction plants where it is liquefied, pumped into LNG storage tanks and then loaded onto LNG ships and transported to the market areas of the world (refer to Figure 1-1). Ireland is one of very few countries in Western Europe with a national gas transmission network that does not have an LNG import terminal. The main sources of natural gas to Ireland are detailed in Figure 1-1 below. Once the LNG is delivered to the regasification terminal, the liquid is unloaded into the storage tanks, converted back into gas and transmitted via the gas pipeline system.



Source: *The National Energy and Climate Change Plan 2021 to 2030 (NECP), Figure 23 Total Primary energy requirement by fuel (WAM) Figure 23 and CRU18105 Copy of Corrib Linkline Element Calculation 2018/19*

Figure 1-1 Irish Gas Supply and Demand

The previously consented 26 km 30" Shannon Pipeline (planning reference: PL08.GA0003), once constructed, will facilitate transport of the natural gas from the Proposed Development site to the national gas network at Foynes.

The Proposed Development has a unique location and flexible design that can easily transition to alternative low carbon fuels, subject to future planning applications and once the technology and public policies are established. The location of the Proposed Development site will provide access to future offshore renewable projects, combined with facilities for the production and landing of hydrogen. This would contribute to the decarbonisation of Ireland's energy system by providing long term hydrogen energy storage (produced onsite and entered into the national gas transmission network) and hydrogen directly used in electricity generation at the Power Plant. The modular Power Plant offers flexibility to incorporate alternative fuels, and the modern nature of the LNG Terminal will ensure it can easily be adapted in future. Refer to New Fortress Energy Inc.'s 'A Step Towards a Zero Carbon Future' policy for further details (Appendix A1-1, Volume 4).

The LNG Terminal could also be operational before the Power Plant and the 220 kV grid connection are completed. Therefore, a medium voltage (10/ 20 kV) connection to supply power to the LNG Terminal in the absence of the 600 MW Power Plant will be required. This medium voltage connection will also be subject to a separate planning application and is included in the cumulative impact assessment within each technical chapter.

The Masterplan for the Shannon Technology and Energy Park will integrate the Proposed Development and a (future) Data Centre Campus (Figure F1-1, Vol. 3). The Data Centre Campus is not included in this application and will therefore be subject to a separate planning application. The Data Centre Campus, the 220 kV and the medium voltage (10/ 20 kV) cables have been considered as part of the cumulative impact assessment within each technical chapter.

Planning consents were previously granted by ABP for the development of an LNG Terminal (2007) and a Combined Heat and Power Plant (CHP) (2013) on the Proposed Development site. The current application is a new Strategic Infrastructure Development (SID) application and does not rely on any of the previous planning applications. A Site Selection Assessment has been undertaken by AECOM in 2021 and a report prepared. The report concluded that Ballylongford/ Tarbert landbank is the most suitable location to accommodate and safely operate the Proposed Development. The location offers the following:

- A large unoccupied landbank on the coast which is zoned for industrial purposes adjacent to the foreshore;
- Access to water depth greater than 13 m;
- A navigational channel of uniform cross-sectional depth suitable for LNG carriers (LNGC) including the largest vessel;
- Turning circle for LNG ships that provides adequate turning space of up to approximately 690 m;
- Space outside the main navigation channel for a marine control zone around the LNGC and Floating Storage and Regasification Unit;
- Protection from swell waves from the Atlantic, being subject only to locally generated wind waves;
- Access to high-capacity gas transmission network that can receive up to 22.6 million Sm^3/d;
- The ability to get a high voltage export grid connection offer within the generation capacity shortfall time window[1]; and
- Access to high-capacity electricity grid (220 kV or higher) that can export 600 MW without undue system constraint.

[1] Shannon LNG Limited made a successful high voltage grid application under Enduring Connection Policy (ECP2.1)

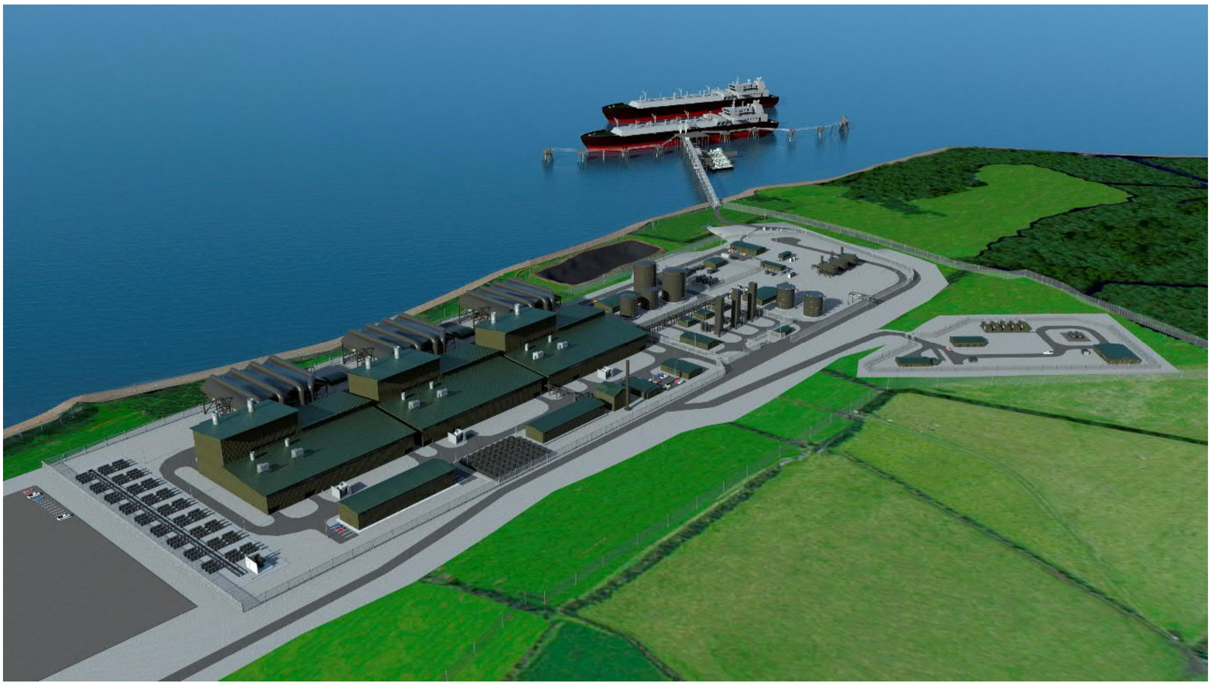


Figure 1-2 Proposed Project Overview (viewed from the north and south respectively)

Further detail in relation to the Proposed Development is provided in the following sections.

1.3.1 Power Plant

The Power Plant is modular and will comprise:

- Three (3) blocks of Combined Cycle Gas Turbines (CCGT), each block with a capacity of approximately 200 megawatts (MW) for a total installed capacity of up to 600 MW;
- Battery Energy Storage System (BESS);
- High voltage 220 kV Substation;
- Auxiliary Boiler;

- Water Storage and Water Treatment Facility
- Structural/ Architectural Buildings (various);
- Sewerage drainage system;
- Process effluent collection system and sump;
- Firewater storage tanks and fire water pumps;
- Fuel storage;
- Roadway and Area lighting; and
- Central control/ operations building.

The Power Plant will employ CCGT technology and its design will comply with all relevant national and international codes. The Power Plant will be located directly adjacent to the LNG Terminal and will provide additional and flexible power generation capacity to support intermittent renewable generation and resolve a predicted generation capacity shortfall, in line with national policy goals. For example, during periods of high wind (renewable) generation, it is expected that the Power Plant would be turned down or off by the system operator (EirGrid) to give priority to renewable power[2]. However, the LNG Terminal will need to be operational all year round.

A detailed description of the main features of the Power Plant is contained in Chapter 02 – Project Description.

1.3.2 LNG Terminal

The LNG Terminal will comprise:

- A Floating Storage and Regasification Unit (FSRU), which will be a ship and will have an LNG storage capacity onboard of up to 180,000 m^3 (equivalent to approximately eight days' gas demand for Ireland, approximately 160 GWh/day). The ship will be up to 300 m long, up to 50 m wide and the height of the vessel including the top of the exhaust stack will be approximately 50 m above sea level. The LNG vaporisation process equipment to regasify the LNG to natural gas will be onboard the FSRU. The main heat for LNG regasification will be from seawater through heat-exchangers, supplemented by heat from gas fired heaters during periods when the water temperatures are too low to provide sufficient heat. The FRSU will regasify LNG at rates required to meet gas demand up to 22.6 million Sm^3/d (approximately 250 GWh/day);
- LNG will be delivered by an LNGC, which is also a ship, and which will be moored to the seaward side of the FSRU in a ship-to-ship transfer configuration. Up to 60 LNGC visits per year are anticipated. The LNG will be discharged from the LNGC, via connecting cryogenic hoses, into the storage tanks of the FSRU;
- A jetty capable of receiving and providing secure berthing for LNG ships with the capacity to accommodate up to 4 tugs;
- Onshore facilities including a nitrogen generation facility, a control room, a guard house, workshop and maintenance buildings, administrative building, instrument air generator, backup power generators and a fire water system;
- Onsite power generation plant of approximately 24 MW capacity; and
- An Above Ground Installation (AGI), which will include an odorisation facility, a gas heater building, gas metering plant and pressure control equipment.

[2] The Power Plant will provide additional and flexible power generation capacity to support intermittent renewable generation and resolve a predicted generation capacity shortfall . The actual operation of the plant will be determined by many factors such as power demand itself, the amount of renewable generation on the system, its bid price into the market compared to other generators and the rules of the grid to ensure priority is given to renewable generation. The Applicant commissioned a detailed market analysis report to consider these issues and model the future operation of the Power Plant from 2023 to 2050. The model assumes the Government's 70% renewable by 2030 target is met. It also considers the detailed requirements of the system operator (EirGrid) to keep the grid stable and secure. In conclusion, analysis confirmed that the flexibility of the Power Plant, including the BESS, is ideally aligned to support a high renewable market from now to 2050. In particular, the Power Plant offers the market high inertia, very low minimum stable generation, and fast response capability, complementing a renewable energy production profile that aligns with national policy goals.

The Proposed Development will have installed capacity to supply up to 22.6 million Sm^3/d (approximately 250 GWh/day) of natural gas to the Irish gas transmission network via the already consented 30 inch Shannon Pipeline.

Note that the LNG Terminal will be constructed as part of the first phase of construction, followed by the Power Plant.

Further details of the LNG Terminal are contained in Chapter 02 – Project Description.

1.4 Planning procedure

1.4.1 Pre-Application Stage

Shannon LNG Limited, the Applicant, entered into a pre application consultation process with ABP under section 37B of the Planning and Development Act, 2000, as amended, (the Act) on 20th March, 2019. ABP served notice on 2nd June 2021 under section 37B(4)(a) of the Act that it is of the opinion that the Proposed Development falls within the scope of paragraphs (a), (b), and (c) of section 37A(2) of the Act, and that the Proposed Development will be strategic infrastructure within the meaning of section 37A of the Act, and an application must therefore be made directly to ABP under section 37E of the Act.

ABP also provided the Applicant with a list of prescribed bodies to be notified of the application for the Proposed Development. Further information on consultations can be found in Section 1.6 Consultation.

1.4.2 Application Stage

Section 37E(1) of the Act states that '*an application for permission for development in respect of which a notice has been served under section 37B(4)(a) shall be made to the Board [ABP] and shall be accompanied by an environmental impact assessment report in respect of the proposed development*'.

The planning application is accompanied by an Environmental Impact Assessment Report (EIAR). A Natura Impact Statement (NIS) also accompanies the planning application. A website, https://stepplanning.com/, containing the application materials will also be available for the duration of the planning process.

The Proposed Development will also be subject to a number of licences which are outlined under the regulatory framework in Section 1.5.

1.5 Regulatory Framework

Once operational, the Proposed Development will be regulated by the following bodies:

- Environmental Protection Agency (EPA);
- Commission for Regulation of Utilities (CRU);
- Health and Safety Authority (HSA); and
- Local Planning Authority (Kerry Co. Council (KCC)).

The Shannon Foynes Port Company has statutory jurisdiction over marine activities, as discussed in Section 1.5.4.

The LNG Terminal and Power Plant will also have to operate within the provisions of a number of codes, such as the EirGrid Transmission Network Grid Code, Single Electricity Market Trading and Settlement Code, GNI Code of Operations.

1.5.1 The Environmental Protection Agency (EPA)

The EPA is the Competent Authority for granting and enforcing Industrial Emissions (IE) licences and greenhouse gas (GHG) permits.

The equipment specifications of the Proposed Development are such that it will be required to operate under an IE licence and a GHG Permit, to submit annual environmental information and emissions reports to the EPA, and to surrender sufficient EU Allowances to cover its annual emissions under the terms of the EU Emissions Trading System (ETS).

1.5.1.1 Greenhouse Gas Permit

Ireland and the EU have GHG emission targets and reduction obligations agreed in the Kyoto Protocol and the Paris Agreement, the international treaties negotiated under the framework of the United Nations Framework Convention on Climate Change (UNFCCC).

The EU 2030 Targets commit to a 40% reduction in EU-wide GHG emissions compared to 1990 levels. Emissions from energy intensive industries and power generation in the EU are regulated under the EU ETS. The EU ETS is administered in Ireland by the EPA. Given the nature of the Proposed Development, and in particular the combustion turbines to be used for power generation, a GHG Permit will be required in relation to the following category of activity listed in Schedule 1 of the European Communities (Greenhouse Gas Emissions Trading) Regulations 2012 (S.I. No. 490 of 2012):

'*Combustion of fuels in installations with a total rated thermal input exceeding 20 MW (except in installations for the incineration of hazardous or municipal waste)*' resulting in the emission of '*Carbon dioxide*'.

The GHG Emissions Permit authorizes the Applicant to emit carbon dioxide from listed emission sources. It also contains requirements that must be met in respect of such emissions, including monitoring and reporting requirements. A licence application will be made to the EPA within one year prior to commencement of operations.

1.5.1.2 Industrial Emission Directive

The Industrial Emissions Directive (IED) (2010/75/EU) came into force on 6th January 2011, as a result of a European Commission review of European legislation on industrial emissions. The IED replaces seven existing directives namely:

- The Large Combustion Plant Directive (LCPD);
- The Integrated Pollution Prevention and Control Directive (IPPC);
- The Waste Incineration Directive (WID);
- The Solvent Emissions Directive (SED); and
- Three existing directives on titanium dioxide.

The EPA is the Competent Authority for granting and enforcing Industrial Emissions (IE) licences for specified industrial and agriculture activities listed in the First Schedule to the Environmental Protection Agency Act 1992 as amended.

All of the emissions arising from the Proposed Development during its operation will be subject to the terms and conditions of an IE licence. An IE licence is required as the Proposed Development entails the carrying out of the following activities:

- Combustion of fuels in installations with a total rated thermal input of 50MW or more.

The IE licence must be in place prior to commencement of operations and will be the result of an application process to the EPA, including an EIA process.

Best Available Techniques (BAT)

The conditions of an IE licence require that the emission limit values must be based on the Best Available Techniques (BAT). A BAT assessment has been prepared, and the Proposed Development will comply with the assessment findings. The BAT assessment covers:

- Emissions from storage;
- Energy efficiency;
- Industrial cooling systems; and
- Large combustion plant.

All required operational controls will be developed prior to commencement of operations and the Proposed Development will be compliant with BAT at commencement of operations. Key elements include:

- The use of best practice design guidance and BAT requirements to inform the detailed design;
- Site/ environmental/ safety management systems including monitoring/ audits and training (such as continuous emissions monitoring);
- Specific recommendations around material storage (such as secondary containment);
- Commitment to an energy management and efficiency policy, including Key Performance Indicators; and
- Closed-circuit air-cooled condenser technology to be used for cooling.

1.5.2 The Health and Safety Authority

The Health and Safety Authority (HSA) is the central competent authority for regulatory control of sites to which the Seveso Directive applies. The Proposed Development will be classified as an Upper Tier Control of Major Accidents Hazards (COMAH) Establishment as a result of the inventory of natural gas potentially present on the Proposed Development site. The Proposed Development will therefore be required to comply with the Chemicals Act (Control of Major Accident Hazards Involving Dangerous Substances) Regulations 2015 (S.I. No. 209 of 2015) (the COMAH Regulations 2015), and in particular, to carry out a detailed quantitative risk assessment (QRA) of the facilities for submission to the HSA. European Union (EU) Directive 96/82/EC on the Control of Major Accident Hazards Involving Dangerous Substances (Seveso II Directive) came into force in 1997 and was implemented into Irish law under EC (Control of Major Accident Hazards Involving Dangerous Substances (COMAH)) Regulations, 2000, S.I. 476 of 2000.

This Directive was restated and repealed by Directive 2012/18/EU (Seveso III Directive) and implemented in Ireland by 2 sets of 2015 Regulations:

- The COMAH Regulations 2015; and
- The European Union (Control of Major Accident Hazards involving Dangerous Substances) (Revocation) Regulations 2015 (S.I. No. 208 of 2015).

The COMAH Regulations 2015 require operators of establishments where dangerous substances are present, in quantities equal to or in excess of defined thresholds listed in Schedule I, Parts 1 and 2, to take all measures necessary to prevent and mitigate the effects of major accidents to human beings and the environment.

1.5.2.1 Safety Report

The Applicant will be obliged to prepare and submit a pre-construction Safety Report to the HSA no later than 4 months prior to start of major construction.

The purpose of a Safety Report is to describe the safety arrangements for activities to be conducted at the Proposed Development and demonstrate how these arrangements ensure that all necessary measures are in place to prevent major accidents occurring and to limit the consequences of any such major accidents for human health and the environment, in accordance with the requirements of regulation 7(1) of the COMAH Regulations 2015. The Safety Report will be developed to meet with the requirements of the COMAH Regulations 2015.

The main objectives of the Safety Report are to:

- Demonstrate that a major accident prevention policy and safety management system for implementing it has been put into effect;
- Demonstrate that major accident hazards have been identified and that the necessary measures have been taken to prevent such accidents and to limit their consequences for human health and the environment;
- Demonstrate that adequate safety and reliability has been incorporated into the a) design and construction, and b) operations and maintenance of the LNG Terminal;

- Demonstrate that internal emergency plans have been drawn up and supply information to enable the external plan to be drawn up in order to take the necessary measures in the event of a major accident; and
- Provide sufficient information to the HSA to enable decisions to be made regarding the siting of new activities or developments around existing establishments.

The Applicant will put in place a Corporate Major Accident Prevention Policy (MAPP) which will form part of the Health, Safety and Environmental Management system and recognise that the control of major accident hazards is an integral part of the business. The MAPP reinforces commitment to the safety of employees, to the prevention and control of major accidents, and to the minimisation of the risk to both the public and the environment of its activities.

The risk management process, as applied through the Safety Case (see Section 1.5.3.2), requires the operator to identify hazards and assess the associated risk levels, identify and implement control and recovery measures to reduce risks, and maintain a documented demonstration that major risks associated with each hazard have been reduced to a level that is As Low As Reasonably Possible (ALARP).

The Safety Report describes how risk management will be carried out at the establishment from the outset. Hazard identification and risk assessment commenced early, to take maximum advantage during design of the potential for elimination of hazards and for the implementation of other, highly effective risk reduction measures. Output from the various studies carried out has been incorporated into equipment and system design such that the risks associated with operations are reduced to ALARP levels. A Hazards and Effects Register will be produced summarising the hazards identified for the establishment, ranking them in terms of associated risk and referencing the key risk controls in place.

The establishment is subject to the typical hazards associated with petroleum production and processing, namely flammable hydrocarbons and other dangerous substances, potentially leading to fires, explosions, pollution, etc. The COMAH Regulations 2015, regulation 2(1), define a major accident as '*an occurrence such as a major emission, fire or explosion resulting from uncontrolled developments in the course of the operation of any establishment, covered by these Regulations, and leading to serious danger to human health or the environment, immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances*'.

A summary of the quantitative risk assessment (QRA) findings is provided in Chapter 02 – Project Description.

The MAPP and Safety Report will be submitted to the HSA in a timely manner, as per HSA timelines for submission of COMAH documentation.

1.5.3 The Commission for Regulation of Utilities (CRU)

The Commission for Regulation of Utilities (CRU) is Ireland's independent energy and water regulator and was originally established as the Commission for Energy Regulation (CER) in 1999. The CER changed its name to the CRU in 2017 to better reflect the expanded powers and functions of the organisation. It has a wide range of economic, customer protection and safety responsibilities in energy and water, and its role includes commercial and safety regulation of utilities.

1.5.3.1 Construction/ Operation of Electricity Generators

The Electricity Regulation Act, 1999 as amended gives the CRU the necessary powers to licence and regulate the generation, distribution, transmission and supply of electricity in Ireland. One of the functions of the CRU under the Act is to grant or refuse Authorisations to Construct or Reconstruct generating stations (an Authorisation), following assessment of an associated application. In relation to this, the Proposed Development will seek the necessary authorisations and licences, as follows:

- Authorisation to Construct:
  - In order to construct the Power Plant, the Applicant must have an Authorisation to Construct or Reconstruct a Generation Station. Once granted, the Applicant will be obliged to comply with the associated conditions of this Authorisation.
- Licence to Generate Electricity:

– In order to operate the Power Plant, the Applicant will require a Licence to Generate Electricity. Once granted, the Applicant will be obliged to comply with the conditions of the Licence.

Such authorisations/ licence will also be required for any emergency or back-up power generators in the LNG Terminal in excess of 1 MW capacity.

1.5.3.2 Energy Safety (Gas Undertakings)

The CRU's role in regulating safety in relation to LNG facilities is set out in the Gas Safety Regulatory Framework for Ireland (CRU, 2019) Part B LNG Undertakings. In general, the CRU Safety Regulations require operators of LNG Facilities (for which a Licence to Operate from the CRU will be required) to submit a Safety Case in respect of their facilities. The Safety Case will as a minimum contain the following sections:

- Facility Description;
- Formal Safety Risk Assessment;
- Safety Management System; and
- Emergency Procedures.

The Safety Case submission and assessment process comprise three main stages:

1. Pre-Submission and Development Safety Case Process;
1. Submission Safety Case Assessment Process; and
2. Acceptance of Safety Case and Licence Approval.

The emphasis of the Safety Case regime is on 'demonstration' by the gas undertaking, e.g. the LNG facility, that acceptable safety arrangements for the management of gas-safety related risks are in place and working effectively on a day-to-day basis. In this context, demonstration involves a higher standard than simply describing the way measures work or are expected to work. There is a requirement on the undertaking to provide evidence that the measures described in the Safety Case work in practice and are monitored to ensure that this actually happens.

There are currently no LNG undertakings within Ireland, under the CRU's regulatory jurisdiction. As a result, the CRU's guidelines state that they will not publish requirements for LNG undertakings as part of the Safety Case Guidelines main document at this time.

The guidelines also state that the CRU recognises that some natural gas operations, such as LNG undertakings, fall under the safety requirements of the Seveso III Directive and the COMAH Regulations 2015 (S.I. No. 209 of 2015). As a result, there is significant overlap between the requirements for the LNG Safety Cases as required by the CRU as safety regulator under the Electricity Regulation Act 1999 (as amended) and the Pre-Operating Safety Report required by the HSA as the Central Competent Authority under the Seveso III Directive and the COMAH Regulations 2015. With this in mind, the CRU will review the requirements with the HSA at such time as the need arises, with the objective of agreeing an approach to the safety regulation of natural gas Seveso sites that minimises the level of duplication of safety reporting by undertakings, whilst respecting the legislative responsibilities of both the CRU and the HSA.

1.5.4 Shannon Foynes Port Company (SFPC)

Shannon Foynes Port Company (SFPC) is a statutory Harbour Authority and has jurisdiction and responsibility for all commercial maritime activities on the Shannon Estuary between Shannon Bridge in Limerick City and an imaginary line at the mouth of the estuary joining Loop Head in Co. Clare to Kerry Head in Co. Kerry.

SFPC has the authority to issue Byelaws pursuant to section 42 of the Harbours Act 1996 (as amended); the current Byelaws came into effect on 10th November 2004. The Harbour Master is vested with the authority to issue 'Directions' to the masters of vessels arriving, departing, or lying within the port. Through contractual arrangement with the port and operational procedures, Shannon Technology and Energy Park will comply, as appropriate, with SFPC Byelaws and Harbour Master 'Directions'.

The FSRU and visiting LNGC will meet all conditions of international navigation, i.e. conditions that have been established by the SOLAS Convention and other international conventions accepted within the International Maritime Organization (IMO). The FSRU will possess valid ship certificates and documents required for such a ship type in accordance with the aforementioned international conventions, whose list is consolidated and updated in the Maritime Safety Committee of the International Maritime Organization's 'List of Certificates and Documents Required to be Carried onboard Ships' document.

The FSRU will also comply with all safety requirements prescribed by the regulations of the ship's registries and the flag State which the vessel is flying, the recognized organizations (RO) and the recognized security organization (RSO).

In addition, the FSRU as a vessel for the transport and storage of liquefied natural gas should meet the requirements of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code), as amended.

If the FSRU decouples from the jetty, it will be subject to the International Convention for the Prevention of Pollution from Ships (MARPOL) (transposed into Irish law by the Sea Pollution Act 1991 (as amended)).

1.5.5 Other Permits and Consents

A number of permits will be required for the Proposed Development, some of which have already been obtained. These include but are not limited to those described below.

1.5.5.1 Construction of Surface Water Drainage

All drainage from the construction phase of the Proposed Development will be managed and monitored in accordance with the planning conditions set out by the planning authority. The mitigation and monitoring measures will also be included in the OCEMP (see Appendix A2-4, Vol. 4).

1.5.5.2 Foreshore Leases and Licences

The Foreshore Act 1933 (as amended) requires that a lease or licence must be obtained from the Minister for the Environment, Climate and Communications for undertaking any works or placing structures or material on, or for the occupation of, or removal of material from, State-owned foreshore.

A foreshore lease will be required for elements of the Proposed Development including the jetty and the surface water discharge pipe. The Applicant has obtained a foreshore lease for a jetty at the proposed location and a foreshore licence for a storm water outfall pipe at the proposed location. Amendments to these licences and leases may be required for the Proposed Development.

1.5.5.3 Fire Safety Certificates

Fire Safety Certificates are required from KCC Fire Brigade. This process consists of a detailed technical appraisal, by a KCC Fire Prevention Officer, of a proposed building design or proposed change of use against Part B (Fire Safety) of the Second Schedule to the Building Regulations 1997 to 2006 (S.I. No. 497 of 1997 as amended by S.I. No. 115 of 2006) and the related Technical Guidance Document B or an approved equivalent standard. The process may also involve pre-project consultation, liaison with consultants and building inspections.

1.5.5.4 Disability Access Certificate for Buildings

A Disability Access Certificate (DAC) will be required from KCC for each building, certifying compliance of the design with the requirements of Part M of the Building Regulations 1997 to 2010 (S.I. No. 497 of 1997 as amended by S.I. No. 513 of 2010). It will need to be applied for and granted for each building prior to construction.

1.5.5.5 Section 50 Consent (Consent to Construct a Culvert)

All works to bridges and culverts on watercourses require approval from the Office of Public Works (OPW) in accordance with Section 50 of the Arterial Drainage Act 1945. KCC will seek Section 50 approval during the Planning Process. The process requires the submission of structural drawings, hydraulic calculations, and reports to the OPW for its approval.

1.5.5.6 Section 254 Licence

A licence must be obtained from the planning authority under Section 254 of the Planning and Development Act 2000, to erect, construct, place or maintain a cable, wire, or pipeline over or along a public road. The application must furnish such plans and other information as the planning authority may require. The planning authority may grant a licence for a specified period and subject to conditions.

1.5.5.7 Archaeological Licences

There are some features of archaeological interest identified on the Proposed Development site that need to be removed prior to the start of construction. A licence to carry out archaeological excavation is required from the National Monuments Service. Facilities will be required to complete the archaeological excavation and associated post-excavation work, including preparation of preliminary and final reports (including specialist reports) to the standard required under the licence.

1.5.5.8 Ecological Licences

Where species are found that should be protected by removal from the Proposed Development site, an application to the National Parks & Wildlife Service (NPWS) for the appropriate ecological licence shall be made and no prohibited work shall be carried out unless under and in accordance with the appropriate ecological licence.

1.6 Consultation

Consultation with relevant statutory and non-statutory bodies forms an important part of the EIA process. The EPA guidance on the information to be contained within an EIAR confirms that '*Consultation is a key element of each stage of the EIA process. The requirement for consultation is included in the definition of EIA in the Directive*.' (EPA, 2017). Consultations – for example during the scoping process – help to ensure that all impacts, issues, alternatives, and mitigation measures, which interested parties believe should be considered in the EIA, have been addressed (in accordance with the European Commission's (EC) 'Environmental Impact Assessment of Projects – Guidance on Scoping', 2017b). Scoping and consultation for the EIA was carried out by the Applicant and focused on meetings, discussions and/ or correspondence with the following bodies only (see Table 1-1 and Appendix A1-5, Vol. 4 for further details).

Table 1-1 Overview of Consultation Undertaken to Date

Consultee and Summary of Comments	Response
Local Authorities	
KCC Planning Department (including KCC Biodiversity Officer) KCC Planning Department indicated that the potential for marine pollution would need to be addressed in the EIAR. They also raised the issues of discharges, emissions and waste, and commented that the EIAR and NIS would need to address these matters, as well as cumulative impacts.	The potential for marine pollution is addressed is Chapter 06 – Water and Chapter 07 – Biodiversity. Discharges, emissions and waste are discussed in Chapter 06 – Water, Chapter 08 – Air Quality and Chapter 16 – Waste. Cumulative impacts are addressed within each technical chapter (Chapters 05 to 17).
KCC Chief Fire Officer KCC Fire Officers enquired about the fire capability of the tugs, requested that the risk of both firewater tanks being lost in one event be considered, requested clarity on the internal fire and rescue plan, requested details on typical fire and rescue systems commonly used in other similar facilities, how many people would be onsite and what would their capability and training be for fire, confirmation that there be self-inflating life rafts on the jetty.	Refer to Chapter 02 – Project Description.

Consultee and Summary of Comments	Response
KCC County Archaeologist Requested detailed mapping of all recorded archaeological features in relation to the Proposed Development (scaled). Noted the testing of untested areas and excavation of all identified/ potential archaeological features and/ or strata within the development boundary will be recommended, and the proposals to carry out this work should be detailed in the application. Given the archaeology that has been uncovered and recorded KCC noted that archaeological, licensed monitoring of all topsoil stripping associated with the development will be required. Requested that any proposals to deal with foreshore and/ or underwater archaeological potential are outlined in the EIAR.	Addressed in Chapter 12 – Cultural Heritage.
KCC Roads Department KCC discussed that the L1010 is to be widened prior to the start of the main construction elements. KCC discussed that, as part of the traffic analysis, consideration be given for construction staff arriving from the N69 Listowel direction. KCC commented that each abnormal load may require its own abnormal load permit to be transferred from Foynes Port to the Proposed Development. KCC recommended that the number of HGVs arriving from the N69 Listowel direction is to be limited due to high kerbs and potential oversailing at the junction.	See Chapter 11 – Traffic and Transport.
Limerick Co. Council No response to date.	-
Clare Co. Council No response to date.	-
State/ Semi-State Bodies	
Gas Networks Ireland (GNI) GNI referred the Applicant to the security of supply study commissioned by the Department of Communications, Climate Action and Environment, with support from the Commission for Regulation of Utilities (CRU); the GNI/ EirGrid Long Term Resilience Study 2018. This study notes that Ireland fails to meet the EU Security of Supply Regulation (Regulation (EU) 2017/1938) and has a key recommendation that: '*The most economically advantageous option to improve the resilience of Ireland's gas supply is a floating LNG terminal*'.	Addressed in Chapter 03 – Need and Alternatives.
EirGrid EirGrid noted the ambitious and strategic nature of the development. EirGrid noted the design seems aligned with what the grid needs in the future to support increased renewable penetration. Specifically, fast acting, low minimum stable generation, and high inertia gas fired power generation. In the context of predicted future capacity shortfall, EirGrid enquired would the Applicant be participating in the 2025/26 T-4 Capacity auction which will be held in March 2021.	Addressed in Chapter 03 – Need and Alternatives.

Consultee and Summary of Comments	Response
Commission for Regulation of Utilities The CRU advised of the predicted generation capacity shortfall and agreed that the proposed Power Plant would be well placed to address this. The CRU advised that the LNG Terminal will need a safety case. The CRU advised of two policy documents – EirGrid plan to 2030 'Pathway to 2030' and EirGrid's Tomorrow's Energy Scenario – both of which outline the enduring role of natural gas fired power plants in supporting intermittent renewable generation.	See Chapter 01 – Introduction (this chapter), Chapter 03 – Need and Alternatives and Chapter 04 – Policy.
Environmental Protection Agency The EPA noted the Applicant's proposal. The EPA suggested that the Applicant commence the IE licence application shortly after the planning application to ABP.	Refer to Chapter 01 – Introduction.
National Parks & Wildlife Service NPWS noted that the scope of surveys and models as presented look like best practice. NPWS noted that the recent surveys seem to build upon the surveys done in earlier years, and that the Applicant should now have a good ecological understanding of the Proposed Development site. NPWS advised of the conservation objectives that Qualifying Interest habitat area should be stable or increasing. NPWS noted that the requirement, in the context of an appropriate assessment, is to demonstrate the absence of adverse effects on European Sites. NPWS advised that in combination effects both for construction and operation would need to be considered in the application. NPWS advised that a full AA is required. NPWS advised that oil spills need to be considered in the application and that NFE should engage with the estuary river pollution protection plan. NPWS requested that an assessment of management of ballast water should be included in the EIAR. Potential for invasive species in ballast or attached to ship's hull should be addressed. NPWS requested an assessment of hull cleaning/ hull fouling in the EIAR. NPWS enquired on potential impacts on birds offshore and within shipping routes. NPWS enquired would the jetty be illuminated at night and would night time lighting pose a collision risk to birds. NPWS requested that if blasting is required, then impacts on fauna including birds and dolphins be assessed. NPWS advised that full accounting of construction and demolition waste needs to be considered in the plan. NPWS advised of the requirement for cumulative impact assessment of the ancillary developments that are functionally dependent on the instant application. NPWS requested that hydrogeological impact be considered in the EIAR. NPWS enquired would the development impact on bat movement.	Addressed in Chapter 07 – Biodiversity.

Consultee and Summary of Comments	Response
NPWS queried the need to update the EIA and appropriate assessment for the gas pipeline, being an integral part of the whole project.	This application does not propose or request permission for any extraction, refining or liquefaction of natural gas. The potential sources of liquefied natural gas are varied and, although not possible to identify, will all be located outside of the State and almost all will be located outside of the European Union. The pre-application observations made by the Development Applications Unit of the Department of Tourism, Culture, Arts, Gaeltacht, Sport and Media suggest that the impacts of source gas extraction should be examined, where such data is available. In accordance with the decision of the High Court in An Taisce v. An Bord Pleanála [2021] IEHC 254 and 422, any impacts on the environment from extraction, refining or liquefaction of source gas are too remote from the proposed development to require examination, analysis and evaluation within the environmental impact assessment and appropriate assessment of the proposed development. We are advised that, for this reason, it is neither necessary nor appropriate to include particulars of any one place where source gas might be extracted.

Consultee and Summary of Comments	Response
Noted from previous meetings that the Proposed Development is not dependent on the use of shale (fracked) gas. However, in the event that this remains a possible option which is not strictly excluded from the proposed project, questioned if it should be taken into account in the EIAR citing potential concerns raised in Pennsylvania to the listed species rayed bean and snuffbox mussel.	The 26km gas pipeline that will connect the Proposed Development to the existing natural gas network is already permitted. By decision dated 17 February 2009, An Bord Pleanála granted approval for this gas pipeline under section 182D of the Planning and Development Act, 2000 (as amended) (Board ref. PL08.GA0003). It follows that the permitted pipeline is an 'approved project', to which Annex IV(5)(e) of the EIA Directive applies. This means the EIA of the Proposed Development must include effects resulting from the cumulation of effects with the permitted pipeline. Similarly, the permitted pipeline is a project for the purposes of the 'in combination' assessment under the Habitats Directive. The pre-application observations made by the Development Applications Unit of the Department of Tourism, Culture, Arts, Gaeltacht, Sport and Media suggest that a revised assessment of the permitted pipeline would appear to them to be necessary. That revised assessment will be included within the required future application for consent under section 39A of the Gas Act 1976 (as amended). We are advised that no such revised assessment is necessary to complete necessary cumulative and in combination assessments. The necessary cumulative and in combination assessments have been completed, on the basis that the permitted pipeline is built in accordance with its existing approval. Refer to the cumulative assessment within each technical chapter (05 to 17).
Shannon Foynes Port Company (SFPC) SFPC completed a navigation risk assessment for the Proposed Development. SFPC concluded that the navigational risk as a result of the presence of the Proposed Development is acceptable and should have minimal impact on the existing navigational risk profile, assuming compliance with embedded, and the implementation of proposed, mitigation measures. SFPC noted the comparatively large geographical size of the estuary, the substantial amount of deep navigable water available and the relatively low density of commercial shipping.	Refer to Appendix A2-1 Marine Navigation Risk Assessment (Volume 4).
Health and Safety Authority (HSA) The HSA requested that a Quantitative Risk Assessment (QRA) be submitted at the time of the submission of the overall planning application to ABP. The HSA also advised the Applicant of the recent HSA consultation document, *Guidance on Technical Land-use Planning Advice for Planning Authorities and Operators of Establishments under the COMAH Regulations* and requested that the Applicant consider this guidance in preparation of the QRA.	See Chapter 02 – Project Description.

Consultee and Summary of Comments	Response
Geological Survey of Ireland (GSI)	
The GSI records show that there are no unaudited County Geological Sites (CGSs) in the vicinity of the Proposed Development site. The GSI Groundwater Data Viewer indicates the Proposed Development site is underlain by a 'Locally Important Aquifer – Bedrock which is Moderately Productive only in Local Zones'. The Groundwater Vulnerability Map indicates the area covered is variable. Landslide susceptibility in the Proposed Development area is classed from Moderately Low to Moderately High at the coastal margins. GSI recommend AECOM utilise the range of data and resources provided by them, as well as their online map viewers, to fully determine site conditions, as often conditions onsite are variable. GSI have also stated that, should development go ahead, all other factors considered, they would much appreciate a copy of reports detailing any site investigations carried out. Should any significant bedrock cuttings be created, GSI ask that they will be designed to remain visible as rock exposure rather than covered with soil and vegetated, in accordance with safety guidelines and engineering constraints. In areas where natural exposures are few, or deeply weathered, this measure would permit on-going improvement of geological knowledge of the subsurface and could be included as additional sites of the geoheritage dataset, if appropriate. Alternatively, GSI ask that a digital photographic record of significant new excavations be provided. Potential visits from GSI personnel to document exposures could also be arranged.	Addressed in Chapter 05 – Land and Soils.
Inland Fisheries Ireland (IFI)	
IFI have raised the following concerns. Fire water will likely be required for the plant and the BESS: the source of this should be addressed. Detail should be provided as to the treatment and disposal of wastewater from onsite hygiene facilities. A pollution prevention and rapid response plan should be prepared in the event of an oil spill during refuelling or a spill of LNG during the unloading/ regasification process. The management of ballast water to prevent the further introduction of alien invasive species should be dealt with. IFI are also concerned about the impact of construction/ piling noise on the auditory and migratory response of resident estuarine and migrant fish species. IFI request modelling of the impact and dispersion of the outlet water and its impact on the temperature and salinity regime in the vicinity of the proposed plant. IFI also request detail of the proposals to prevent fish impingement/ entrainment on any water intake pipes and the adequacy of any proposed systems to prevent same. Regarding tanker access to the new jetty, IFI have asked if additional dredging of the channel is required and if so, the impact of this must be adequately assessed. IFI have asked that the in-combination effects of all of the above with the Data Centre and 220 kV connection be addressed.	Refer to Chapter 02 – Project Description and Chapter 07 – Biodiversity.

Consultee and Summary of Comments	Response
Irish Aviation Authority (IAA) The IAA noted that no information in relation to general heights or elevations of the Proposed Development are provided. Nevertheless, the Authority would consider it prudent for AECOM to engage with Shannon Airport Authority and the IAA's Air Navigation Service Provider at Shannon Airport to undertake a preliminary assessment of the proposal to ensure that there is no potential impact on Shannon's obstacle limitation surfaces, flight procedures and communication, navigation and surveillance equipment. The IAA advised that, based on the information provided, it is likely that during a formal planning process, it will only make general observations in relation to the construction process and the notification of proposed crane operations with at least 30 days notification to the IAA.	More detail is provided in Chapter 02 – Project Description.
Department of Housing, Local Government and Heritage (Foreshore Unit) The Department requested that a copy of their response letter be sent to ABP and to Aquafact for their information, as they are also currently working on the project. They asked for AECOM's consent to copy both of these parties on any observations the Department sends to AECOM.	Refer to Chapter 01 – Introduction (this chapter).
Underwater Archaeology Unit c/o Department of Tourism, Culture, Arts, Gaeltacht, Sport and Media The Department recommended that a cultural heritage section submitted with a new application should include a full overview of all previous archaeological results – these to include terrestrial, foreshore and subtidal data. The Department also recommended a renewed foreshore/ intertidal archaeological survey by way of updated Underwater Archaeological Impact Assessment (UAIA) be undertaken to assess if any cultural heritage has been revealed within the footprint of the newly revised Shannon Technology and Energy Park. This should concentrate particularly on any parts of the foreshore which will be the focus of disturbance, e.g. for outfall works, plant and machinery movements, etc.	Included in Chapter 12 – Cultural Heritage.
Department of Tourism, Culture, Arts, Gaeltacht, Sport and Media The Department advised that a co-ordinated heritage related response would be issued within 6 weeks. No response has been received to date.	-
The Heritage Council No response.	-
Irish Water Irish Water provided feedback on the capacity to supply water for the Proposed Development.	See Chapter 06 – Water.

Consultee and Summary of Comments	Response
Office of Public Works No response received to date.	-
Garda Siochána Traffic Corps No response received to date.	**-**
ESB Networks An application was made to ESBN to import up to 10 MW of power from the electricity distribution system.	See Chapter 15 – Material Assets.
Fáilte Ireland No response received to date.	**-**
Birdwatch Ireland Contacted for background information on the Shannon Estuary and I-WeBS data.	Refer to Chapter 07 – Biodiversity.
Southern Regional Assembly No response received to date.	**-**
South West Regional Authority No response received to date.	**-**
Mid West Regional Authority No response received to date.	**-**
An Taisce No response.	-
Public Consultation	
Kilcolgan, Tarbert and Ballylongford Residents and Development Associations An online public consultation event was held with the Kilcolgan, Tarbert and Ballylongford Associations. The consultation was held via MS Teams due to Covid-19. Key discussion points included the requirement to satisfy the SID Public Consultation obligations in light of Covid-19 restrictions, the Applicant's engagement in the media, source of LNG suppliers and Ship to Ship LNG transfer safety.	Addressed in Chapter 01 – Introduction (this chapter) and Chapter 02 – Project Description.

The Applicant undertook a period of public engagement from 23rd June 2021 to 10th July 2021. The purpose of the engagement was to provide information to the public on the Proposed Development.

Due to social distancing regulations in place as a result of the Covid-19 pandemic, it was not possible to hold the public event in-person. Therefore, a virtual public information room was developed which was hosted on a dedicated website accessible at https://step.consultation.ai/.

The website captured details of the Proposed Development, representative views of the development and included a feedback mechanism (see Appendix A1-2 in Volume 4).

Adverts notifying of the information event were posted in Kerry's Eye and The Kerryman newspapers in advance of the launch on 24th June and 23rd June, respectively. Refer to Appendix A1-3 in Volume 4 for copies of the advert.

The virtual public information room received 1,112 visitors and 36 public comments during the engagement period. 97% (35) of the public comments were supportive of the development. Specifically, of the 35 supportive comments, 16 were supportive due to the local employment opportunities that STEP will create, 13 were expressions of general support and 6 supportive of the development to address national energy security concerns (Figure 1-3). Only 1 comment questioned the need for the development and was not supportive. Refer to Appendix A1-4 in Volume 4 for a summary of the feedback received.

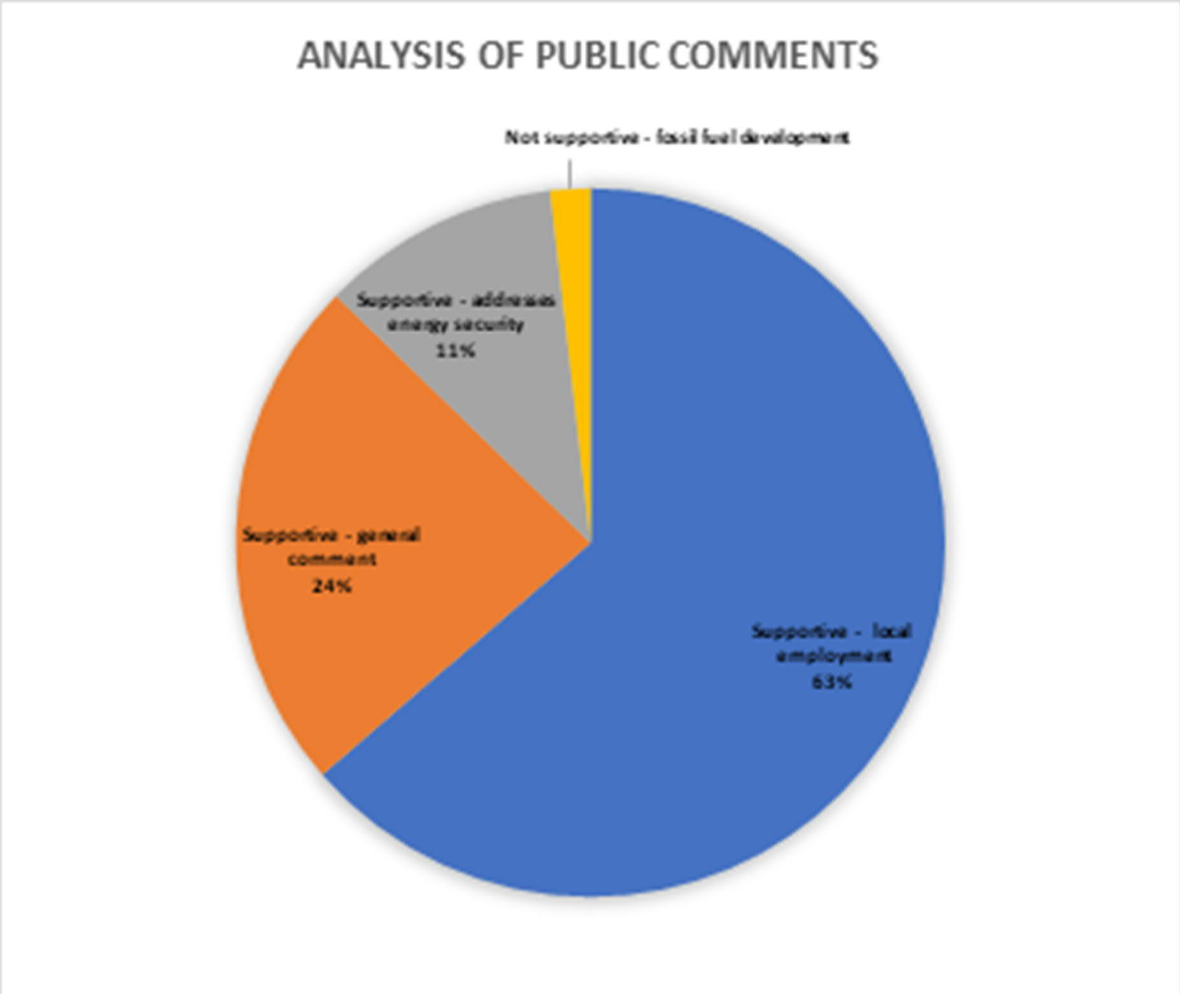


Figure 1-3 Summary of Feedback from Public Consultations

1.7 Environmental Impact Assessment Legislation and Guidance

EIA requirements derive from Directive 2011/92/EU (the 'EIA Directive') of the European Parliament and the Council on the assessment of the effects of certain public and private projects on the environment, as amended by Directive 2014/52/EU. Directive 2014/52/EU required that it be transposed into national law by 16th May 2017; it was transposed into Irish planning law on 1st September 2018 by the European Union (EU) (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 298 of 2018).

This EIAR has been prepared in accordance with the requirements set out in the EIA Directive and relevant associated guidelines and documentation including:

- EPA's draft 'Guidelines on the Information to be Contained in Environmental Impact Assessment Reports' (EPA, 2017) (the 'EPA draft guidelines');
- EC, 'Environmental Impact Assessment of Projects, Guidance on the preparation of Environmental Impact Assessment Reports' (EC, 2017a);
- EC's 'Environmental Impact Assessment of Projects – Guidance on Scoping (EC, 2017b);
- EC's 'Interpretation of definitions of project categories of Annex I and II of the EIA Directive' (EC, 2015);

- EC's 'Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment' (EC, 2013);
- Guidelines for Planning Authorities and An Board Pleanála on carrying out Environmental Impact Assessment, (Government of Ireland, 2018); and
- Other guidelines relevant to the environmental aspects assessed, as noted in specific chapters of the EIAR.

1.7.1 Why the Proposed Development Requires an Environmental Impact Assessment

The Proposed Development falls under the Seventh Schedule of the Planning and Development Act 2000 (as amended), as:

- '-*An onshore terminal, building or installation, whether above or below ground, associated with an LNG facility, and for the purpose of this provision, 'LNG facility' means a terminal which is used for the gas liquefaction of natural gas or the importation, offloading and re-gasification or liquified natural gas, including ancillary services*'; and
- '*A thermal power station or other combustion installation with a total energy output of 300 megawatts or more*'.

In accordance with sections 37A and 37B of the Act, the Proposed Development has been determined by ABP to fulfil the criteria requiring the application for permission to be made directly to ABP instead of the local planning authority. Section 37E of the Act provides that such an application shall be accompanied by an EIAR.

1.8 Methodology

1.8.1 Environmental Impact Assessment Process

EIA is a process for anticipating the impacts and associated effects (both positive and negative) from a proposed development or project on various environmental receptors. In EIA, impacts are defined as the changes resulting from an action, whereas effect is the term used to express the consequence of an impact (expressed as the 'significance of effect'). If the anticipated effects are unacceptable, design measures or other relevant mitigation and monitoring measures can be implemented to reduce or avoid those effects. The EIAR describes the current state of the environment and assesses the likely significant effects and impacts of a proposed development on the environment, including the residual impacts and effects once mitigation and monitoring measures have been implemented.

The EIA process can involve several stages, including: consultation, screening, scoping, baseline surveys, impact assessments, ongoing feedback into a project design, and preparation of the EIAR (Figure 1-4). For this Proposed Development, the EIAR will be submitted as part of a planning application to ABP, which is the Competent Authority (CA), to enable ABP to assess the impacts and carry out an EIA before consenting or otherwise.

This EIAR will also accompany the IE licence application to the EPA following submission of the planning application. The EPA is the CA in respect of IE licensing and will also carry out an EIA to ensure that, subject to compliance with the conditions of the licence, any emissions from the licensed activities will comply with and not contravene any of the requirements of section 83(5) of the Environmental Protection Agency Act 1992 (as amended), i.e. will not adversely affect human health or the environment, that the operation of the installation is in line with the latest developments in the best available techniques, and will meet all relevant national and EU standards. Likewise, the EIAR will accompany any applications for Foreshore licences/ leases.

The EIAR must include the necessary information and assessments in accordance with the EIA Directive.

The EIA Directive states in Article 1(2)(g) that '*environmental impact assessment*' is a process consisting of:

'*(i) the preparation of an environmental impact assessment report by the developer, as referred to in Article 5(1) and (2);*

(ii) the carrying out of consultations as referred to in Article 6 and, where relevant, Article 7;

(iii) the examination by the competent authority of the information presented in the environmental impact assessment report and any supplementary information provided, where necessary, by the developer in accordance with Article 5(3), and any relevant information received through the consultations under Articles 6 and 7;

(iv) the reasoned conclusion by the competent authority on the significant effects of the project on the environment, taking into account the results of the examination referred to in point (iii) and, where appropriate, its own supplementary examination; and

(v) the integration of the competent authority's reasoned conclusion into any of the decisions referred to in Article 8a.'

Further details of the EIA process and methodology undertaken for the Proposed Development are presented in the following subsections and Figure 1-4.

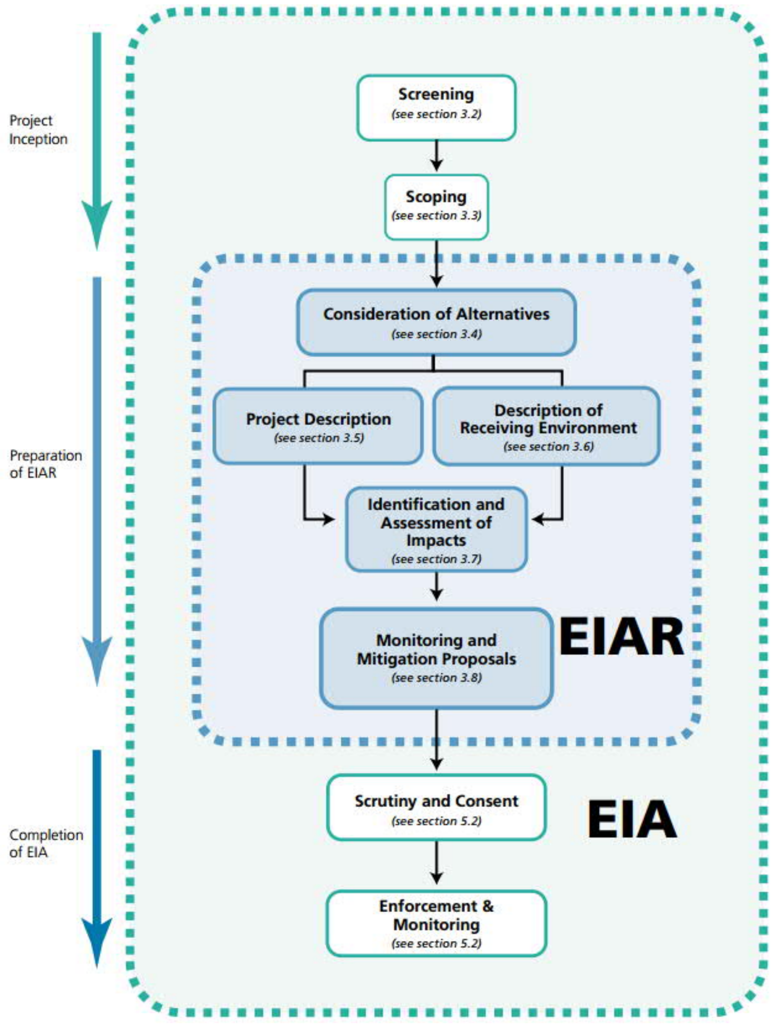


Figure 1-4 EIA Process (EIAR Draft Guidelines, EPA, 2017)

1.8.1.1 Screening

The first step in the EIA process is 'Screening', which determines if an EIA is required, and usually commences at the project design stage. The EIA Directive lists those projects that require a mandatory EIA (Annex I) and those projects for which an assessment must be undertaken to determine if they are probable to result in likely significant effects (Annex II). For Annex II projects, individual member states can choose to institute specific thresholds or project specific considerations, or a combination of both of these approaches to arrive at a decision regarding the requirement to undertake an EIA.

Annex II developments that do not exceed the thresholds for the mandatory requirement to prepare an EIA are categorised as sub-threshold and must be assessed on a case-by-case basis to determine whether they are likely to have significant effects on the existing environment. The likelihood of a significant environmental effect is the principal matter around which consideration of the requirement for an EIA is based.

Annex III of the EIA Directive sets out the criteria to be examined when carrying out EIA screening. These criteria include the characteristics of projects, location of projects, and type and characteristics of the potential impact.

In Ireland, generally the process of ascertaining whether a development requires an EIA is determined by the Planning and Development Act 2000 (as amended) and the Planning and Development Regulations 2001 (as amended), in particular Schedule 7 thereof.

An EIAR is mandatory for the Proposed Development in line with paragraph 2(a) of Annex I and paragraph 3(a) of Annex II of the EIA Directive, as transposed, respectively, by paragraph 2(a) of Part 1 of Schedule 7 to the 2001 Regulations and paragraph 3(a) of Part 2 of Schedule 7 to the 2001 Regulations. In addition, the Proposed Development falls under the Seventh Schedule of the Planning and Development Act 2000 (as amended).

1.8.1.2 Scoping

If it is determined that an EIA is required, the next step is to 'scope' the content of the EIAR. Scoping considers the potential for likely significant effects throughout different phases of a proposed project to determine '*the content and extent of the matters which should be covered in the environmental information to be submitted in the EIAR*' (EPA, 2017).

As described in the draft EPA guidelines, '*the potential for likely significant effects throughout different phases of the proposed project, are considered as far as possible at scoping stage – whether they would individually require consent or not. These include, as relevant, site investigations, construction, commissioning and operation to eventual decommissioning. Scoping also considers the range of alternatives to be considered in an EIAR*' (EPA, 2017).

Throughout various stages of the project, relevant statutory and non-statutory consultees were contacted and consulted on the project design. The consultees are listed in Section 1.6 of this report.

A summary of consultation and responses in included in Appendix A1-4 in Volume 4.

Please see individual chapters for the content and scope of each assessment chapter.

1.8.1.3 Environmental Impact Assessment Report

An EIAR is prepared as part of the EIA process. A range of environmental topics are assessed and documented within the EIAR. Typically, the EIAR includes a baseline assessment to determine the status of the existing environment; impact prediction and evaluation to identify impacts and effects and determine the significance of effects (this can include cumulative effects); delineation of mitigation and monitoring measures to reduce the impacts identified; and a residual impact assessment of the significance of effects once any mitigation and monitoring measures have been implemented.

An EIAR is defined in section 2 of the Planning and Development Act 2000 (as amended by the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018) as:

'*A report of the effects, if any, which proposed development, if carried out, would have on the environment and shall include the information specified in Annex IV of the Environmental Impact Assessment Directive*'.

General Approach to Assessment

For each technical EIAR chapter, the classification and significance of effects is generally evaluated in accordance with the EIA Directive and the methodology outlined in the EPA's Draft 'Guidelines on the Information to be Contained in Environmental Impact Assessment Reports' (EPA, 2017). Where more relevant and specific standards and methodologies exist, they are adopted and outlined in the respective methodology sections within each technical chapter (for example, specific criteria and assessment terminology used to assess ecology impacts).

Determining the Sensitivity of the Existing Environment/ Receptor

Each receptor and/ or environmental resource which may be impacted by the Proposed Development is identified and assigned a value based on its importance or sensitivity to the potential impacts. The terminology used to describe the sensitivity of resource/ receptor is high, medium, low, or negligible. The sensitivity, importance, or value of a receptor/ resource is normally derived from:

- Designated status within the land use planning system;
- Reference to standards in environmental assessment guidance;
- The number of individual receptors, such as residents;
- An empirical assessment based on characteristics such as rarity or condition; and
- The ability of a receptor/ resource to absorb change.

Determining the Character of Effects

The potential effects of the Proposed Development and associated effects on the sensitive receptor are then determined. This is undertaken by assessing the character of effect (including magnitude, duration, probability, and quality) in comparison to baseline conditions using the relevant terminology outlined in the EPA's draft guidance (EPA, 2017). The significance of effect is then determined based on the character of the predicted impact and sensitivity of the receiving environment. The assessment of effects considers any embedded mitigation that forms an inherent part of the Proposed Development. For this assessment, 'embedded mitigation measures' are those that have been incorporated into the design of the development. Any 'additional mitigation measures' are those preventing, reducing and offsetting any remaining significant adverse effects.

The assessment also takes into consideration cumulative impacts with consented, planned and reasonably foreseeable projects. A desktop search of proposed and existing planning applications was undertaken in January 2021 and updated in May, June and July 2021. The search used publicly available data from the MyPlan.ie 'National Planning Application' database (data outage was recorded from 11th January 2021), the KCC planning application portal and the ABP online database.

The purpose of this search is to inform the cumulative impact assessments within this EIAR. The cumulation of the Proposed Development with other existing and/ or proposed developments has been assessed within each relevant chapter of this EIAR. The scope of the search was based on:

- Planning applications on the Proposed Development site;
- Planning Applications (excluding individual dwellings and works to individual dwellings) within approximately 5 km of the Proposed Development site over a 10-Year Period;
- Other Relevant Planning Applications (outside the 5 km radius of the Proposed Development site); and
- Other Relevant Planning Proposals (outside the 5 km radius of the Proposed Development site).

The relevant planning application search is listed in Appendix A1-5 in Volume 4.

There are three ancillary developments planned at the Shannon Technology and Energy Park that will be subject to separate planning applications:

1. Medium voltage (10/ 20 kV) grid connection;
2. 220 kV grid connection; and
3. The masterplan vision for the expansion of the site also includes a Data Centre Campus.

These will also be considered in the cumulative impact assessment within each EIAR chapter.

Where it has not been possible to quantify effects, qualitative assessments are carried out, based on expert opinion and professional judgement. Where uncertainty exists, this is noted in the relevant EIAR chapter. Overall, a character of effect of high, medium, low, or negligible is then assigned to the impact being assessed (unless otherwise stated in individual technical chapters).

Classifying Significance

The matrix (Figure 1-5) adapted from the EPA's draft guidance (EPA, 2017) is then used to classify the significance of effect being assessed. This considers the overall character of effect with the sensitivity of the receptor/ existing environment.

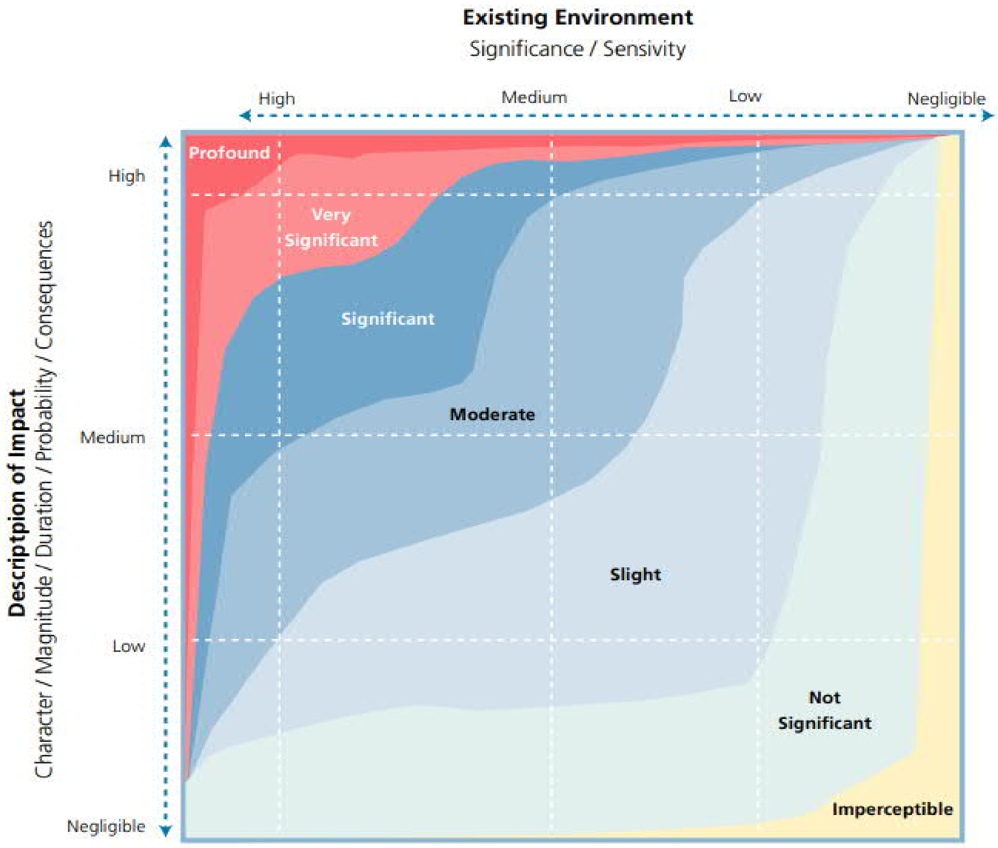


Figure 1-5 Determination of Significance (*Source: EPA's draft 'Guidelines on the Information to be Contained in Environmental Impact Assessment Reports' (EPA, 2017)*)

Mitigation and Monitoring Measures

Mitigation and monitoring measures are identified through the assessment process to prevent, reduce, offset/ remedy the likelihood of an identified environmental impact arising.

Residual Impacts and Effects

The residual impacts and associated effects are the final or intended effects which occur after the proposed mitigation measures have been implemented (EPA, 2017). As per the EPA draft guidelines, the effects from the impacts that remain after all assessment and mitigation are referred to as 'Residual Effects' (EPA, 2017). Determination of the residual effects follows the same methodology outlined above.

It is important to note that the methodology outlined above is a general approach only. Characterising the character/ significance of a potential effect can have specific criteria which are documented in the assessment chapters.

1.9 Previous Consents

The consents already granted in respect of the Proposed Development site are outlined below. For the avoidance of doubt, the current application is a new SID application and is not an alteration to current or previous consents.

- On 31st March 2008, the Board granted SID permission for an LNG terminal (Board ref. no. PL08.PA0002).
- On 17th February 2009, the Board granted approval for the gas pipeline under section 182D of the Planning and Development Act 2000 (as amended) (Board ref. PL08.GA0003).
- On 21st December 2010, foreshore leases for the jetty and a construction materials Jetty were obtained. Foreshore licences were also obtained for a seawater intake and outfall system and storm water outfall pipe in December 2010.
- On the 11th July 2013, the Board granted SID permission for a CHP plant (Board ref. no. 08.PA0028).
- On 13th July 2018, the Board amended PL08.PA0002 to extend the life of the permission from 10 to 15 years (Board ref. no. PL08.PM0014).
  - Proceedings to question the validity of that amendment were commenced on 6th September 2018: Friends of the Irish Environment CLG v. An Bord Pleanála, High Court 2018 No. 734JR. After reference to the Court of Justice of the European Union ([2019] IEHC 80 and Case C-254/19), an order was made on 9th November 2020 quashing the amendment. It follows that the 2008 permission (PL08.PA0002) is now expired.

1.9.1 Structure of the EIAR

This EIAR has been prepared in accordance with the EPA's draft guidance (EPA, 2017). Table 1-2 provides the structure of the EIAR.

Table 1-2 EIAR Contents

Volume	Content	
Volume 1	Non-Technical Summary	
Volume 2	Chapter 01	Introduction
	Chapter 02	Project Description
	Chapter 03	Project Need, Site Selection and Consideration of Alternatives
	Chapter 04	Policy (Energy and Planning)
	Chapter 05	Land and Soils
	Chapter 06	Water
	Chapter 07	Biodiversity
	Chapter 08	Air Quality
	Chapter 09	Airborne Noise and Groundborne Vibration
	Chapter 10	Landscape
	Chapter 11	Traffic and Transport
	Chapter 12	Cultural Heritage
	Chapter 13	Population and Human Health
	Chapter 14	Major Accidents and Disasters
	Chapter 15	Climate
	Chapter 16	Waste
	Chapter 17	Material Assets
	Chapter 18	Interactions
	Chapter 19	Summary of Mitigation and Monitoring Measures

Volume	Content	
Volume 3	Figures	*Various figures to accompany the technical assessment chapters*
Volume 4	Appendices	*Various appendices to accompany the technical assessment chapters*

1.10 Expertise of the EIAR Team

This EIAR has been compiled by AECOM on behalf of the Applicant with assessment and reporting provided by competent experts from AECOM and other consultancies for each individual topic. Table 1-3 provides the details of the management and technical leads responsible for the preparation of this EIAR along with their relevant qualifications and a brief summary of relevant experience.

Table 1-3 Expertise of the EIAR Team

	EIAR Chapters/ Role	Consultant	Qualification/ Summary of Relevant Experience
	Project Director	Barry Sheridan (AECOM)	Technical Director, Environment and Sustainability RoI, BA (Mod) Env Barry Sheridan is Technical Director and Head of Environment & Sustainability for AECOM in Ireland. He has over 19 years of professional experience in a variety of areas within environmental management and licensing. He has experience of environmental impact assessment and planning consents for projects in Ireland & the United Kingdom (UK).
	Project Manager/ EIAR co-ordinator	Niamh O'Connell (AECOM)	Associate Director Environment and Sustainability, BA (Mod) Eng, H dip Env Eng, MSc, PM, MIEnvSc CSci Niamh O'Connell is a Chartered Scientist and Associate Director in the AECOM Environment and Sustainability Team and has more than 16 years' post-graduate experience. She has extensive experience of managing environmental issues on major projects for both public and private sector clients taking projects from feasibility through EIAR, the planning process and later through detailed design and construction phases.
1	Introduction	Adèle Wratten (AECOM)	Senior Environmental Consultant, MEnvSci, PIEMA, REnvP Adèle Wratten has five years' experience coordinating multi-disciplinary teams across all stages of the EIA process. She has experience of managing site appraisal and feasibility assessments, EIA screening, scoping and Environmental Impact Assessment reports, and the discharge of consents and permits across a range of sectors including energy, water, commercial and residential developments.
2	Project Description	Niamh O'Connell (AECOM)	*As Above*
3	Alternatives	Niamh O'Connell (AECOM)	*As Above*
4	Planning and Development Context	Aiden O'Neill (Coakley O'Neill Town Planning Ltd)	Town Planning Consultant and Coakley O'Neill Town Planning Ltd Director, BSc (Hons), DipTCP, MIPI. Aiden O'Neill has over 24 years' professional experience in town planning in the public and private sectors, and has provided consultancy services in respect of several urban development and infrastructural developments. Aiden is a corporate member of the Irish Planning Institute, a member of the Public Affairs Council of Cork Chamber of Commerce and the Cork Co. Council Planning Strategic Policy Committee (SPC).
5	Land and Soils	Kevin Forde (AECOM)	Associate Hydrogeologist, BSc(Hons), Dip Comp Sci, MSc Hydrogeology. Kevin Forde is an Associate Hydrogeologist in the AECOM Ground, Energy and Transaction Services team and has more than 28 years' post-graduate experience. He graduated with an honour's degree in Geology (1991) and has since earned a post graduate diploma in Computing (UCC, 1992) and a Masters in Hydrogeology (UCL, 1993). He has extensive experience of ground contamination assessment and remediation for both public and private sector clients involving environmental due diligence, pre-construction site investigation, EIAR, contaminated land remediation and construction phase soil waste management.

EIAR Chapters/ Role	Consultant	Qualification/ Summary of Relevant Experience
6 Water	Kevin Forde (AECOM)	*As Above.*
7 Biodiversity	Brendan O'Connor (Aquafact),	Brendan O'Connor PhD established AQUAFACT International Services Ltd in 1986 and has been its MD since then. AQUAFACT is an environmental consultancy with particular expertise in coastal and marine projects and Brendan set it up with the expanding focus on environmental legislation in the 1980s and the development of salmon farming in Ireland. Brendan specialises in the biology and ecology of sea bed invertebrate communities. He was formerly Assistant Director of NUIG's Benthos Research Group and has been associated with the drafting, management and reporting of all AQUAFACT's contracts and reports. He was a member of the board of the Marine Institute for a 5-year term. Outside Ireland, he has worked in the U.K., France, Italy, Norway, Bahrain, Qatar, South Africa, Namibia, Angola and Australia and projects include aggregate extraction, marina and port developments, offshore wind farms, sea bed and sea shore surveys, oceanographic measurement campaigns and various types of aquaculture projects. He is the lead ecologist on the Galway Harbour Expansion project.
	Carl Dixon (Dixon Brosnan)	Carl Dixon MSc (Ecology) is a senior ecologist who has over 20 years' experience in ecological and water quality assessments. He also has experience in mammal surveys, bat surveys, invasive species surveys and ecological supervision of large-scale projects. Projects in recent years include the Waste to Energy Facility Ringaskiddy, Shannon LNG Project, supervision of the Fermoy Flood Relief Scheme, Skibbereen Flood Relief Scheme, Upgrade of Mallow WWTP Scheme, Douglas Flood Relief Scheme, Great Island Gas Pipeline and Arklow Bank Wind Park Phase 2.
8 Air Quality	Gareth Hodgkiss (AECOM)	Gareth Hodgkiss Associate Director, BSc (Hons), MSc, MIEnvSc, MIAQM Gareth Hodgkiss is a full member of the Institute of Air Quality Management and the Institution of Environmental Sciences, with over 14 years' professional experience in the delivery of air quality services for various development led projects across the British Isles and further afield. Of relevance to the Proposed Development, Gareth has undertaken, reviewed and verified assessments of local air quality impacts of major remediation works and large construction projects, which have considered impacts on human health, amenity and sensitive ecology, to support planning applications and the requirements of the appropriate regulator.
9 Noise and Vibration	Chris Skinner (AECOM)	Regional Manager – Acoustics, Environment and Ground Engineering, UK, MSci MA MIOA Chris Skinner has over 20 years' experience in acoustics research and consultancy. Having started his career with the Building Research Establishment, where he worked on a range of environmental noise and consultancy projects, he joined AECOM in 2006, and now leads the AECOM acoustics team in the UK midlands. Chris has experience in a wide range of areas of acoustics research and consultancy, including measuring, predicted and assessing sound emissions from a wide range of industrial facilities as well as residential and mixed used developments and infrastructure projects. Chris also has particular experience in monitoring and modelling of sound from complex facilities. He has also undertaken independent peer review roles for a range of acoustic assessments.

EIAR Chapters/ Role	Consultant	Qualification/ Summary of Relevant Experience
10 Landscape and Visual	Joerg Schulze (AECOM)	Associate Landscape Architect, Dipl.-Ing. (FH), LA, MILI Joerg Schulze has over 16 years' professional experience working for clients in the private and public sectors. He has a comprehensive track record in developing and managing landscape and visual impact assessments of large industrial, commercial, residential, infrastructural, renewable energy, tourism and civic developments throughout the island of Ireland. He has extensive experience in all stages of the planning, design, tender and implementation process, contract management and as consultant for Part 8 applications for road schemes and EIA processes. He has prepared residential visual impact assessments, manages the production of photomontages and the preparation of zones of theoretical visibility and theoretical visual intensity mapping.
11 Traffic and Transport	Carolyn Rollo (AECOM)	Associate MA(Hons) CIHT Carolyn Rollo is the technical lead for Traffic & Transport. A transport planner with over 13 years' experience, Carolyn's focus has been ranging from the development of new: roads, railway stations, and towns to energy solutions. Carolyn is the transport lead for UK&I energy projects and has inputted to over 50 EIARs including working on some of the UK's flagship energy projects such as: Unconventional Oil & Gas, nuclear, pumped hydro, solar and windfarms. Carolyn also supports the post planning for these energy projects including supporting public inquiries/ Hearings.
12 Cultural Heritage	David Kilner (AECOM)	Senior Archaeological Consultant, BA (Hons), PG Dip, MSc, MIAI David Kilner has over 18 years' experience in the heritage sector. Prior to joining AECOM, David was Senior Archaeologist with a commercial archaeological company based in Belfast which involved working all over Ireland. His experience covers a range of projects, from planning advice to archaeological baseline research and EIA to procuring and managing archaeological specialists and sub-contractors undertaking field survey.
13 Population and Human Health	Dave Widger (AECOM)	Regional Director, BSc (Hons), MSc Dave Widger is Regional Director in AECOM's Economic Development & Regeneration Team with over 19 years' experience in economic development and regeneration with particular expertise in health impact assessment, and community and socio-economic impact assessment of major mixed-use and infrastructure schemes. Dave Widger is an experienced Technical Lead with significant experience of working with internal and external staff to deliver complex, major infrastructure projects. He has worked on and led population and health assessments for High Speed 2, Heathrow, A303 Stonehenge and Dublin Airport.
14 Major Accidents and Disasters	Alison Couley (AECOM)	Associate Process Safety Consultant BEng (Hons) CEng MIChemE Alison Couley is an Associate within AECOMs Air Quality, Permitting and Process Safety Team in the UK. Alison has over 24 years' professional experience in process engineering and process safety, working for EPC contractors and consultants. Her areas of expertise include risk assessment (HAZOP, HAZID, ERA), COMAH/ Seveso Compliance and DSEAR/ ATEX.
15 Climate	Ian Davies (AECOM)	Associate Director, BA (Hons) Ian Davies has over 15 years' professional experience in the management and delivery of greenhouse gas and climate change assessments across the UK and Ireland. He has led the climate impact and mitigation strategy assessment studies for inclusion in EIA and ESIA on a range of climate impact assessments for large scale infrastructure projects, industrial and residential development.

EIAR Chapters/ Role	Consultant	Qualification/ Summary of Relevant Experience
16 Waste	Mike Bains (AECOM)	Technical Director, BSc (Hons), CChem MRSC Mike Bains has 24 years' experience in environmental consultancy, predominantly in the field of waste management in Ireland, the UK and internationally. He has been subject-matter expert for waste management in a large number of major projects, including nationally significant infrastructure projects in the UK. Mike is also experienced in waste management in the pharmaceutical sector.
17 Materials Assets	Niamh O'Connell (AECOM)	*As Above.*
18 Interactions	Adèle Wratten (AECOM)	*As Above.*
19 Schedule of Mitigation Measures	Adèle Wratten (AECOM)	*As Above.*

1.11 References

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Delivering a better world

CHAPTER 02
Project Description

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park
Environmental Impact Assessment Report

Table of Contents

Figures

Tables

2. Project Description

2.1 Introduction

This chapter describes the design, construction, operation, commissioning and decommissioning of the Proposed Development. It should be read in conjunction with the drawings in Volume 3 of the EIAR. The chapter provides an overview of the following:

- Site Location and Area Land Use (Section 2.2);
- Shannon Estuary Navigation and Port Operation (Section 2.3);
- Main Features of the Proposed Development (Section 2.4);
- Discharges and emissions (Section 2.5);
- Site Management (Section 2.6);
- Process Control and Monitoring (Section 2.7);
- Health, Safety and Environmental Aspects (Section 2.8);
- Construction Phase including environmental protection measures (Sections 2.9);
- Commissioning Phase (Section 2.10); and
- Decommissioning (Section 2.11).

2.2 Site Location and Area Land Use

The Proposed Development site is shown in Figure 2-1 (below) and Figure F2-1, Vol. 3. The Proposed Development site is located within the boundary of two townlands: Kilcolgan Lower and Ralappane, Co. Kerry.

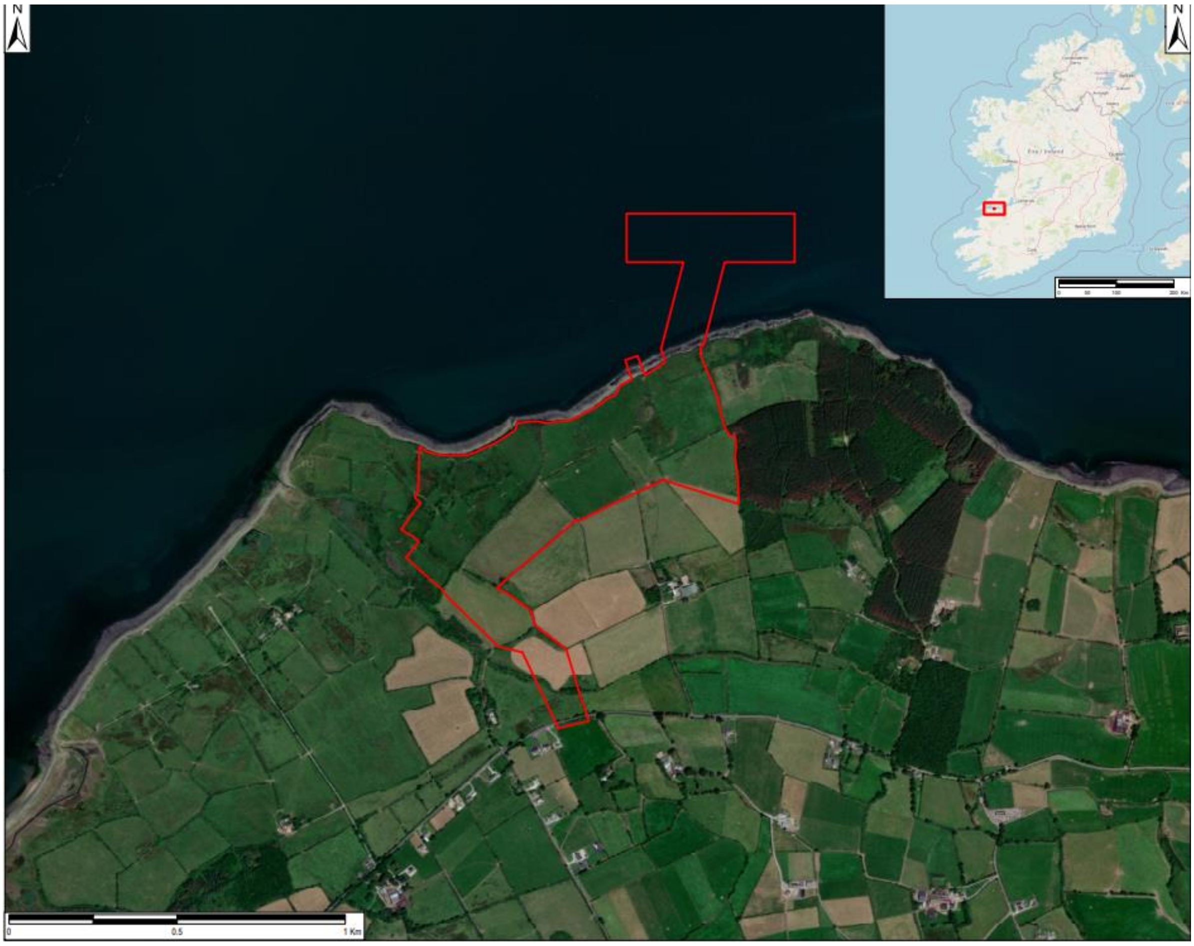

Figure 2-1 Site Location

The Proposed Development will be located on the Shannon Estuary, approximately 4.5 km from Tarbert and 3.5 km Ballylongford in the townlands of Kilcolgan Lower and Ralappane, Ballylongford, Co. Kerry. The site for the Proposed Development is 52 hectares (ha) (including both the onshore and offshore elements). The Shannon Landbank on which the site is located has a total area of 243 ha. The Proposed Development site is zoned for marine-related industry use by Kerry County Council (KCC) (County Development Plan 2015-2021), and has been identified as a Strategic Development location in the Shannon Integrated Framework Plan 2014-2020, the Regional Spatial and Economic Strategy (RSES) for the Southern Region 2020, the Kerry County Development Plan 2015-2021, and the Listowel Municipal District Local Area Plan 2020 (refer to Chapter 04 – Policy (Energy and Planning) for further detail).

The Proposed Development site has access to deep water (approximately > 13 m depth) in the Shannon Estuary, which is suitable for navigation by large vessels. Given the natural depth of the water, no dredging is required for the Proposed Development. The Proposed Development site is also close to national gas and electricity transmission grids; 220 kilovolt kV and 110kV electrical transmission are available from the Electricity Supply Board Network (ESBN) / EirGrid Kilpaddoge 220 kV substation located approximately 3 km east of the Proposed Development site and a Gas Network Ireland (GNI) owned gas transmission pipeline located approximately 26 km east of the Proposed Development site, presenting a suitable location for an liquified natural gas (LNG) terminal and power plant. Planning permission exists for the development of a 26 km 30" natural gas pipeline which will facilitate connection from the Proposed Development site to the GNI transmission network at Foynes in Leahys, Co. Limerick.

The Lower River Shannon Candidate Special Area of Conservation (cSAC) is partly within and adjacent to the site along the northern/ north-western boundary and also along part of the eastern boundary (see Figure F7-1, Vol. 3). The Ballylongford Bay proposed Natural Heritage Area (pNHA) is located adjacent to a part of the north-western boundary of the Proposed Development site. The Shannon-Fergus Estuary Special Protection Area (SPA) is to the west of the Proposed Development site (at a distance of approximately 750 m from the western extremity of the terrestrial elements of the Proposed Development site). The jetty will extend into the Lower River Shannon cSAC and the River Shannon and River Fergus Estuaries SPA. Refer to Figures 7-1 and 7-2 in Chapter 07B – Terrestrial Biodiversity for the locations of these designated areas.

The Proposed Development site is in pasture, comprising primarily improved grassland with some wet grassland adjacent to the Shannon Estuary, as shown on the aerial photograph in Figure 2-2.

Figure 2-2 Proposed Development Site

The Proposed Development site is currently drained by a number of shallow drainage channels. Several longer drainage features cross the southern portion of the Proposed Development site, generally flowing in a west or northwest direction. The drainage features along the access road all ultimately drain to a single surface water course, the Ralappane Stream, which discharges into the Shannon Estuary. The Proposed Development site is bordered to the north by the Shannon Estuary and to the south by the Coast Road L1010, connecting Tarbert to Ballylongford. Fields in pasture and forestry lie beyond the eastern boundary and the Shannon Development Landbank extends westward beyond the Proposed Development site's western boundary.

The topography of the land within the Proposed Development site is generally undulating. Some of the fields are waterlogged in wet weather and there are pockets of marshy ground. There are a number of old disused farm buildings and structures on the Proposed Development site.

The Strategic Integrated Framework Plan for the Shannon Estuary (SIFP) is the inter-jurisdictional land and marine based framework to guide the future development and management of the Shannon Estuary. The SIFP states:

'*Ballylongford benefits from a significant deepwater asset and extant permission for a major LNG plant, the availability of natural gas, the proximity to the national grid and the potential for refrigeration from the regasification process, combined with the additional physical infrastructure in terms of roads and water. This makes the lands a very attractive location for other industries to locate in the future. There is also potential for gas fuelled electricity generation in the future. The SIFP proposes a Strategic Development Location around the Tarbert-Ballylongford complex to accommodate further development of the energy infrastructure and allow for economic development that will be attracted to such a significant site by virtue of its energy provision and deepwater facilities*'.

The Proposed Development site is currently owned by Shannon Commercial Enterprises DAC (formerly Shannon Free Airport Development Company Limited) registered at Shannon Airport, Co. Clare. The Applicant has entered into an agreement for the purchase of the land from Shannon Commercial Enterprises DAC.

There are a small number of residential properties located within 500 m of the onshore facilities on the Proposed Development site. Residential properties are also located along the existing L1010 (Coast Road) immediately south of the Proposed Development site, with additional residential properties to the east and west along the L1010.

Tarbert Power Station is located approximately 5 km to the north east of the Proposed Development site, with Moneypoint Power Station located on the northern shore of the Shannon Estuary, approximately 3 km to the north of the Proposed Development site.

2.3 Shannon Estuary Navigation and Port Operation

The Shannon Estuary comprises 500 square kilometres (km^2) of navigable water extending from Loop Head, in Co. Clare, and Kerry Head, in Co. Kerry, eastwards to the city of Limerick, a distance of 100 km. The naturally occurring deep and sheltered waters of the estuary are connected to the Atlantic Ocean and are accessible to large ocean-going vessels of varying types and sizes of up to 185,000 dwt (deadweight tonnes).

Within the estuary there are existing port facilities currently handling approximately 850 ships per year amounting to a total of 10 million dwt of shipping activity:

- Shannon Airport fuel jetty – 20 ships/ year, typically 6,500 dwt ships;
- Limerick Port – 220 ships/ year, typically 5,000 dwt general cargo ships;
- Aughinish Alumina – 50 ships/ year, typically over 75,000 dwt Panamax bulkers (bauxite import) and 220 ships/ year to 40,000 dwt (caustic import, process materials and supplies import and alumina export);
- Foynes Port – 325 ships/ year, typically from 4,000 to 50,000 dwt general cargo ships, bulk carriers and petroleum and chemical tankers;
- Tarbert Power Station (oil) – 4 ships/ year, typically 150,000 dwt bulkers and up to 185,000 dwt maximum size; and
- Moneypoint Power Station (coal) – 4 ships/ year, typically 150,000 dwt bulkers and up to 185,000 dwt maximum size.

Recently there has been an increase in Post Panamax Vessels, Oil Tankers in addition to Mini Cape and Cape size vessels.

Limited small vessel traffic includes local trade to Cappagh pier near Kilrush, with no ships recorded in recent years, though Kilrush has a large marina. A regular vehicle ferry service operates across the estuary between Tarbert on the south shore and Killimer on the north. Mariculture is a feature of the estuary.

Recreational marine activities include dolphin watching with over 500 trips per annum (see Marine Navigation Risk Assessment in Appendix A2-2, Vol. 4) operating out of Carrigaholt and Cappa. The Shannon Estuary is a cSAC) and is home to more than 100 bottlenose dolphins (which are one of the qualifying interests of the site).

Shannon Foynes Port Company (SFPC) is responsible for all maritime activities on the estuary. The Harbour Master & Pilotage Superintendent has authority over all matters related to pilotage, direction to vessels and movement of vessels. There are a total of 68 lights and shapes in the Shannon Estuary, making SFPC the second largest lighthouse authority in Ireland after the national authority. British Admiralty charts are used in Ireland, the relevant Shannon ones being numbers 1547, 1548 and 1819.

All vessels entering the Shannon have to cross the Ballybunion Bar, clearance over which is regulated for deep draught (>17 m) vessels. A wave rider buoy is positioned on the bar to provide real time information on the height of the swell which is used by SFPC in a customized computer programme to present 'go/ no-go' information. The maximum draft[1] of the proposed LNG ships is approximately 13 m, which will not pose any problems at the bar. The Atlantic swell is not experienced inside the Shannon Estuary and wind generated waves are restricted by the length of fetch available.

[1] The distance between the surface of the water and the lowest point of the vessel.

From Ballybunion Bar, the Beal Bar Channel leads into the estuary where arriving vessels transiting east, pass to the south of Scattery Island. Designated anchorages are available to the north of the main channel for vessels waiting to transit to berths upriver at Foynes and Limerick.

Port operations are managed on International Organization for Standardization (ISO) methods and a formal risk assessment is carried out for all trades. A Vessel Traffic Management Information System (VTMIS) employing three radar stations is able to observe, record and replay traffic movements in the estuary.

There are eight First Class Pilots licensed by the Port Authority who operate from Cappa Pier employing a 15 m, 20 knot pilot boat. The pilot boarding position varies depending upon the size of ship and for large displacement/ deep draught vessels the boarding station is outside Ballybunion Bar. Pilots can monitor some types of vessels on radar and talk/ guide them into the shelter of the Estuary on a shore-based pilot system if the weather is too bad for safe pilot boarding. Pilots regularly carry Pilot Portable Units (PPUs) which will operate independently of ships' navigational equipment and assist pilots in the safe navigation and berthing of ships.

The tidal range in the Estuary is 4.5 m and the maximum observed current is approximately 4 knots on the spring ebb off Moneypoint jetty. The prevailing winds are from the west and south west and seldom reach hurricane force within the Shannon Estuary. An average of 9.8 days/ year experience gales, and 32 days/ year experience fog.

Two tugs are based at Foynes and are available to assist vessels berthing and sailing at all the existing facilities in the Estuary, however they are not suitable for the Proposed Development due to limited size and power. Appropriate tugs will be sourced by the Proposed Development and licensed separately by the Port Company. Mooring boats and gangs are independently contracted to terminal owners and ship operators.

SFPC is charged with oil pollution prevention and control in compliance with Irish national and international legislation and has established a response team with locally interested parties. The team carries out annual exercises to ensure readiness and swift reaction to any incident. Also, as required by legislation, SFPC in cooperation with the local authorities, the Irish Coast Guard and port users has developed a Marine Emergency Response Plan for the entire Shannon Estuary.

2.4 Main Features of the Proposed Development

The Proposed Development will comprise the following components:

1. A Power Plant;
2. A LNG Terminal;

These components are described in the following sections and shown in Figure 2-3 and Appendix A2-1, Vol. 4. The layouts are provided in Volume 3.

Figure 2-3 Proposed Development Site Layout

2.4.1 Power Plant

The proposed Power Plant, as shown in Figure 2-4, will comprise:

- Three (3) blocks of Combined Cycle Gas Turbines (CCGT), each block with a capacity of approximately 200 megawatts (MW) for a total installed capacity of up to 600 MW (See Section 2.4.1.1);
- Battery Energy Storage System (BESS) (See Section 2.4.1.2);
- High voltage 220 kV Substation (See Section 2.4.1.3);
- Auxiliary Boiler (See Section 2.4.1.4);
- Raw water treatment building (See Section 2.4.1.6.1);
- Firewater storage tanks and fire water pumps (See Section 2.4.3.1.4);
- Fuel storage (See Section 2.4.1.7); and
- Ancillary buildings common to both the Power Plant and LNG Terminal (See Section 2.4.3).

Figure 2-4 Proposed Power Plant at the Proposed Development Site

The Power Plant will be operated using natural gas as its primary fuel, and generate power exported via the 220 kV connection to the national electricity grid. It will also provide electricity for its own needs and for those of the LNG Terminal. The 220 KV connection will have to be installed prior to commencing operation of the Power Plant, as such it is anticipated that the Power Plant will be constructed in parallel with the 220 KV grid connection.

The Power Plant is designed to operate alongside intermittent renewable electricity power generation and is expected to mainly operate at full capacity during periods of low renewable supply, and otherwise to be turned down or turned off. For example, during periods of high wind (renewable) generation it is expected that the Power Plant will be turned off by the system operator (EirGrid) to give priority to renewable power. Similarly, during periods of sudden low renewable generation, the system operator will call on the Power Plant to be ramped up to supply electricity. Due to the design of the CCGT with low minimum generation and the economic advantage of the Power Plant relative to other facilities, it is expected that the Power Plant would be called on earlier by the system operator than other gas plant. A battery system (BESS, see below) will provide electricity into the grid as the Power Plant is being ramped up. Once the Power Plant is up and running the supply from the BESS will be switched off.

The Power Plant will have an installed capacity of up to 600 MW and will be designed in accordance with best available techniques (BAT) for large combustion plants, industrial cooling systems, energy efficiency and emissions from storage.

The fuel supply to the Power Plant will normally be from the LNG Terminal, but it can also be powered from the gas grid via reverse flow through the Above Ground Installation (AGI) as defined in Section 2.4.2.6.

The Power Plant will use up to 2.8 million Sm^3 per day[2] (approximately 25.5 GWh per day) when operating at full capacity. The LNG Terminal will have sufficient capacity to supply gas requirements for the Power Plant.

It is not intended that diesel will be used as a secondary fuel for the Power Plant. However, small amounts of diesel fuel will be available onsite for the emergency power generators. Consequently, the Proposed Development, unlike most other large power plants in Ireland, will not store and combust large quantities of LNG. Avoiding storing, and combusting, large quantities of LNG on site significantly reduces safety and environmental risks. Refer to Section 2.4.1.7 for further discussion.

[2] Million Sm^3/d = Million Standard cubic metres per day of natural gas: cubic metre natural gas at 101,325 Pa and 15°C, dry

A small amount (approximately 20 MW) of the electricity generated by the Power Plant will be used in the LNG Terminal, and in the operation of the Power Plant itself. The balance of the electricity produced is intended for the market and will be sold into the integrated Single Electricity Market (iSEM).

The electricity generated by the Power Plant will be exported through a new substation located between the Electricity Generation Facility and the LNG Terminal. It is anticipated that the new substation will be connected to the 220 kV transmission grid at the ESBN / EirGrid Kilpaddoge 220 kV substation but the location and precise nature of the connection are subject to further discussions between the Applicant and EirGrid and do not form part of the scope of this EIAR. The new substation and grid connection are assessed in the cumulative impact assessment within each technical chapter.

The Power Plant will use CCGT technology (see description in 2.4.1.1 below), and its design will comply with all relevant national and international codes.

The contract to supply and construct the Power Plant will be awarded following a commercial tendering process prior to the start of construction. The tendering process will result in a contract for a particular model of electric generation plant. Therefore, the precise size, configuration, performance, and layout of the equipment will be finalized following the award of the contract and a site-specific detailed design process, however this will not affect the design of the buildings or emissions as described in this EIAR. The construction contract will identify a preferred Contractor to construct the Proposed Development, in accordance with the mitigation and monitoring measures set out in this EIAR. The Client (the Applicant) will administer the construction contract and liaise with the Local Authority to discharge planning conditions as appropriate.

Further descriptions of the main features of the Power Plant are outlined in the following sections.

2.4.1.1 Combined Cycle Gas Turbine Power Block Description

The Power Plant will contain three blocks with one CCGT, each block with a nominal capacity of up to 200 MW (Figure F2-2, Vol.3). The multi-shaft arrangement of each block will provide fast acting response, such as will be required in a system with a low level of stable generation, and is therefore ideally suited to support a high level of intermittent renewable power generation.

Each block will comprise:

- Two gas turbines with generators;
- Two heat recovery steam generators with exhaust stacks;
- One steam turbine;
- Electricity generator;
- One air-cooled condenser;
- Air-cooled heat exchanger (6 m x 2.6 m);
- Generator step-up transformer (GSU);
- Natural gas fuel system;
- Turbine Hall;
- Condenser Polisher Equipment Enclosure;
- Air-cooled condenser (ACC) Air Extraction and Equipment Enclosure; and
- High voltage electrical switchgear and 220 kV substation.

Each proposed power block will use the following process:

- The gas turbine burning natural gas will be connected to a generator for electricity production;
- Exhaust gases from the gas turbine will pass through two heat recovery steam generators to generate steam;
- The steam generated will be routed through a steam turbine, which will also be connected to a generator to produce further electrical power;

- The spent steam exiting the steam turbine will then be directed into the air-cooled steam condenser. The resulting condensate will then be pumped back into the heat recovery steam generator to repeat the steam cycle; and
- Power from the three generators will be combined and the voltage increased to the export voltage by the generator step-up transformer (GSU).

A schematic of the power generation process is presented in Figure F2-3 in Volume 3.

The electricity generated will be fed to a set of transformers where the voltage will be stepped up to the transmission voltage, specified by EirGrid in the, yet to be issued, interconnection offer.

2.4.1.1.1 Gas Turbine Generator (6 m x 15 m)

The gas turbine will consist of an air compressor, a combustion chamber, and a turbine. The air compressor will take in large quantities of filtered air from the atmosphere and compress it. Fuel gas and compressed air will then be injected into the combustion chamber and the fuel/ air mixture ignited. The addition of heat energy and combustion gases in the combustion chamber will raise the temperature of the combined gases to over 1,300 °C. The hot gases will expand through the turbine section. The high velocity gas passing through the turbine will spin the main shaft which drives both the air compressor, which will produce the compressed air, and the generator, which will produce the rated electrical power output. The expansion of the hot gases passing through the turbine, and the extraction of mechanical work from them via the turbine will reduce the temperature of the gases to less than 600°C.

The gas turbine will be coupled to a generator for power generation at 50 hertz (Hz).

2.4.1.1.2 Heat Recovery Steam Generator

A gas turbine, as described above, is referred to as operating in open or simple cycle mode. It will be possible to generate approximately 50% more electricity by operating in combined cycle mode. In combined cycle mode the hot exhaust gases leaving the gas turbine will be directed through the Heat Recovery Steam Generator (HRSG), which will extract heat to make steam. The heat recovery steam generator will be multi-pressure type. The temperature of the hot combustion gases will be reduced in this process to less than 100°C.

The HRSG will discharge the exhaust gases to atmosphere through an integral exhaust stack exiting at approximately 35 m above ground.

2.4.1.1.3 Steam Turbine Generator

Water supply for the heat recovery steam generator is discussed in Section 2.4.6.2. The water treatment facility will provide demineralized water for steam cycle makeup to each CCGT block.

The high-pressure steam produced by the HRSG will flow through inter-connecting pipework to the steam turbine. The steam turbine will be of a multiple stage type suitable for coupling to a generator for power generation at 50 Hz. The low-pressure exhaust steam will flow out of the steam turbine to the ACC.

2.4.1.1.4 Air Cooled Steam Condenser (48.6 x 55.8 m)

The ACC will be of a standard design. Steam from the steam turbine will enter the ACC and pass through air-cooled fin tubes. The steam will not be in direct contact with the air. The heat is transferred from the steam to the surrounding ambient air, which leads to the steam condensing. This condensate represents boiler quality feed water. The condensate will then be returned to the HSRG in a closed loop. i.e. condensate will not be discharged to the environment. The key advantage of an air-cooled steam condensers is that cooling water and associated systems are not required.

Non-condensable gases (i.e. air ingress into the ACC) will be removed from the ACC by use of vacuum pumps located in an equipment enclosure near the ACC. The condensed steam will be collected in the condensate collection tank located below the ACC where it is pumped by the condensate pumps back to the HRSG through the condensate polisher (whose purpose is to remove impurities and reduce corrosion in the water/ steam cycle). The condensate polisher is located in an equipment enclosure near the condensate pumps.

2.4.1.1.5 Generator Step-up Transformer (GSU) (10 m x 10.4 m)

Power from the gas turbine and steam turbine generators will be collected at the generator voltage level and will be connected to the 220 kV GIS substation through one generator step-up transformer for each of the three blocks.

2.4.1.1.6 Natural Fuel Gas System

The gas used to fuel the Power Plant will be supplied from the LNG Terminal via the metering and regulating station at a pressure suitable for the specific gas turbine equipment selected. This fuel gas will pass through gas conditioning equipment dedicated to each block/ gas turbine that is anticipated to be comprised of:

- Filter separator;
- Performance heater;
- Final pressure control station; and
- Gas quantity and quality measurement as required for performance management and environmental protection monitoring.

2.4.1.1.7 Buildings Within Each CCGT Block

Each CCGT Block will include the following buildings and enclosures to house the main plant equipment noted above:

- Turbine hall (65 m x 93 m);
- Condenser Polisher Equipment Enclosure (6.3 m x 16.3 m);
- ACC Air Extraction and Equipment Enclosure (8.5 m x 12.2 m); and
- Air Cooled Condenser Electrical Power Distribution Centre .

These are described in the following sections.

The buildings will be constructed using two main building methods:

- Type 1 will be used for all buildings with the exception of the PDC. These will be steel framed buildings with concrete floor slabs; and
- Type 2 will be used on the PDC. This building will be a pre-manufactured metal equipment enclosure using a steel base and framing to form an all-weather enclosure. The enclosure will be mounted on steel support legs or concrete piers to elevate the enclosure and allow bottom entry for electrical/ control wiring.

Structural and architectural details have been prepared including particulars of the shallow and deep foundations, lifting equipment, steel structures, and protective coatings. The paint colours of the buildings will be selected to minimise the visual impact of the Power Plant. This is discussed further in Chapter 10 – Landscape and Visual Impact. Landscape drawings are provided in Figure F2-4, Vol. 3.

Turbine Hall (65.9 m x 93.7 m)

This building will house the combustion turbine generator (CTG), HRSGs, STG and other balance of plant systems required for a complete CCGT Block. The turbine hall will accommodate the selected OEM’s recommended component layout, including laydown and maintenance requirements within the building. A bridge crane will be provided for steam turbine maintenance while the gas turbines are each supplied with an overhead crane for maintenance and removal of the gas turbine engine. The building will have internal rooms to house the necessary electrical and control equipment required for each CCGT Block including a stand-by diesel generator. The diesel fuel tank for stand-by diesel generator will be stored in a bunded area, or in a double walled tank.

Condenser Polisher Equipment Enclosure (6.3 m x 16.3 m)

The condenser polisher equipment enclosure will house the condensate polisher associated with the ACC, as described in Section 2.4.1.1.4.

Air-Cooled Air Extraction and Equipment Enclosure (12.8 m x 15.3 m)

This enclosure will house the electrical breakers and motor control centres (MCC) associated with the ACC.

Air Cooled Condenser Electrical Power Distribution Centre (8.5 m x 12.2 m)

Three PDCs will house electrical and control equipment necessary to distribute power and control throughout the Power Plant. Each PDC will be a pre-manufactured all-weather steel enclosure. The enclosure will be mounted on steel support legs or concrete piers to elevate the enclosure and allow bottom entry for electrical/ control wiring.

2.4.1.2 Battery Energy Storage System Equipment (33.9 m x 163 m)

A 120 MW 1-hour (120 megawatt hour (MWh)) BESS is included in the Proposed Development. The BESS will comprise 27 battery containers, approximately 4.5 MWh each, containing lithium ion batteries. Each battery container is paired with two power conversion system (PCS) skids that contain the electrical systems (inverters, etc.) to deliver the power from the batteries to the grid via a 220 kV generator step-up transformer. Due to its fast response, the BESS allows the power Station to provide electricity during ‘ramp up’ and supports intermittent renewable generation. This was also discussed in Section 2.4.1.1 above.

Once the Power Plant is operating at the necessary capacity the electrical demand is met, the BESS will be shut down and recharged.

2.4.1.3 High Voltage 220 kV Substation (18 m x 60.9 m)

A high voltage 220 kV substation is included in the Proposed Development. The substation will be gas insulated (GIS) and enclosed in a building. The substation will accept the 220 kV output from each CCGT Block and BESS and connect to the national electricity grid. When the Power Plant is not in operation, power from the national electricity grid will backfeed to the Power Plant via this same grid connection.

This Power Plant GIS substation will in turn route power to the LNG Terminal, even when the Power Plant is shutdown.

2.4.1.4 Auxiliary Boiler (within Auxiliary Boiler Building, 14.3 m x 14.3 m)

An auxiliary boiler will be included in the Proposed Development. The auxiliary boiler will burn natural gas, be of a standard design and be enclosed in a building with a separate 32 m high exhaust stack. Steam from the auxiliary boiler will be used by the Power Plant to keep the equipment warm which allows for faster start up to support intermittent renewable generation.

2.4.1.5 Raw Water Storage Tanks (24 m x 18 m)

Water used by the Power Plant will be supplied from the potable water connection. This raw water will be stored in two raw/ service/ fire water storage tanks. The tanks will supply service water to the Power Plant and raw water to the water treatment facility with reserve storage for fire water. The tanks will be field fabricated welded steel tanks.

2.4.1.6 Buildings

The Power Plant will also include the following buildings, common to the three CCGT Blocks and BESS operations:

- Water treatment building;
- Administration building;
- Central control/ operations building;
- Auxiliary boiler building;
- Workshop/ stores/ canteen building; and
- Firewater pumps enclosure.

Buildings and enclosures common to both the Power Plant and LNG Terminal are described in Section 2.4.3.

2.4.1.6.1 Water Treatment Building (18 m x 35 m)

The water treatment building will make demineralized water for steam cycle makeup to each CCGT Block. The demineralized water will be stored in two demineralized water storage tanks (15.5 m x 13 m) which will be field fabricated welded steel tanks.

2.4.1.6.2 Administration Building (14 m x 22.7 m)

The administration building will include offices, training rooms and meeting rooms for the administrative personnel stationed at the Power Plant.

2.4.1.6.3 Central Control/ Operations Building (14 m x 22.7 m)

Operation of the Power Plant will be monitored and controlled from the central control/ operations building. This building will include a control room, meeting room and offices for the operations personnel stationed at the Power Plant. The Power Plant will be operated from the main control room (MCR),. From the MCR it will be possible to monitor and adjust all of the plant equipment and instrument control systems including all safety control systems.

2.4.1.6.4 Auxiliary Boiler Building (14.3 m x 14.3 m)

This building will house the auxiliary boiler stack.

2.4.1.6.5 Workshop/ Stores/ Canteen Building (14 m x 52.3 m)

The workshop/ warehouse/ canteen building will provide storage for equipment and material spares required to maintain an operational facility. The building will also have maintenance offices, a workshop area and canteen.

2.4.1.6.6 Firewater Pumps Enclosure (4.5 m x 10.5 m)

Both the Power Plant and LNG Terminal will house a firewater pumps enclosure.

2.4.1.7 Fuel Storage

A mandate to store defined quantities of fuel onsite is specified in ‘Secondary Fuel Obligations on Licensed Generation Capacity in the Republic of Ireland’ (CER/09/001), was issued by the CER (now CRU) on 12th January 2009. For power plants, the storage requirement totals one day’s worth of fuel consumption, calculated assuming the Power Plant is operating at its maximum capacity. After consultations between the CRU and the Applicant, the CRU has agreed that fuel storage requirements can be met by storing five days’ worth of LNG in the FSRU LNG storage tank(s). Avoiding storing large quantities of liquid fuel on site significantly reduces safety and environmental risks as well as increasing the Power Plant’s reliability.

2.4.2 The LNG Terminal

The proposed LNG Terminal will comprise (Figure F2-2, Vol.3):

- An LNG ship in the form of a FSRU, with LNG storage capacity of approximately 170,000 m^3 (up to 180,000 m^3). This EIAR considers a capacity of up to 180,000 m^3. The FSRU is a ship that can store LNG onboard, and which also is fitted with an onboard regasification unit which can return stored LNG into a gaseous state. The ship will be up to 300 m long and up to 50 m wide and the height of the vessel including the top of the exhaust stack will be approximately 50 m above sea level. The FSRU will be an existing suitably classified marine vessel that will be modified to ensure it operates in accordance with the terms of the Planning Permission, the Industrial Emissions Licence and all the other relevant statutory approvals required for its operation. Further details of the FSRU is provided in Section 2.4.2.1 below;
- A jetty with an access trestle, with the jetty comprising an unloading platform, mooring dolphins and breasting dolphins with capacity to accommodate up to four tugs. They will facilitate safe mooring operations for the FSRU and visiting LNG carriers as required. Further details are described in Section 2.4.2.2 below;
- Onshore receiving facilities including a nitrogen generation facility, a control room, a security building, workshop and maintenance buildings, instrument air generator, backup power generators fire water system. Further details are described in Section 2.4.2.5 below; and
- An Above Ground Installation (AGI) to include an odourisation facility, gas heater building, chromatography, gas metering and pressure control equipment. The AGI will facilitate the export of LNG to the national gas transmission network via the already consented 26 km 30” Shannon Pipeline. Further details are described in Section 2.4.2.6 below.

LNG will be delivered to the LNG Terminal by a visiting LNG Carrier (LNGC) which will be moored to the seaward side of the FSRU.

A detailed description of the main characteristics of the LNG Terminal are outlined in the following sections.

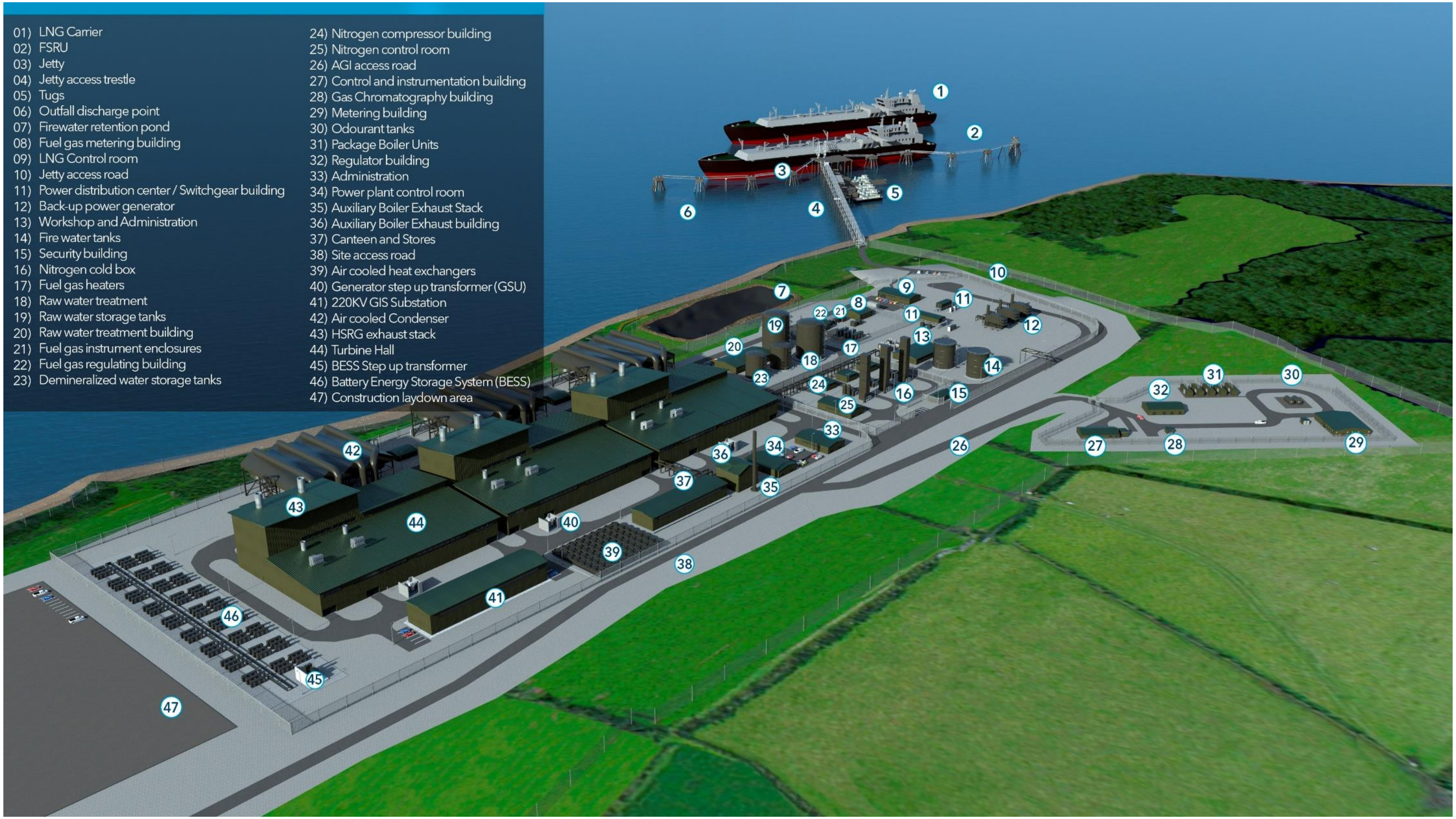

Figure 2-5 Proposed Layout of the Proposed Development

2.4.2.1 Floating Storage Regasification Unit

The FSRU will be berthed at the jetty. Being an oceangoing vessel, the FSRU will have approximately 35 crew members onboard and will be operating under all relevant national and international maritime rules. Further information on the emissions and waste from the FSRU are provided in Section 2.5.

The FSRU will be connected to onshore receiving facilities except when disconnected due to adverse weather conditions, during planned yard maintenance and in the event of emergencies (see planning application drawings for details).

LNG vaporisation process equipment to regasify the LNG to natural gas will be onboard the FSRU. Heat energy necessary for regasification of LNG will be derived from locally drawn seawater, supplemented by gas fired heaters for use during periods when the water temperature is inadequate.

At the time of writing this EIAR, the charter agreement for a specific FSRU for the LNG Terminal at Shannon Technology and Energy Park has not been completed. Therefore, the exact characteristics, equipment layout and details of the technical systems which form an integral part of the FSRU are not known. For the purposes of the EIAR, a worst-case scenario in terms of emissions and the potential for environmental impact, has been derived from a review of a range of vessels on the market from various FSRU suppliers.

The FSRU is anticipated to have an LNG storage capacity of approximately 170,000 m^3 (up to 180,000 m^3), with 180,000 m^3 representing the maximum amount of LNG to be stored. The FSRU will be up to 300 m long and up to 50 m wide with a maximum draft of 13 m. In a deep water channel (approximately 20 m) the FSRU will be located at a nominal depth of 12 m. See Figure 2-6.

The FSRU will float on the water, hence its height will vary due to tides, the amount of LNG cargo onboard and ballasting operations. For example, at mid tide and with a Scantling Draft water line, the top of the highest structure on the FSRU (its communication mast) will be 46.0 m above Ordnance Datum. During Mean High Water Spring (MHWS) tides and with the FSRU unladen (at ballast draft) the height of the FSRU will be 51.4 m above Ordnance Datum. Regardless of tides, cargo and ballasting, the physical height of the FSRU structure as measured from bottom of the hull to the top of the highest structure will be 58.9 m.

The FSRU will be double-hulled and contain LNG cargo tanks designed for storing LNG at very low temperatures, i.e. approximately -163ºC. The tanks will be lined with specialised membranes to allow the storage of chilled LNG. The low temperature and the insulation will keep the LNG cargo in a liquid state until it is required for regasification.

The LNG vaporisation equipment onboard the FSRU will be designed to meet a send-out capacity of up to 22.6 million Sm^3/d (approximately 250 GWh per day) natural gas. Additional information is outlined in Section 2.4.2.1.1 below.

When the FSRU's LNG tanks are empty,[3] another ship will arrive to fill the FSRU. Visiting ships, known as LNG Carriers, will moor alongside the FSRU and refill the FSRU storage tanks via ship-to-ship transfer. The refilling process will take approximately 35 hours, after which the visiting LNG carrier will depart. Further information on this is provided in Section 2.4.2.4 below.

The FSRU will be self-sufficient in terms of producing the necessary electricity and heat to run the ship's systems and the LNG storage and vapourisation process. The vessel will use electricity to power pumps, the regasification equipment, auxiliary systems and for the crew accommodation. Generators will be powered by dual-fuel engines which will use boil-off natural gas from the LNG storage tanks as main fuel. As a pilot fuel, the engines will burn a small amount of marine diesel oil (MDO), estimated at up to 1 m^3/day at maximum.

In the event of an onshore emergency, the FSRU will be disconnected, and its mooring lines automatically released from the jetty, enabling the FSRU to sail quickly to a safe area.

A Process Control System (PCS) and an associated Fire and Gas (F&G) and Emergency Shut-Down (ESD) System will be in place to ensure the integrity of the facility and the safety of personnel. Should

[3] Note that a minimum of 18,500 of LNG will always remain in the FSRU LNG tanks to comply with operational and secondary fuel storage obligations

a loss of containment of natural gas and/ or a fire occur, the F&G System will detect the incident and trigger the operation of the active fire protection system and the ESD system.

The FSRU will operate in accordance with international conventions on safe navigation, i.e. conditions that have been established by the SOLAS Convention and other international conventions accepted within the International Maritime Organization (IMO). Additional information on permitting is outlined in Section 1.5.5 of Chapter 01 – Introduction.

The FSRU will also meet all the relevant requirements of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code), as amended (IMO, 1986).

The specification of the FSRU is presented in Table 2-1. The EIAR has considers the maximum values for the purpose of the impact assessments.

Table 2-1 Specification of the Floating Storage Regasification Unit FSRU

	Minimum	Maximum
LNG Storage capacity (m^3)	130,000	180,000
Length (m)	250	300
Width (m)	43	50
Draught (m)	9.0	13
Crew capacity	20	35
LNG storage tank type	Spherical or membrane	
Peak day LNG send out capacity	22.6 million Sm^3/d	

2.4.2.1.1 Liquid Natural Gas Vaporisation Process

When natural gas is needed downstream of the LNG Terminal, i.e. in the gas transmission network, or at the Power Plant, LNG stored onboard the FSRU will be vapourised or regasified onboard the FSRU. The natural gas will then be discharged under pressure via Gas Loading Arms (GLAs) to gas piping on the jetty and onwards to the onshore receiving facilities. From there the gas is routed to the Power Plant, LNG Terminal gas turbine generator and/ or GNI's gas transmission network at the AGI.

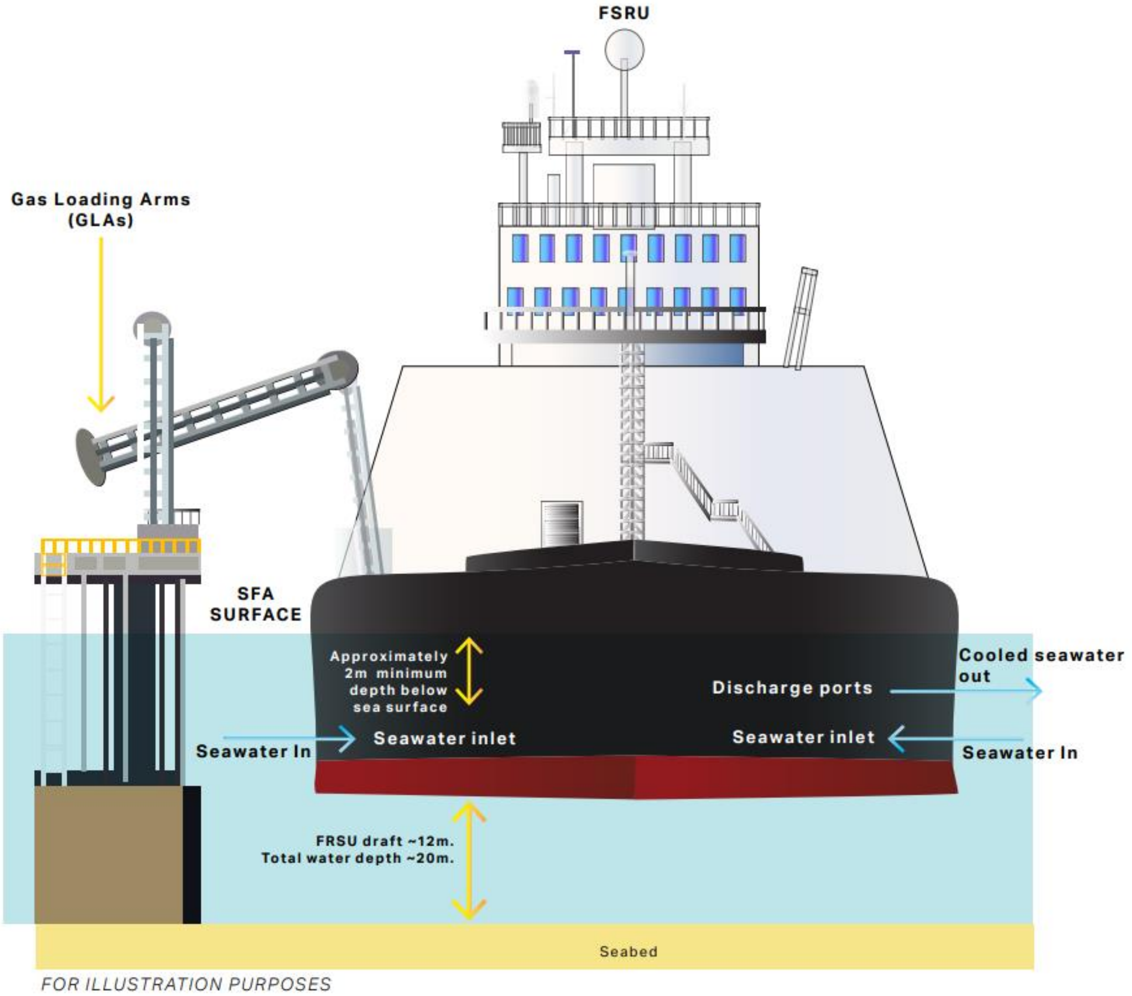

Figure 2-6 FRSU Overview

The onboard regasification unit will have several regasification trains operating in parallel. This enables a degree of turndown, i.e. delivery of varying rates of gas to shore, with the minimum throughput capacity of a single regasification train representing the minimum flowrate and the maximum throughput rate of all of the trains operating simultaneously representing the maximum discharge rate from the FSRU. The number of trains that will be in use at any one time depends on the gas demand. Generally, it is anticipated that the FSRU will be operating with one or two regasification trains running, representing low to medium throughput rates.

The intake and discharge of seawater will be required for the regasification process. Details on the seawater volume, treatment and discharged are presented in Section 2.4.2.1.2.

Seawater needed for the regasification process will be drawn through a seawater intake in the hull of the FSRU located approximately 2 m below water level. Seawater pumps will circulate the seawater at the required rates through heat exchangers in the FSRU regasification trains. The heat exchangers rely on two phases of heat exchange process:

- Between seawater (as the heat source) and an intermediate fluid (for example propane); and
- Between the intermediate fluid and the LNG.

The pumps will be turned on or off as required based upon the number of regasification trains running.

Two modes of regasification will be employed.

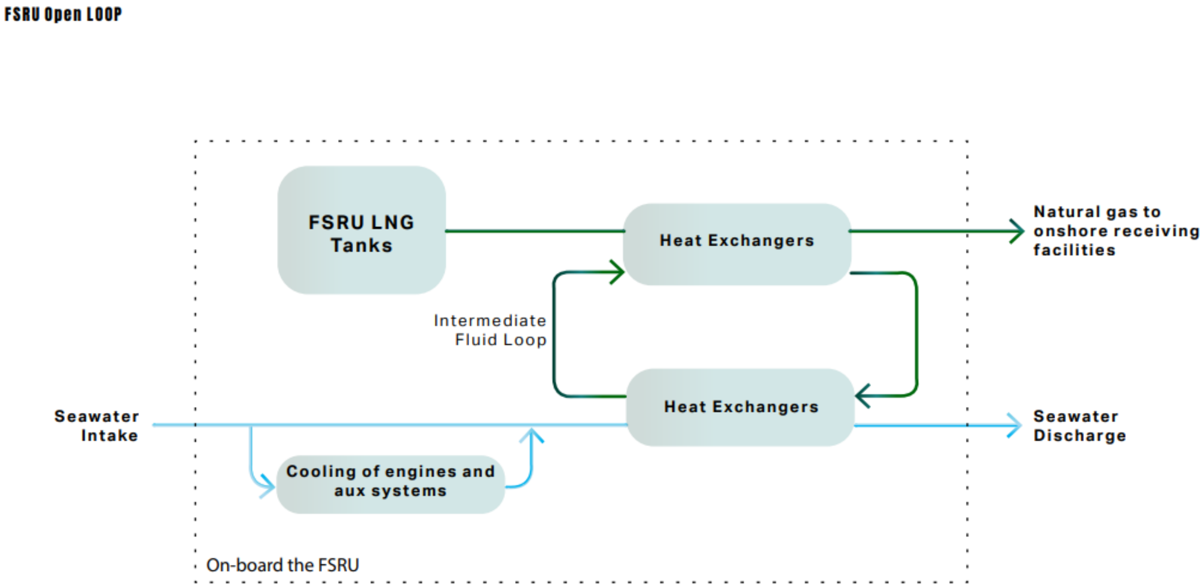

Figure 2-7 Open Loop Regasification

An 'open loop' regasification mode will be used when the seawater intake temperature is approximately 12 °C or higher, and a 'Combined loop' regasification mode will be used when the seawater temperature is below 12 °C.

The charter agreement for a specific FSRU has not been completed. Following a review of a range of vessels on the market from various FSRU suppliers, a range of temperatures between 9 °C to 12 °C were identified at which open loop commences and combined loop stops. For the purposes of this EIAR, a temperature of 12 ^{0}C for commencement of open loop mode was selected. 12 °C is a conservative assumption in terms of emissions and to consider the potential environmental impact. It may be the case that the final FSRU will commence open loop at a lower temperature.

In the open loop regasification mode, the heat provided from the seawater, via the heat-exchangers will be sufficient to regasify the LNG. In the combined loop mode seawater will still be used; however, additional supplementary heat will be supplied into the seawater via steam from gas-fired boilers prior to the seawater entering the heat-exchangers in the regasification system. The gas-fired boilers use boil-off gas (BOG) from the LNG storage tanks as fuel gas.

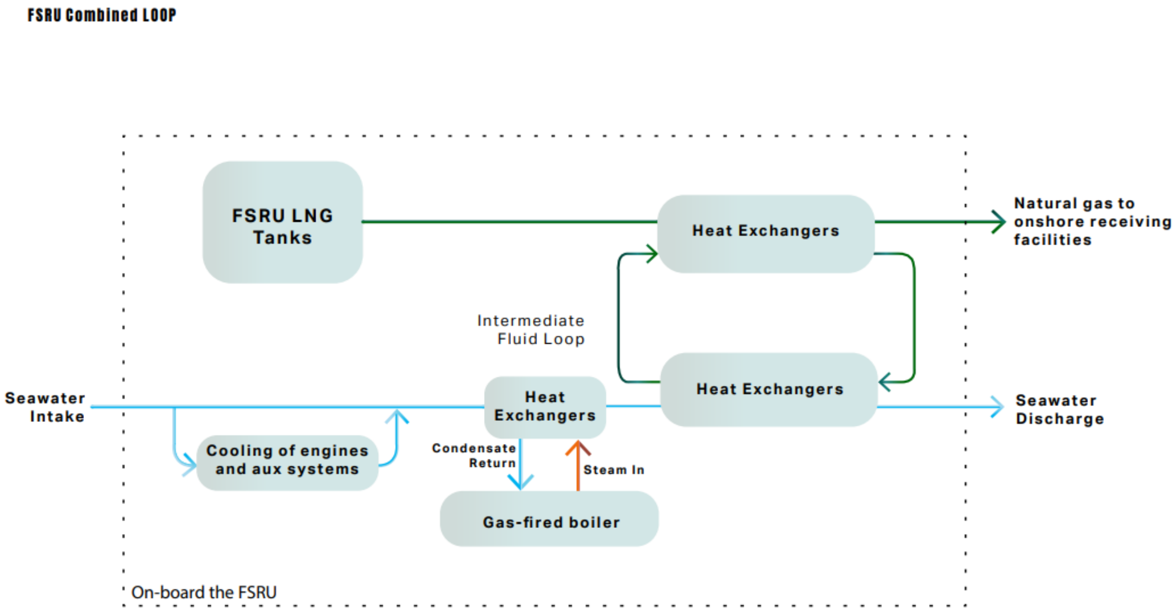

Figure 2-8 Combined Loop Regasification

The seawater that has been used for regasification will be discharged from the FSRU via a subsea pipe located approximately 2.4 m below water level. On discharge, this seawater will be up to 8 °C colder than the receiving ambient seawater. In order to optimise mixing and return of the seawater to ambient conditions, the seawater discharge ports will be orientated to deliver a horizontal water jet below the water surface.

When taking into account local seawater temperature data, it is predicted that the combined loop regasification mode will need to be used from the middle of November to early May. During this period supplementary gas fired heaters will be required. The exact temperature of the river Shannon varies from season to season, so the precise timing of the combined loop operation will vary from season to season. The amount of supplementary heat produced will be proportionally increased/ decreased as the water temperature gets colder/ warmer from the 12 °C open loop setpoint, aiming to use heat from the seawater as much as possible.

Boil-off Gas

Despite insulation of the tanks in which the LNG is stored which will limit the admission of external heat, slight evaporation of the LNG will occur during storage, shipping and loading/ unloading operations. This natural evaporation of small amounts of LNG is known as boil-off gas (BOG) and is removed from the tanks to manage tank pressure.

During regasification, BOG is recovered and used as a fuel source in the power generators onboard the FSRU, with any excess BOG being recondensed back into a liquid and stored as LNG. BOG can also be compressed via a minimum send out compressor (MSO) onboard the vessel and discharged via the jetty to downstream users i.e. the gas transmission network via the AGI or the Power Plant.

Table 2-2 presents a summary of the regasification process.

Table 2-2 Regasification Summary

Regasification Summary	
Peak day send out capacity, Max	22.6 million Sm^3/d
Gas Discharge Temperature	Between 1 °C and 4 °C
FSRU Maximum send out pressure	98 Barg
Seawater temperature for ‘Open Loop’	> 12 °C or 12 °C

Regasification Summary

Seawater temperatures for 'Combined Loop'	<12 ^{0}C
[4] Approximate heat required for LNG regasification	145 MW

2.4.2.1.2 FSRU Water Consumption

The FSRU requires seawater for the following purposes:

Ship systems:

- Main engine cooling;
- Auxiliary machine systems cooling;
- Freshwater generation;
- Ballast; and
- Firewater and service water (intermittent).

LNG Regasification and LNG ship-to-ship transfer:

- Heating/ regasification; and
- Water curtain (during ship to ship transfer from LNG Carrier, intermittent).

The FSRU will manage its draught using untreated ballast water with a maximum capacity of approximately 55,000 m^3. During unloading of LNG i.e. during regasification, the FSRU will take in seawater as ballast to compensate for the reduction of LNG inventory in the cargo tanks as the natural gas is exported to shore. During loading, i.e. ship-to-ship transfer of LNG to the FSRU storage tanks from the LNGC, ballast water will be discharged from the FSRU.

The FSRU will also use seawater for main engine cooling (approximately 1500 m^3/hr), auxiliary systems cooling (approximately 2000 m^3/hr) and onboard freshwater generation (approximately 100 m^3/hr).

There will be intermittent uses of seawater; for example, to test the onboard firefighting systems, intermittent deck washing (approximately 70 m^3/hr), and to create a water curtain when loading LNG from the LNGC (approximately 300 m^3/hr). The water curtain protects the hull from being directly exposed to cryogenic temperatures in the unlikely event that any LNG were to escape during unloading operations. The FSRU firewater system is anticipated to be tested for approximately one hour every 2 weeks.

In addition to the seawater discharge ports for regasification water, several auxiliary discharge ports will be located near the FSRU engine room, including for cooling and ballast as is typical for ocean-going vessels.

Seawater Intakes

Seawater intakes will be located in the hull of the FSRU, approximately 2 m below water level. Screens will be covering the intakes to prevent fish, crustaceans and debris from entering the seawater system within the FSRU. The design of the water intakes will be such that the approach velocity of the seawater entering the screens will not be greater than 0.3 m/s to allow mobile marine biota to swim away. The screen mesh size will be approximately 5 mm x 5 mm. It is anticipated that any silt entering the seawater circulation system will remain in suspension and carry right through the system.

Seawater Discharge

A schedule of FSRU seawater use is presented in Table 2-3 below.

[4] The exact amount of heat depends on each LNG cargo delivered

Table 2-3 FSRU Water Use Summary

Description	Typical (Notes 1, 2)	Maximum	Temperature Difference to Ambient Sea temp.
Seawater for LNG regasification process	11,000 m3/hr	22,000 m^3/hr.	- 8 °C
Seawater for main engine cooling	1,360 m^3/hr	1,500 m^3/hr	+12 °C
Seawater for auxiliary systems cooling	1,040 m^3/hr	2,000 m^3/hr	+5 °C
Seawater for freshwater generation	80 m^3/hr	100 m^3/hr	None
Intermittent use: seawater for onboard firefighting systems and deck washing	70 m^3/hr	70 m^3/hr	None
Intermittent use: Seawater curtain during ship to ship transfer of LNG from the LNGC	300 m^3/hr	300 m^3/hr	None

Note 1 The largest continuous use of seawater is for the LNG regasification process at 22,000 m^3/hr. This flowrate has been calculated for the day peak gas send out of 22.6 million Sm^3/d, which will only happen very infrequently (estimate 1% of the year). On an annual average basis, the FSRU will be send out approximately 14.8 million Sm^3/d of gas. At this annual average rate, the water consumption will be about 11,000 m^3/hr. Refer to Section 2.4.2.1.1 for further discussion on the regasification system.

Note 2 The amount of seawater for engine cooling and auxiliary systems is calculated conservatively with all engines running and all the auxiliary pumps running. Typically, only one main engine and one auxiliary cooling pump will be in operation at the nominal send-out capacity of 14.8 million Sm^3/d.

2.4.2.1.3 Seawater Electrochlorination

A small amount of sodium hydrochlorite is injected into the FSRU seawater systems to control microbial growth. The sodium hypochlorite is generated onboard in an electro-chlorination unit. The electro-chlorination unit will consist of cells housing platinised titanium electrodes between which a direct electric current flows. The sodium chloride salts in the sea water passing between the electrodes dissociate to form residual sodium hypochlorite (chlorine) without the addition of any chemicals. As the seawater passes through the system and is discharged back into the estuary, the chlorine will dissipate back into the sea water from which it will have been produced. The concentration of residual chlorine at the seawater discharge will be monitored and will not exceed 0.5 mg/l.

2.4.2.2 Jetty and Access Trestle

The jetty will be capable of receiving and providing secure berthing for the FSRU as specified above. Its main purposes are for the safe berthing of the FSRU, and for accommodating the necessary gas piping and equipment to safely transfer natural gas from the FSRU to the onshore receiving facilities. The jetty head will comprise (Figure 2-9 and Figure 2-10):

- An unloading platform;
- 8 no. mooring dolphins; and
- 2 no. breasting dolphins.

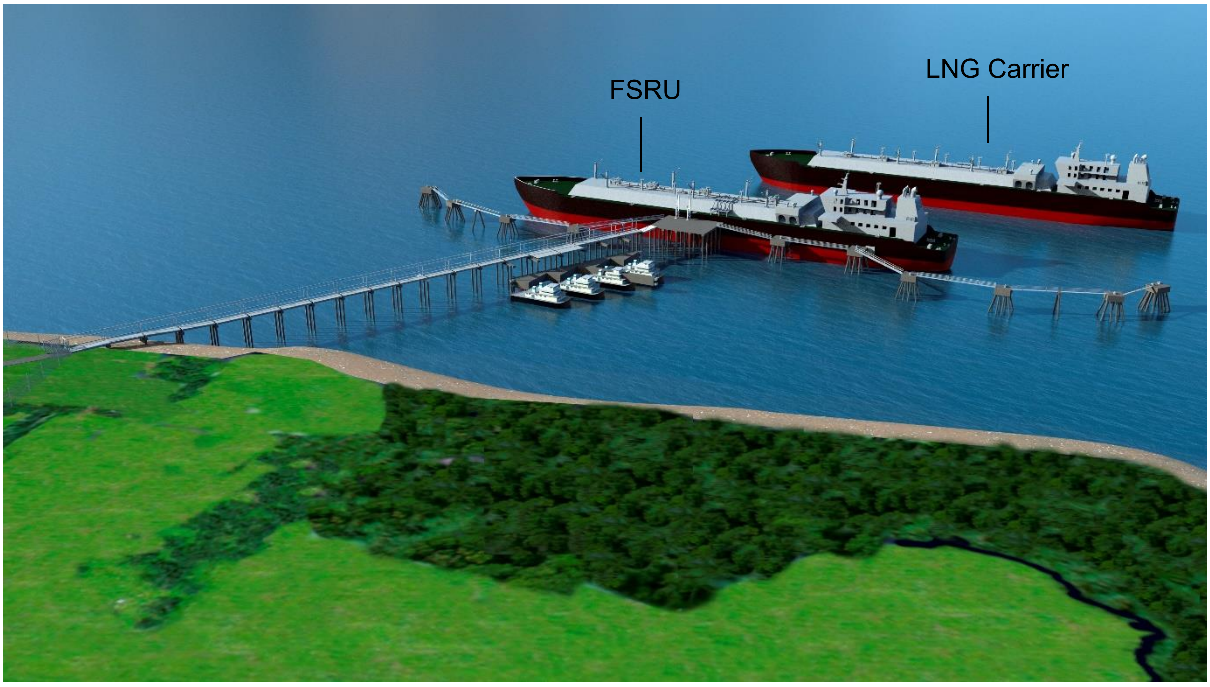

Figure 2-9 Proposed Development Jetty Configuration

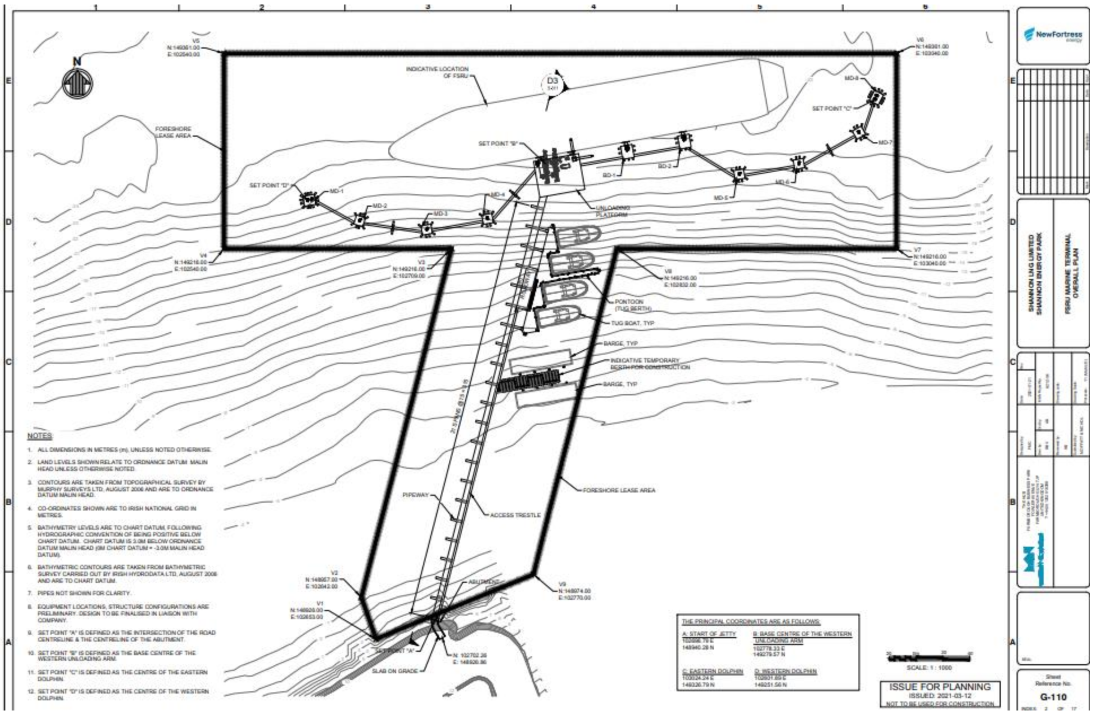

Figure 2-10 FSRU Marine Terminal Layout

The mooring dolphin layout is based on standard industry recommendations for angles of mooring lines (Oil Companies International Marine Forum, 2008). The unloading platform will be supported by steel piles with an additional row of piles along the berthing face to support the weight of the gas unloading arms. The design of the breasting dolphins will take into account the parallel mid-body width of the LNG ships, their various manifold positions forward and aft of mid length, to ensure that ships have adequate fender contact at all times. The unloading platform will also be equipped with fenders. Each of the dolphins will be supported by approximately eight tubular steel piles (see planning application drawings for further detail).

The access trestle, which will connect the jetty head to the shore, will be approximately 315 m in length, and will include a roadway for operational and maintenance access. The trestle will comprise 21 spans of approximately 15 m length with a width of approximately 11 m. The jetty platform elevation will be set at +9 m OD (Malin Head), to be clear of extreme water levels and waves. In total there will be approximately 203 piles inserted into the riverbed for the jetty and the access trestle. Following a constructability review, a temporary loading/ mooring facility has been included in the proposed jetty design which allows a mooring point for the construction of plant. Further details on the construction of the jetty can be found in Section 2.9.4.1.

Given the natural water depth at the site, no dredging is required for the Proposed Development.

The infrastructure to be installed on the jetty will include:

- Two GLAs on the unloading platform;
- A 30” (750 mm) gas pipe. The gas piping will run from the unloading arm on the platform to the onshore receiving facilities via a pipe rack which will be installed on the western side of the trestle;
- Hydraulic gangway tower to access the FSRU from the jetty;
- Power Distribution Centre (PDC);
- Compressed air system;
- Fire-fighting systems;
- Spill containment equipment; and
- Lighting and CCTV security system.

The GLAs will facilitate the connection of the 30” gas pipe described above to the FSRU discharge flange/ connector. The arms will be composed of rigid pipe sections which can swivel to allow a flexible connection between the floating (potentially moving) vessel and the rigid gas piping on the jetty. The top of the unloading arms will be approximately 30 m above the platform of the jetty. The 30”gas piping on the jetty will be designed to withstand the maximum discharge pressure from the FSRU. In the event that the FSRU is disconnected from the jetty, the gas inventory within the piping on the jetty will be isolated at the interface with the GLAs. The gas held in the arms will be vented back to the FSRU before disconnecting.

The FSRU will discharge the natural gas into the GLAs at pressures ranging from 48 to 98 barg at flowrates up to 22.6 million Sm^3/d.

It is anticipated the jetty will be operationally available 24 hours a day. Table 2-4 presents a summary of the key specification of the jetty.

Table 2-4 Key Jetty Specification

Description	Quantity
Number of GLAs	2
Jetty gas pipeline nominal diameter	750 millimetres
Jetty gas pipeline length	315 metres
Fire fighting system	Fire pumps, fire monitors, hydrants
Associated infrastructure	Gangway tower, substation, air compressors, transformer, lighting and CCTV system

2.4.2.3 Tugs

Visiting LNGCs delivering LNG to the Proposed Development will require tug support during both arrival and departure as well as for estuary channel navigation. Figure 2-11 presents the specification of a typical tug, which will be used.

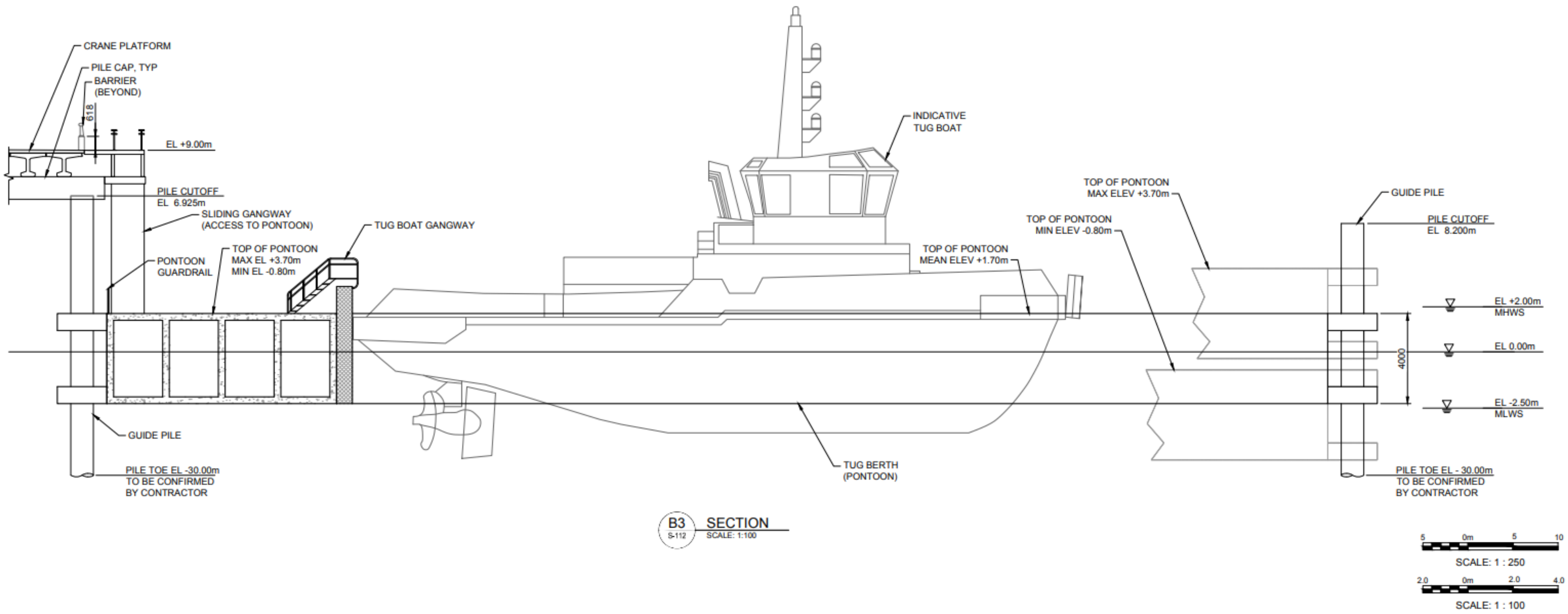

Figure 2-11 Typical Specification of a Tug

The basic functions of the tugs will be for push-pull, escorting, berthing, towing, and in certain circumstances firefighting and pollution control operations. The procedures for towage operations will be developed and written in consultation with and agreed with SFPC.

It is proposed that four new tractor type tugs of about 70 tons bollard pull each are included as part of the LNG Terminal.

The specification of the tug design will be finalised once the FSRU has been selected and contracted. The tugs will be licensed to operate at the Proposed Development by SFPC. The four tugs will be available for FSRU and LNGC mooring operations i.e. typically to safely moor/ unmoor the LNGC alongside the FSRU for LNG transfer. The tugs will be stationed at the jetty in order to meet the necessary service notice requirements, with a minimum of two tugs being moored there. Two fire monitors will be controlled remotely from the wheelhouse of the tug.

When a LNGC is berthed alongside the FSRU, a minimum of one tug will be on standby, underway near the jetty and ready for immediate use. Its primary function will be to provide offshore fire-fighting capabilities during LNG loading operations. A second tug will available at 30 minutes' notice and the third and fourth tugs will be at two hours' notice.

During normal operations when there is no LNGC moored at the jetty, it is anticipated that there will be a minimum of one tug available at the berth, tied alongside but manned and available for immediate use with a second tug at 30 minutes' notice. The third and fourth tugs will be at 2 hours' notice.

The specification of the tugs will be such that at least 2 of the 4 tugs are 'escort notated'. Escort tugs employed in active roles are designed to be capable of operating at speeds of approximately 1.5 times the speed of the approaching LNGC.

2.4.2.4 LNG Supply by LNG Carriers

The LNG in the LNG Terminal will be supplied from visiting LNGCs moored alongside the FSRU in a ship-to-ship transfer configuration. The LNG will then be transferred from the LNG tanks of the LNGC into the LNG storage tanks onboard the FSRU. Once the transfer of LNG is complete, the LNGCs will depart from alongside the FSRU with the assistance of tugs.

Up to 60 LNGC visits per year are anticipated. In addition to the 35 hours required to transfer the LNG, approximately 25 hours in total will be required to moor, berth, unmoor and unberth the LNGC. Ship passage time from the mouth of the Estuary to the Proposed Development is estimated at 4 hours.

The Proposed Development is designed to accommodate LNGCs with a varying capacity ranging from 130,000 m^3 to 265,000 m^3. As of June 2021, 57% of the current world LNGC fleet is between 150,000 and 180,000 m^3 (International Gas Union, 2021). Therefore, it is anticipated that the majority of LNGCs arriving at the Proposed Development will be in the range between 150,000 and 180,000 m^3. See Figure 2-12 for the LNGC berthing plan.

The LNGCs to be used will comprise double hull construction with the LNG containment systems, equipment and insulation typically installed within the inner hull. LNG will be carried in specially designed cargo tanks onboard the LNGC. The natural gas, which consists predominantly of methane, has a boiling point of approximately -163^{o}C, and LNG is stored at -163^{o}C at atmospheric pressure to remain liquid. The LNG storage tanks are insulated to minimise the thermal flow from the environment to the LNG storage tanks and to minimise the amount of evaporation i.e. BOG produced. The tanks are surrounded completely by two insulation spaces. The insulation spaces will be filled with inert gas, typically nitrogen to provide an inert blanket around the tanks whilst also supporting the gas detection systems installed to continuously monitor the cargo.

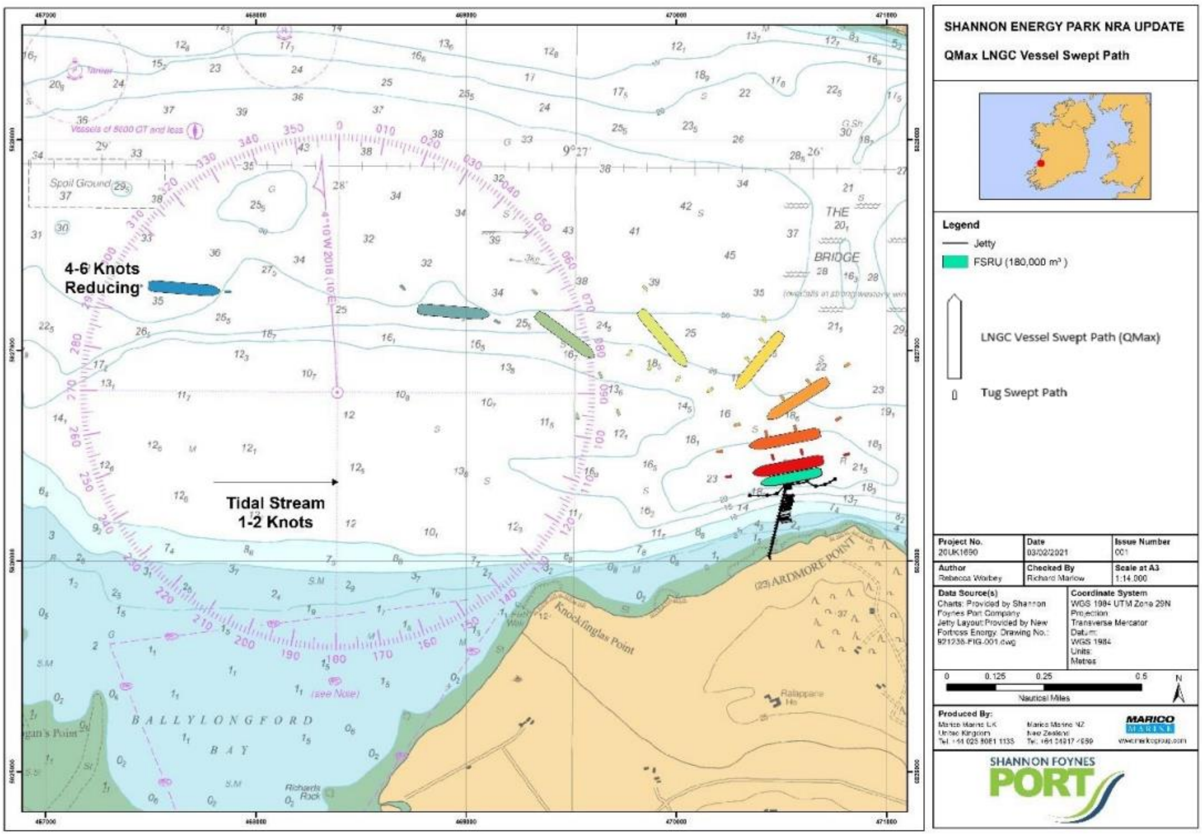

Figure 2-12 LNGC Berthing Plan

The LNGCs will employ either one of two main cargo containment systems:

1. Moss spherical tanks system, identified by its large spheres above deck level; or
2. Membrane tank system with a more conventional flat deck appearance.

Refer to Figures 2-13 and 2-14, for an image of both a Moss type and membrane type ships (respectively).

Figure 2-13 LNG Carrier with Moss Spherical Tank System

Figure 2-14 LNG Carrier with Membrane Tank System

Modern newbuilds have for the most part adopted the membrane type. Specifically, 79% (454) of the LNGC fleet today use membrane tanks, with the remaining 21% (118) being Moss type (International Gas Union, 2021).

The LNGCs that will be employed will be fuelled by natural gas in the form of BOG, diesel, heavy fuel oil, or a combination of BOG with either of the liquid fuels. The current world fleet of LNG ships is predominantly steam turbine powered, having sea service speeds of approximately 19 knots. They are equipped to burn BOG from the cargo in their boilers thus minimizing consumption of fuel oil and avoiding any venting of gas to the atmosphere. Specifically, of the 572 active LNGCs in the world, 92% (526) use either wholly natural gas in form of BOG, or a combination of BOG with either of the liquid fuels. Only 8% (48) exclusively use diesel as fuel (International Gas Union, 2021). All LNGC engines will comply with the emissions standards set by the MARPOL convention, when using liquid fuel. New generation ships now entering service include dual-fuel natural gas burning diesel electric propulsion systems, which also burn BOG, eliminating any venting of gas.

While the frequency of LNGCs accessing the operational facility is currently estimated at up to 60 visits per year, the LNG containment type, size and propulsion system for each visiting LNGC will vary within the limits set out above.

Pilotage of vessels, including the LNGCs, will be provided by Shannon Estuary Pilots under the direction of the Harbour Master.

For details of the procedures for the arrival and berthing of an LNGC, the unloading operation and for departure, refer to Appendix A2-2, Vol. 4 Marine Navigation Risk Assessment (SFPC, 2021).

It is envisaged that the port side of the FSRU will be moored to the jetty, and the LNGC will be berthed by the port side to the FSRU. The main reason for such an arrangement is to point the bow of both vessels to the open sea during the stay on berth so that fast departure of vessels in case of extraordinary circumstances is possible, even without tugs.

Visiting LNGC will arrive full of LNG and there will be no discharge ballast water into the Shannon. The LNGC will take on seawater as ballast as they unload their cargo.

2.4.2.5 Onshore Receiving Facilities

The onshore receiving facilities comprises the following components (Figure 2-15):

- Nitrogen generation plant for gas blending (Section 2.4.2.5.1);
- Buildings (Section 2.4.2.5.2);
- Onsite power generators (Section 2.4.2.5.3);
- Black start diesel generator (Section 2.4.2.5.4);
- Instrument and plant air package (Section 2.4.2.5.5);
- Fire water storage tanks and fire water pumps (Section 2.4.3.1.4); and
- Gas metering and regulation area (Section 2.4.3.1.2 and Section 2.4.3.1.3).

Figure 2-15 Proposed Onshore Receiving Facilities

2.4.2.5.1 Nitrogen Generation Plant

The function of the nitrogen generation plant will be to generate nitrogen from air and store it for use at the LNG Terminal. Nitrogen gas will be required for blending in the event that natural gas received from the FSRU to meet the requirements of GNI. Nitrogen will then be injected into the gas stream to achieve the required specification. Nitrogen will also be required for purging of equipment and piping during operation and maintenance activities.

2.4.2.5.2 Buildings

The LNG Terminal will comprise the following buildings:

- Main LNG control building;
- Nitrogen generation package control building;
- Nitrogen compressor building;

- Electrical switchgear enclosures;
- Continuous emissions monitoring (CEMS) enclosures; and
- Workshop/ warehouse building.

Buildings and enclosures common to both the Power Plant and LNG Terminal are described in Section 2.4.3.

Main LNG Control Building (22.7 m x 14 m)
Operation of the LNG Terminal will be monitored and controlled from the Main Control Building. This building will include a control room, electrical and instrumentation room, meeting room and offices for the personnel stationed at the LNG Terminal.

Nitrogen Generation Package Control Building (24 m x 12 m)
The operation of the nitrogen generation plant (see Section 2.4.2.5.1) will be monitored and controlled from the Control Room in the Nitrogen generation package control building. This building will also comprise an electrical and instrumentation room, meeting room and offices for the personnel associated with the nitrogen generation plant.

Nitrogen Compressor Building(8.6 m X 12 m)
Nitrogen gas compressors to pressurise the nitrogen up to 98 barg for injection into the natural gas will be housed in the nitrogen compressor building. This building will normally be unoccupied.

Electrical Switchgear Enclosures (9 m x 26 m and 18 m x 5 m)
Two electrical switchgear enclosures – main and secondary – will house the electrical and control equipment necessary to distribute power and control throughout the LNG Terminal. The enclosures will be pre-manufactured from all-weather steel. The enclosures will be mounted on steel support legs or concrete piers to elevate the enclosures and allow bottom entry for electrical/ control wiring, and will normally be unoccupied.

Five transformers (3 m x 3 m) will be provided as part of the LNG Terminal equipment.

Continuous Emissions Monitoring Enclosures (1.9 m x 1.9 m)
Three enclosures will house the CEMS.

Workshop/ Warehouse Building (18 m x 28 m)
The workshop and warehouse building will provide storage for equipment and material spares required to maintain an operational facility. The building will also include a number of maintenance offices and a workshop area. A summary of the proposed architectural colour scheme is provided in Table 2-5.

Table 2-5 Summary of Proposed Architectural Colour Scheme

Building Unit	Colour
Fencing, enclosure/ equipment container sides and tops, racks, evaporators, water tanks	RAL 6006 (Grey-Olive)
Building and enclosure façades	RAL 6003 (Olive green)
Building and enclosure roofs	RAL 6020 (Chrome green)
Doors, window frames, auxiliary boiler and fuel gas stacks and cooler pipes	RAL 7043 (Traffic grey B)
Façade for the turbine halls	RAL 6011 (Reseda Green)
Turbine air intakes and diesel generator/ HRSG exhaust stacks	RAL 9023 (Pearl dark grey)

2.4.2.5.3 Onsite Power Generators
It is anticipated that once operational, a small percentage of the electricity generated by the Power Plant will be used to power to the LNG Terminal. Three no 8 MW gas fired electricity generators will be used to provide onsite power generation to the LNG facilities while the 220 kV connection is being constructed in the absence of the 220 kV and medium voltage (10/ 20 kV) grid connections. Fuel gas for these generators will be supplied from gas from the FSRU. However, if there is no gas from the FSRU, the generators will be powered by fuel gas which will be reverse flowed from the consented 26 km 30" Shannon Pipeline.

If the 220 kV and medium voltage (10/ 20 kV) grid connections are consented, these power generators will be used as back up power generation if the grid connections fail, or are unavailable.

Additional information can be found in Section 2.4.6.1.

2.4.2.5.4 Black Start Diesel Generator (5 m x 9.4 m)

A black start diesel generator will be provided to enable start-up of the onsite power generators without a connection to the electricity grid. The diesel fuel for the black start generator will be stored in a bunded or a double-walled tank.

2.4.2.5.5 Instrument and Service Air Package (11.7 m x 4.6 m)

Compressed air for instrument use and for service and maintenance use will be generated onsite. A combined instrument and service air distribution system will be installed and compressed air will be supplied from a compressed air generation unit. This will include a backpressure regulator to prevent loss of pressure in the instrument air system when pneumatic tools are being used, along with associated equipment such as filters.

2.4.2.6 Above Ground Installation

The AGI will accommodate the valves and control equipment to facilitate the connection to the already consented 26 km 30” Shannon pipeline. It will facilitate the transportation of gas to GNI, and will include odorisation, fiscal metering and pressure control of the gas flow prior to it entering the national gas network. The AGI is located in a separate compound within the Proposed Development site covering an area of approximately 11,282 m^2. Once commissioned, GNI will operate the AGI. The indicative layout of the AGI is shown in Figure 2-16. A detailed layout of the AGI is shown in Figure F2-5 in Volume 3.

Figure 2-16 Proposed Layout of the AGI

The details provided on the AGI are based on information provided by GNI and will be typical of existing GNI AGIs on the national gas transmission network. If required, the AGI will be able to supply the LNG Terminal and/ or Power Plant with a gas. In addition to gas piping and associated valves, the AGI will house the following equipment and buildings (see Figure F2-5, Vol. 3):

- Odorisation package including bulk odorant storage;
- Pig-trap (Bi-directional);
- Filtration;
- Fuel gas heaters/ heat exchangers and associated fuel gas skid;
- Metering equipment located in a Metering Building;

- Gas pressure regulation system located in a Regulator Building;
- Gas chromatographs/ Chromatograph Building;
- Generator Kiosk; and
- Control and Instrumentation building.

The AGI compound will be remotely operated and will normally be unmanned.

2.4.2.6.1 Odorisation (12.1 m x 11.7 m)

Natural gas, which mainly comprises methane, has little or no natural smell. The gas entering the transmission network is therefore injected with small traces of a strongly smelling substance, which is added for the purpose of safety and leak detection for consumers. The odorant is stored in odorant tanks, a control system and associated pipework will be installed to enable the injection of carefully controlled volumes of odorant into the natural gas (typically 6 milligrams per m^3).

2.4.2.6.2 Pig-Trap (Bi-directional)

A bi-directional pig-trap (and associated equipment) will be installed to launch (or retrieve) the pipeline inspection gauge (pig). Pigs are in-line tools which are propelled through the pipeline for two main purposes: namely initially during the gassing-up/ commissioning to clean and dewater the pipeline, and later, when the pipeline is operational, to inspect the internal condition such as the wall thickness of the pipeline. This inspection pig is also termed an intelligent pig.

2.4.2.6.3 Pressure Reduction/ Flow Control

The pressure reduction/ flow control equipment, which is to be included in a 20.5 m x 12.6 m regulator building, will enable the pressure and flow rate of the natural gas entering the gas transmission network to be controlled as required by the network operator, GNI.

2.4.2.6.4 Heat Exchangers (31.9 m x 40.5 m)

During times when gas pressure is reduced, as described above, the act of reducing the pressure of the gas causes a drop in gas temperature (through the Joule Thompson effect). The gas is therefore passed through a set of heat exchangers to preheat the gas prior to pressure reduction ensuring the gas is 2 ˚C or higher in temperature before it enters the grid. The heating medium to be used for these heat exchangers will be water heaters in boiler units (see below).

2.4.2.6.5 Fuel Gas Heaters

The heating medium (water) combined with Alphi 11 anti-freeze is heated by gas fired boilers planned to be housed in individual buildings (3 number 18.1 m x 17.1 m).

2.4.2.6.6 Metering Building (25 m x 20 m)

Fiscal metering of the gas will occur in a metering building.

2.4.2.6.7 Regulator Building (20.5 m x 52.7 m)

See Section 2.4.2.6.3.

2.4.2.6.8 Chromatograph Building (3.5 m x 4.5 m)

The gas chromatography building will house a gas chromatograph where the calorific value of the gas is determined prior to entering the grid.

2.4.2.6.9 Generator Kiosk (4.8m x 3.5m)

Generator(s) will be located in the generator kiosk.

2.4.2.6.10 Control and Instrumentation Building (20 m x 10 m)

A control room, normally unmanned, will be located in the control and instrumentation building.

2.4.2.6.11 Pipework

The majority of valves and pipework within the AGI compound will be located below ground level. A short section of the export pipe will extend above ground level to provide the connection for the pig trap (launcher and receiver), which will be required from time to time to allow internal cleaning or inspection of the pipeline.

2.4.3 Ancillary Buildings

The following buildings will be used by both the Power Plant and LNG Terminal:

- Security building;
- Fuel gas regulating enclosure;
- Fuel gas metering enclosures; and
- Fire water storage tanks and fire water pumps.

The buildings will be steel framed buildings with concrete floor slabs. Structural and architectural details have been prepared including particulars of the shallow and deep foundations, lifting equipment, steel structures, and protective coatings.

2.4.3.1.1 Security Building (11 m x 5.8 m)

The security building will include a reception area to check in visitors, along with a break area and toilets for security staff.

2.4.3.1.2 Fuel Gas Regulating Enclosure (12.6m x 13.2 m)

The function of the fuel gas regulating enclosure will be to regulate the pressure and temperature of the gas used by the onsite power generators and the Power Plant.

2.4.3.1.3 Fuel Gas Metering Enclosures

There will be several small unoccupied enclosures included in the gas metering area (12.6m x 13.2m) to house instrumentation, such as a gas chromatograph, to measure the calorific value of the gas for onsite use.

These will include:

- Metering and regulating area kiosk enclosure (3 m x 3 m);
- Metering and regulating area analyzer enclosure (3 m x 4.4 m); and
- Metering and regulating area instrument enclosure (3 m x 4.4 m).

2.4.3.1.4 Fire Water Storage Tanks and Fire Water Pumps

Fire water will be supplied from the municipal water supply system and will be stored onsite in two separate tanks (16 m height x 14 m diameter), which will be field-fabricated welded steel tanks, each with a dedicated capacity representing a minimum of two hours of fire water requirement during firefighting. In addition, One 100% capacity electrically driven fire pump, one 100% capacity diesel engine driven fire pump, and two jockey pumps will be located within the fire water pump enclosure. The pumps will be designed to provide the required volume of firewater needed for any automatic suppression system plus flow for fire hydrants or hose stations. A diesel fuel tank for the diesel driven fire pump will be either located in a bunded area or within a double-walled tank.

In addition to the firewater storage tanks, additional firewater will be stored in the firewater retention pond as described in Section 2.4.7.3.

2.4.4 Roads, Site Access and Car Parking

2.4.4.1 Internal Roads

Internal roadways will be constructed to support delivery of equipment, facility operations, and connection between buildings (Figure 2-17). Main routes in the Proposed Development site will be reinforced as required to support significant loads and vehicles. All permanent road works will be designed, constructed and specified in accordance with relevant applicable Irish standards and codes of practice. The minimum road width is provided in Table 2-6.

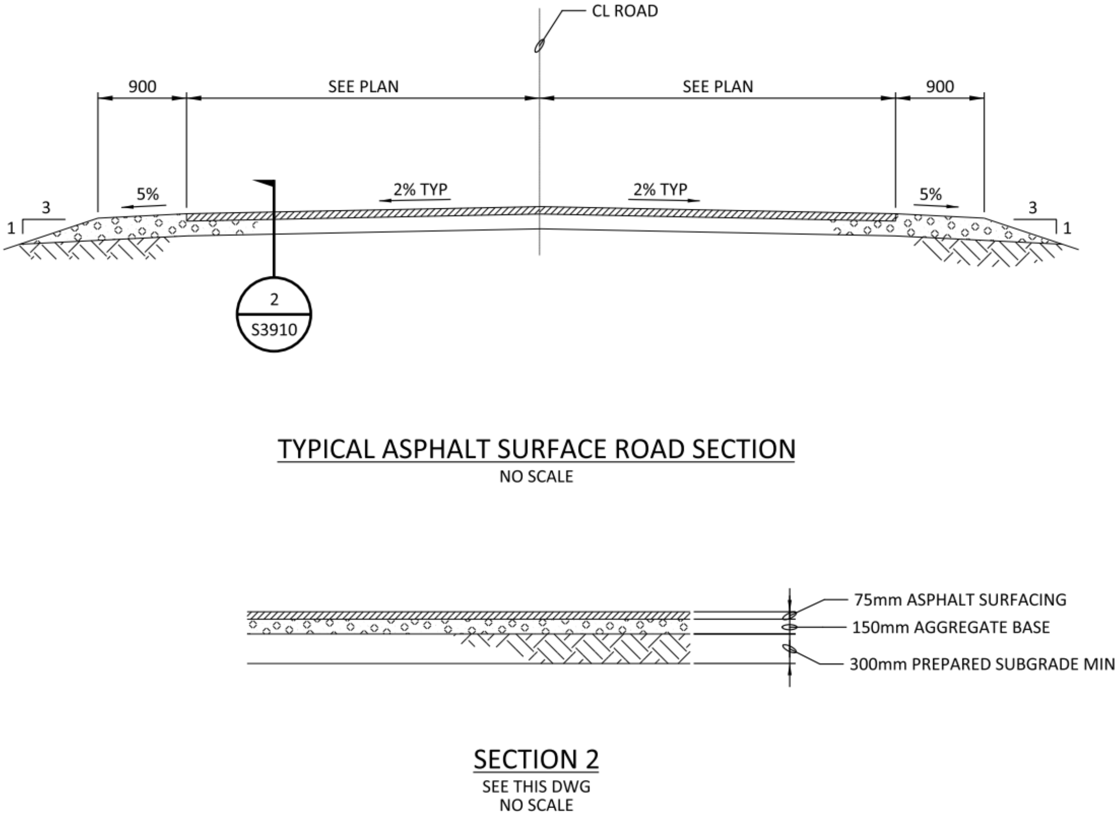

Figure 2-17 Cross Section of Internal Roads

Table 2-6 Internal Road Dimensions

Road	Total Width (m)	Paved Width (m)	Shoulder Width (m)
Paved Interior Roads	7.8	6	0.9

2.4.4.2 Site Access

Site access will be located off the existing L1010 (Coast Road), which is the primary access road to the townlands of Kilcolgan Lower and Ralappane from Tarbert and Ballylongford. Appropriate signage will be installed.

The AGI will be operated remotely by GNI and normally unmanned, but pedestrian access and vehicular access will be required for inspection and maintenance purposes.

See Section 2.4.5 for details of proposed fencing and security gates.

There will be three watercourse crossings within the boundary of the Proposed Development, as discussed in Chapter 06 – Water:

- 600 mm culvert;
- 1200 mm culvert; and
- Pre-cast concrete bridge over the Ralappane Stream (Figure 2-18).

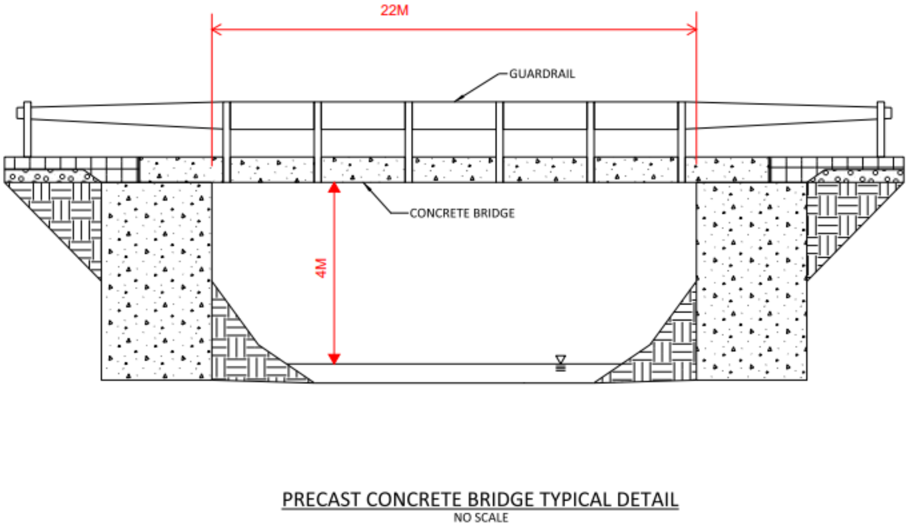

Figure 2-18 Proposed Pre-cast Concrete Bridge over the Ralappane Stream

2.4.4.3 Car Parking

Parking is proposed during the operational phase which will comprise:

- 42 car parking spaces including:
  - A minimum of 2 mobility spaces;
  - A minimum of 2 electric vehicle charging points; and
- A minimum of 40 cycle parking spaces provided throughout the Proposed Development site.

Additional parking is accommodated in the laydown area, which will cover any overflow requirements in the event of maintenance or shutdown.

2.4.5 Security

There are three separate fence lines in the Proposed Development:

1. An outer perimeter fence line surrounding the whole development;
2. An inner security fence line surrounding the operational Power Plant and LNG Terminal; and
3. A separate double fence line surrounding the AGI.

A CCTV system will also be installed.

The fence lines are detailed in the sections that follow.

2.4.5.1 Outer Perimeter Fence

The outer perimeter fence will comprise a 2.4 m high chain link fence, galvanised and PVC coated in evergreen and topped with three layers of barbed wire (see Figure 2-19). For visual impact mitigation the outer perimeter fence line will be set back from the L1010 road to avoid crossing watercourses as far as possible. The fencing is not expected to impact surface water flow where two watercourses are crossed, as there will not be a requirement for this fencing to be extended below the water's surface.

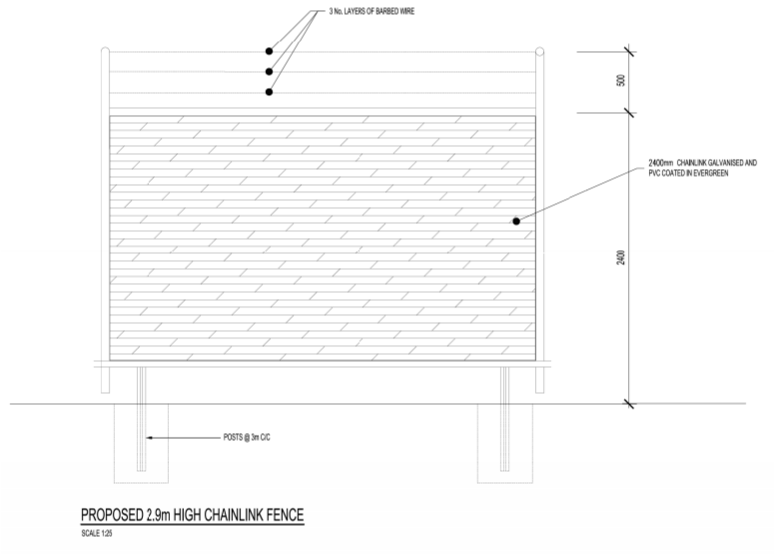

Figure 2-19 Proposed 2.9 m Outer Perimeter Fence

2.4.5.2 Inner Security Fence

A 4 m inner security fence will surround the Power Plant and LNG Terminal (see Figure 2-20). This will comprise a fully galvanised and PVC coated palisade fence in evergreen (2.4 m high), topped with an electric wire fence. The LNG Terminal and Power Plant will be manned for round-the-clock service for operations and maintenance purposes, although planned maintenance activities will predominantly be conducted during the daytime. The inner security fence line will not cross any watercourses.

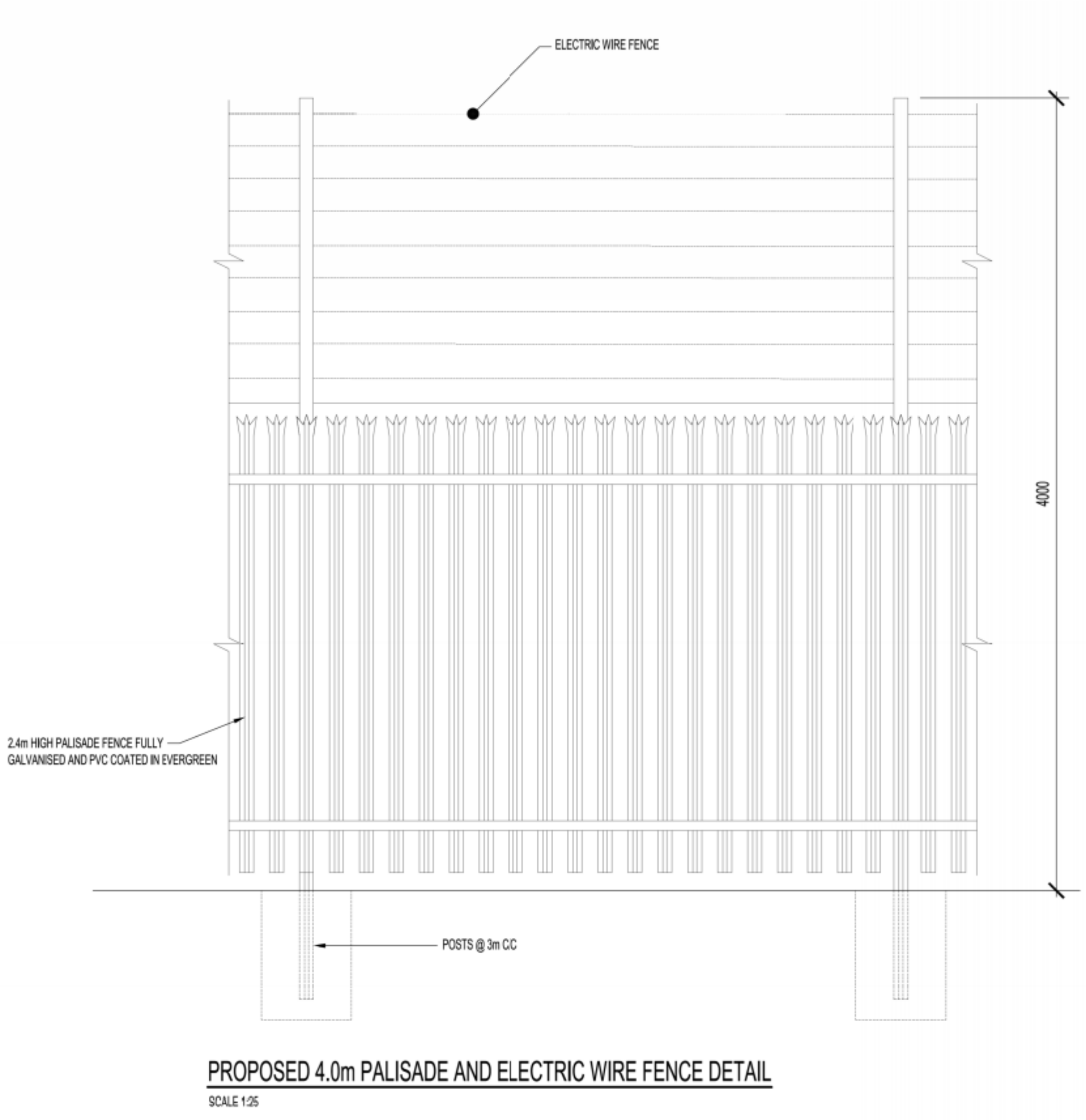

Figure 2-20 Proposed 4 m Inner Security Fence

2.4.5.3 AGI Fenceline

Two layers of fence will surround the AGI (see Figure 2-21). This will comprise a spiked palisade fence, galvanised and PVC coated in dark green, with a weld mesh access security gate and a weld mesh fence in the same colour. The AGI double fenceline will not cross any watercourses.

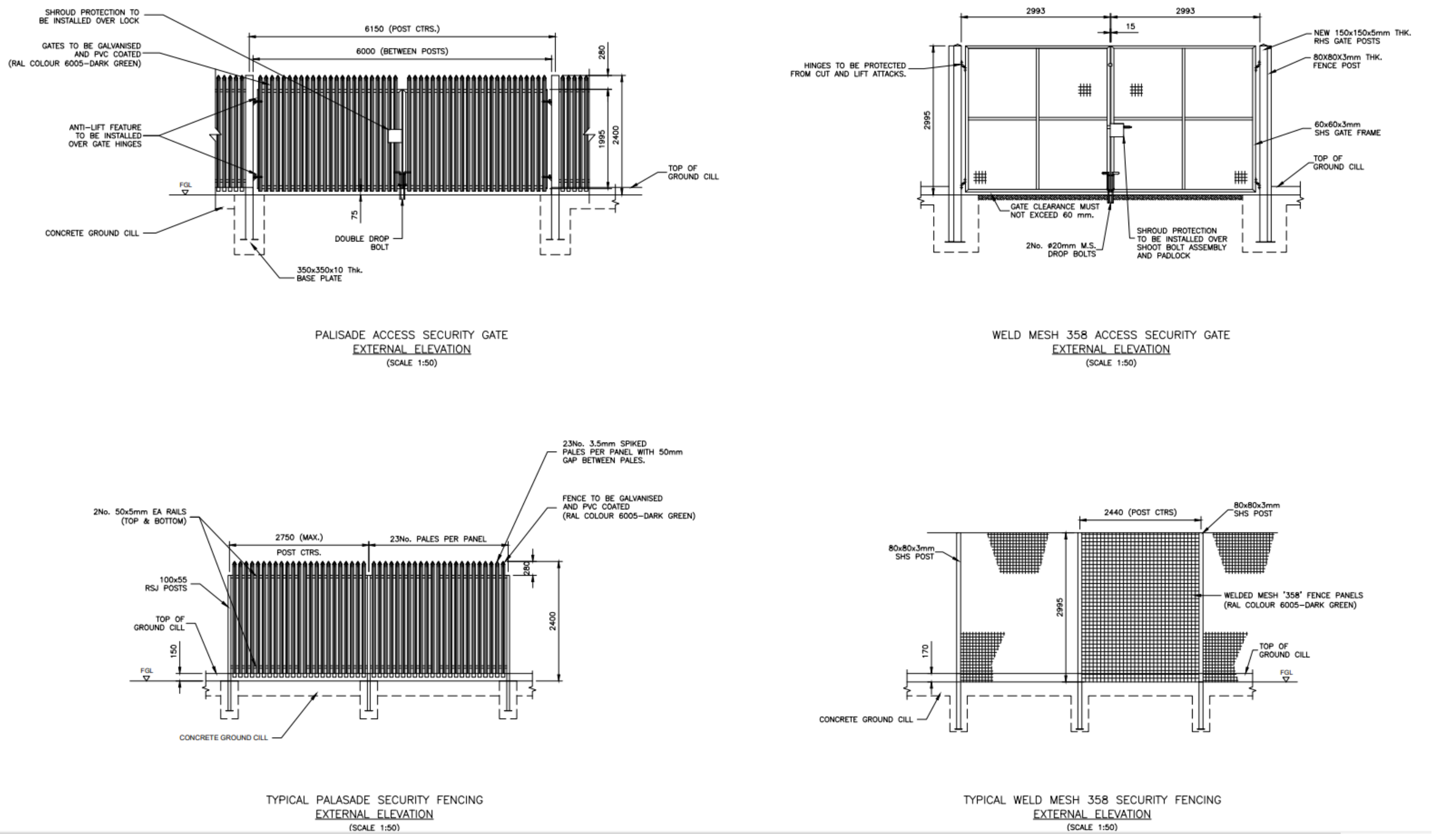

Figure 2-21 Proposed AGI Fenceline

2.4.6 Utilities

The Proposed Development will require connection to the following utilities:

- Electricity;
- Gas;
- Municipal water; and
- Telecommunications.

In addition, the Proposed Development will require stormwater and surface water drainage, sewerage drainage and process effluent drainage infrastructure.

2.4.6.1 Electricity

2.4.6.1.1 Overview

A high voltage (HV) 220 kV grid connection to the national electrical transmission network is required to export power from the Power Plant, when operational. During periods of high wind (renewable) generation it is expected that the Power Plant will be turned off by the system operator (EirGrid) to give priority to renewable power. In this event, the LNG Terminal will require power. At times when the Power Plant is shut down, power may be imported to the Proposed Development site via the proposed future 220 kV high voltage grid connection.

It is currently anticipated that the LNG Terminal will be operational before the Power Plant and the 220 kV grid connection are completed. Therefore, a medium voltage (10/ 20 kV) grid connection will be required to supply power to the LNG Terminal.

Once the Power Plant and/ or future 220 kV grid connection are completed, this medium voltage (10/ 20 kV) grid connection will be reserved as a backup power supply if the Power Plant and 220 kV grid connection are not available. These will be subject to a connection agreement with EirGrid and ESBN. These grid connections will be subject to separate planning applications and do not form part of the Proposed Development.

Additional information on the potential future 220 kV and medium voltage (10/ 20 kV) grid connections are outlined in the following sections.

2.4.6.1.2 The 220 kV High Voltage Connection

An application to connect to the national electrical transmission network was submitted to EirGrid in September 2020 under the Enduring Connection Policy 2 (ECP2) process. An offer has yet to be received so the precise connection details cannot be confirmed at the time of writing. The development of the grid connection will be subject to a separate planning application and associated EIAR by the Applicant once the offer is received, and the precise connection details are known. The aspects and impacts of the construction and operation of the grid connection have been included in the cumulative impact assessments in this EIAR.

It is anticipated that the connection point will be the ESBN / EirGrid Killpaddogue 220 kV substation which is located approximately 5 km east of the Proposed Development site with connection provided via a 220 kV cable(s) under the L1010 road as shown in Figure 2-22. The grid connection will be laid under the L1010 from the Proposed Development to the entrance road to Kilpaddoge 220 kV substation. At the entrance road to Kilpaddoge substation, the grid route will follow the substation access road and connect to the Kilpaddoge substation. No works are anticipated at Kilpaddoge 220 kV substation. The cable route will be approximately 4.6 km in length and is anticipated to be located entirely under private and public roadways. Approximately 3.5 km will be installed under public roadway (L1010). Local access will be maintained throughout the cable installation process.

It is anticipated that the 220 kV grid connection will require an onsite EirGrid 220 kV substation. This is currently proposed to be located onsite and approximately 500 m from the main Proposed Development site entrance. The details of the planned 220 kV substation will be included in the future 220 kV connection planning application.

It is expected that the planned 220 kV substation will comprise lightning protection masts, cable sealing ends, high voltage disconnectors, circuit breaker, current and voltage transformers all contained within a fenced area, approximately 60 m by 50 m. The electrical equipment is not expected exceed 9 m in height with the exception of the lightning protection monopoles which are expected to be between 15 – 18 m in height. A single storey control building of masonry block construction, up to 5 m height, with an estimated footprint of approximately 375 m^2 also is planned within the site boundary.

The planned 220 kV substation will in turn connect to the Power Plant 220 kV GIS substation, as described in Section 2.4.1.3.

2.4.6.1.3 The Medium Voltage Connection (10/ 20 kV)

If the LNG Terminal commences operation before the Power Plant and/ or 220 kV high voltage grid connection are completed or operational an alternative electricity supply is required. Therefore, a separate medium voltage (10/ 20 kV) connection to power the LNG Terminal in the absence of the Power Plant and/ or 220 kV high voltage grid connection will be installed. Once the Power Plant and/ or future 220 kV grid connection are completed, this medium voltage (10/ 20 kV) grid connection will be reserved as a backup power supply. However, the connection is subject to a connection agreement with ESBN and will be considered under a separate planning application. This will be included in the cumulative impact assessment within each EIAR chapter.

If consented, the LNG Terminal medium voltage (MV) connection will be via a new onsite substation and underground cable from the existing ESBN / EirGrid Kilpaddoge 220 kV substation. The onsite substation will be adopted by ESBN post commissioning and will form part of the overall medium voltage (10/ 20 kV) distribution system.

The onsite substation will be located within the Proposed Development site redline boundary approximately 800 m from the Proposed Development site entrance. The onsite substation will comprise a single-storey building size of 10 m x 4.5 m approximately and will include separate ESBN and Customer MV switchrooms. The proposed underground cable route will follow the L1010 route in parallel with the 220 kV cables as described above.

The below sections summarise the power requirements and supply for the LNG Terminal and Power Plant considered under this planning application and EIAR.

2.4.6.1.4 LNG Terminal Power Requirements

It is anticipated that once operational approximately 10 MW of electricity generated by the Power Plant will be supplied to the LNG Terminal. However, as outlined above, the LNG Terminal may commence operation prior to the completion of the Power Plant and/ or future 220 kV high voltage grid connection and medium voltage (10/ 20 kV) grid connection. In this case, power to the LNG Terminal will be supplied via onsite gas generators until the Power Plant or the medium voltage (10/ 20 kV) connection are operational.

The onsite power generation will comprise three 8 MW gas fired electricity generators. Fuel gas for these generators will be supplied from gas from the FSRU. However, if there is no gas from the FSRU, the generators will be powered by fuel gas which will be reverse flowed from the 26 km 30” Shannon Pipeline.

Once the medium voltage (10/ 20 kV) grid connection is available, the onsite gas generators will be utilised as backup power supply in the event that the LNG Terminal’s grid connection fail.

See Appendix A2-3, Vol. 4 for the medium voltage (10/ 20 kV) and 220 kV connections construction information.

2.4.6.2 Municipal Water Supply

The Proposed Development will require water supply for the following:

- Domestic site staff – 3.6 m^3/day; and
- Process water – ranging between 10 m^3/hr and 33 m^3/hr.

The Applicant has made a connection request to Irish Water, which will require connection to a mains water system. It is anticipated that this will be provided along the Coast Road from Ballylongford to the Proposed Development site (Figure 2-22). The water connection does not form part of the scope of this EIAR.

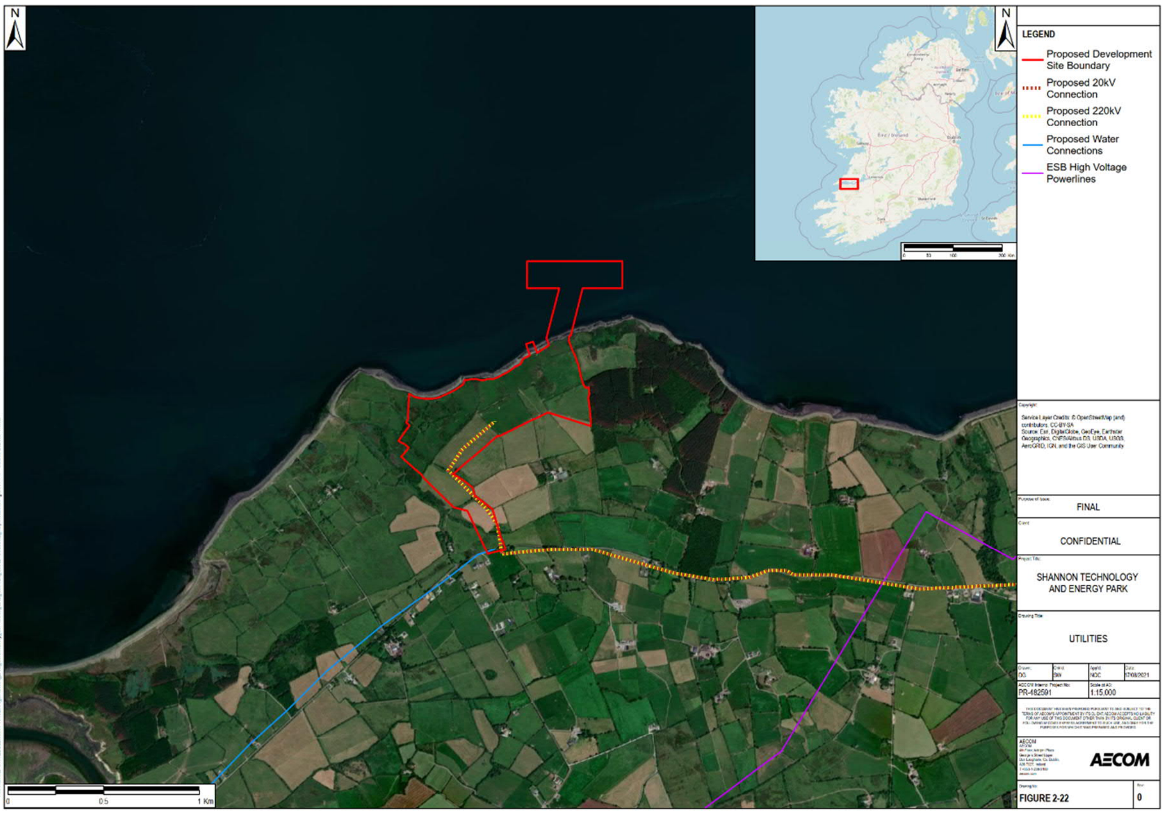

Figure 2-22 Proposed Electrical and Water Connections

In addition, the fire water supply will come from the potable water supply system and will be stored onsite in two separate firewater tanks.

Water will be supplied to the vessels via portside hose connections and/ or tankers and stored onboard in potable water tanks. Freshwater will be subject to further treatment onboard before is it used for human consumption.

2.4.6.3 Telecommunications

The Proposed Development will require a connection to a broadband network. It is anticipated that it will be serviced by a new fibre cable which will be supplied via a new duct under the widened L1010 road. The installation of telecommunication utilities does not form part of the scope of the EIAR.

2.4.7 Drainage

2.4.7.1 Stormwater and Surface Water Drainage

It is proposed that stormwater from all paved and impermeable areas covering approximately 14 hectares) within the Proposed Development site boundary will be collected and discharged directly to the Shannon Estuary via a discharge pipe with an outfall located 5 m beyond the low water mark at a water depth of approximately 2.4 m. See Figure F2-6, Vol. 3 for an overview of proposed drainage at the site.

Impermeable areas include the following:

- Heater Building, nitrogen compressor building, regulator building, electrical substations, heat exchangers, administration and security buildings;
- Laydown and car parking area;
- Access road, jetty road and footpaths;
- Lined outfall; and
- A percentage of the side slope and landscaping areas.

All stormwater collected from paved and impermeable areas will pass through an attenuation system including a class 1 hydrocarbon interceptor prior to discharge to the Shannon Estuary via the outfall pipe located 5mm offshore in a water depth of approximately 2.4m. The stormwater discharge rate has been calculated at 162 L/s/ha. Stormwater collected from roof drains and permeable areas will discharge directly to the Shannon Estuary via the final discharge monitoring station. All bunded areas within the Proposed Development site will have valved discharge points as part of their connection to the drainage network.

Groundwater seepages from springs or at the toe of cut slopes will be collected via a groundwater drainage network which will then discharge directly to the Shannon Estuary via the same discharge outfall pipe as the surface water.

Silt traps will be incorporated in all groundwater drainage points prior to discharge.

During the operational phase, all drainage from the Proposed Development site will be controlled and monitored in compliance with the terms of the IE licence.

Details of discharge mitigation measures are presented in the Outline Construction Environmental Management Plan (OCEMP) prepared as part of this application (Appendix A2-4, Vol. 4).

2.4.7.2 Sewerage Drainage System

In the LNG Terminal, sewerage effluent (foul water) will be generated at four locations onsite:

- The workshop/ warehouse building;
- The nitrogen generation package control building;
- The main control building; and
- The AGI Control and Instrumentation Building.

In the Power Plant, sanitary effluent (foul water) will be generated at the following locations on the Proposed Development site:

- The administration building;
- Central control/ operations building;
- Workshop/ stores/ canteen building; and
- Each turbine hall.

All sanitary effluent from the Proposed Development will be transferred to the dedicated onsite wastewater treatment plant (WWTP) which will treat the wastewater using a biological Wastewater Treatment System prior to discharge to the Shannon Estuary via the storm water outfall pipe. The WWTP will be designed to treat wastewater for up to 67 personnel, which is the maximum number of staff anticipated to be onsite during normal working hours (excluding the FSRU and tug staff). An average flow of 0.4 L/s (34.5 m^3/day) is expected to be discharged from the WWTP.

Figure 2-23 provides an overview of the treatment process. The treated wastewater will be monitored for compliance with the IE licence limits prior to discharge and will be continuously monitored for pH before discharging to the estuary. The automatic control system associated with the WWTP will sound an alarm if pH falls outside of expected range. This will alert the operator to take corrective action to remedy the problem. If the problem continues to go outside the pre-set range, this will automatically close the discharge valve and effluent will be diverted to a holding tank.

Table 2-7 summarises the characteristics of the WWTP discharge.

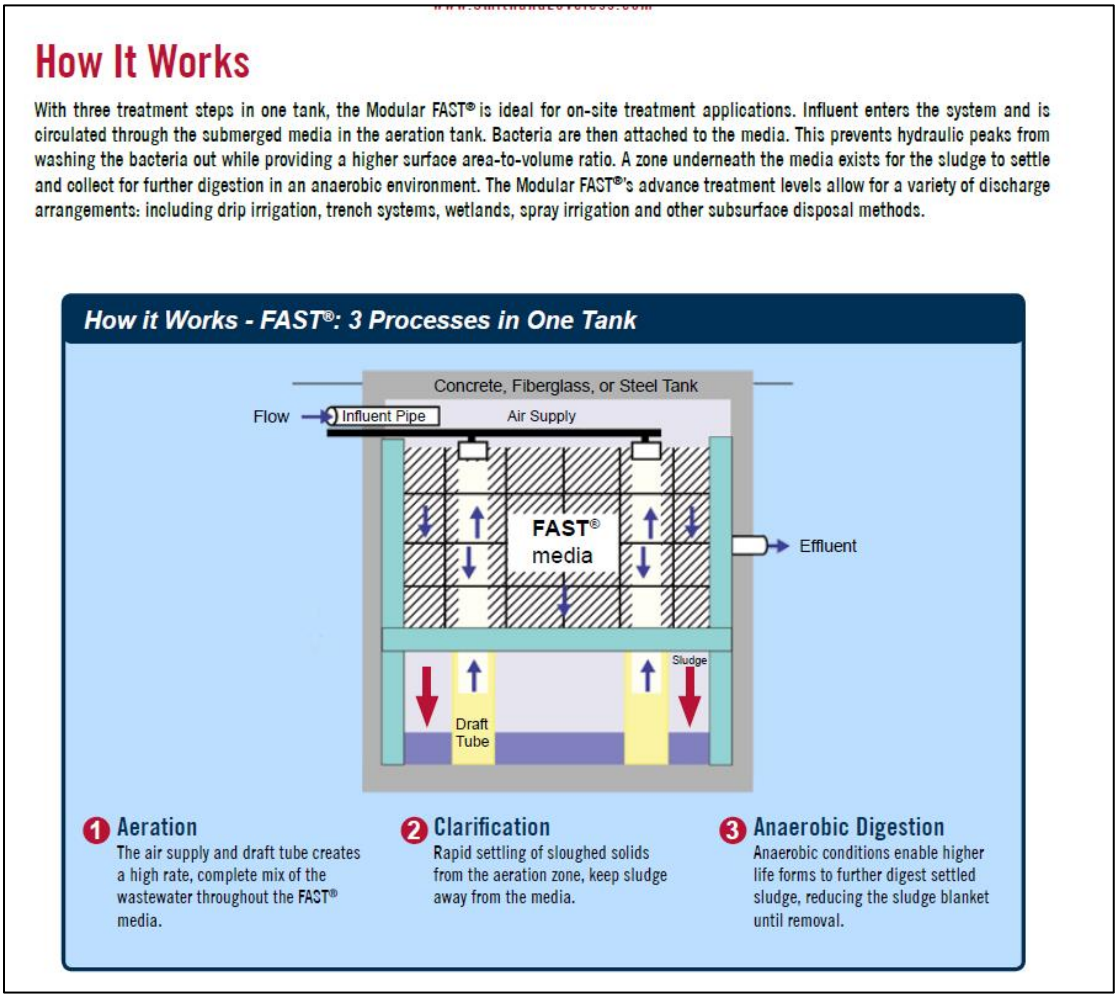

Figure 2-23 Overview of Proposed Wastewater Treatment System

Table 2-7 Characteristic of Wastewater Treatment Plant Discharge

Parameter	Discharge Limit Value
Volume	35 m^3/day
pH	6 – 10
BOD	25 mg/l
Suspended Solids	35 mg/l
Ammonia	5 mg/l as N
Total Phosphorous	2 mg/l as N

All sanitary effluent from the FSRU will be retained onboard and pumped to a vacuum lorry for transfer to a licensed waste facility. Table 2-8 provides estimated of expected operational waste quantities from onshore operations, the FSRU, tugs and potentially from visiting LNGCs.

Table 2-8 Estimated Waste Quantities

Waste Type	Waste Classification	Quantity per Year (m^3)	Potential Waste Management Route
Galley waste (garbage from FSRU, tugs and LNG carriers)	Non-hazardous	240	In accordance with MARPOL Annex V requirements, when in port waste all waste will be stored in suitable containers onboard. Periodically this will be transferred to shore and taken to a licensed waste

Waste Type	Waste Classification	Quantity per Year (m^3)	Potential Waste Management Route
			management site by a licensed waste contractor. Waste from visiting LNG carriers will be managed as International Catering Waste and securely transferred to a designated and licensed disposal site. Source segregation of recyclables (e.g. paper/ card, plastics, metal & glass) for non-ICW
General office waste from onshore activities	Non-hazardous	50	Source segregation of recyclables (e.g. paper/ card, plastics, metal & glass) Residual waste transported to licensed waste treatment facility (landfill or energy-from-waste)
Oily waste (waste from FSRU, tugs and LNG carriers, e.g. sludges from oil water separators)	Hazardous	900	In accordance with MARPOL Annex I the material will be transferred to shore to a licensed waste contractor for management or disposal at a licensed site.
Hazardous materials, e.g. chemicals from FSRU, LNG Terminal and CCGT	Hazardous	10	Export to hazardous waste management facility for recycling/ recovery or high-temperature incineration – delivery to an approved reception facility offshore
Sanitary waste from site washrooms	Not applicable (not subject to Waste Framework Directive)	Faecal wastewater ('black water'): 270 m^3 Other sanitary wastewater ('grey water'): 2430 m^3	Treated by onsite wastewater treatment plant (WWTP) and discharged.

2.4.7.3 Firewater Retention

A firewater retention pond is included in the Proposed Development and sized according to Environmental Protection Agency (EPA) Guidance on Retention Requirements for Firewater Runoff, as the most effective and suitable measure for retaining firewater. The retention pond will be rendered impermeable by use of an appropriate liner, and integrity-tested in line with the requirements of the site's licence. All drainage will pass through the retention pond. An automatic shut-off valve linked to the site's fire detection system will be installed on the drainage outlet point.

2.5 Discharges and Emissions

2.5.1 Power Plant: Process Effluent Collection System and Sump

The Power Plant will generate several process water effluent streams. Some of the effluent streams will be collected and transported offsite to a licensed facility and the remaining effluent streams will be pumped or fall by gravity to the effluent sump. Refer to the water flow diagram below (Figure 2-24).

The wastewater effluent collection will comprise:

- Water treatment process effluent;
- Steam cycle blowdown/ drains;
- Auxiliary boiler blowdown/ drains;
- Turbine hall drains; and
- Gas turbine wash water effluent.

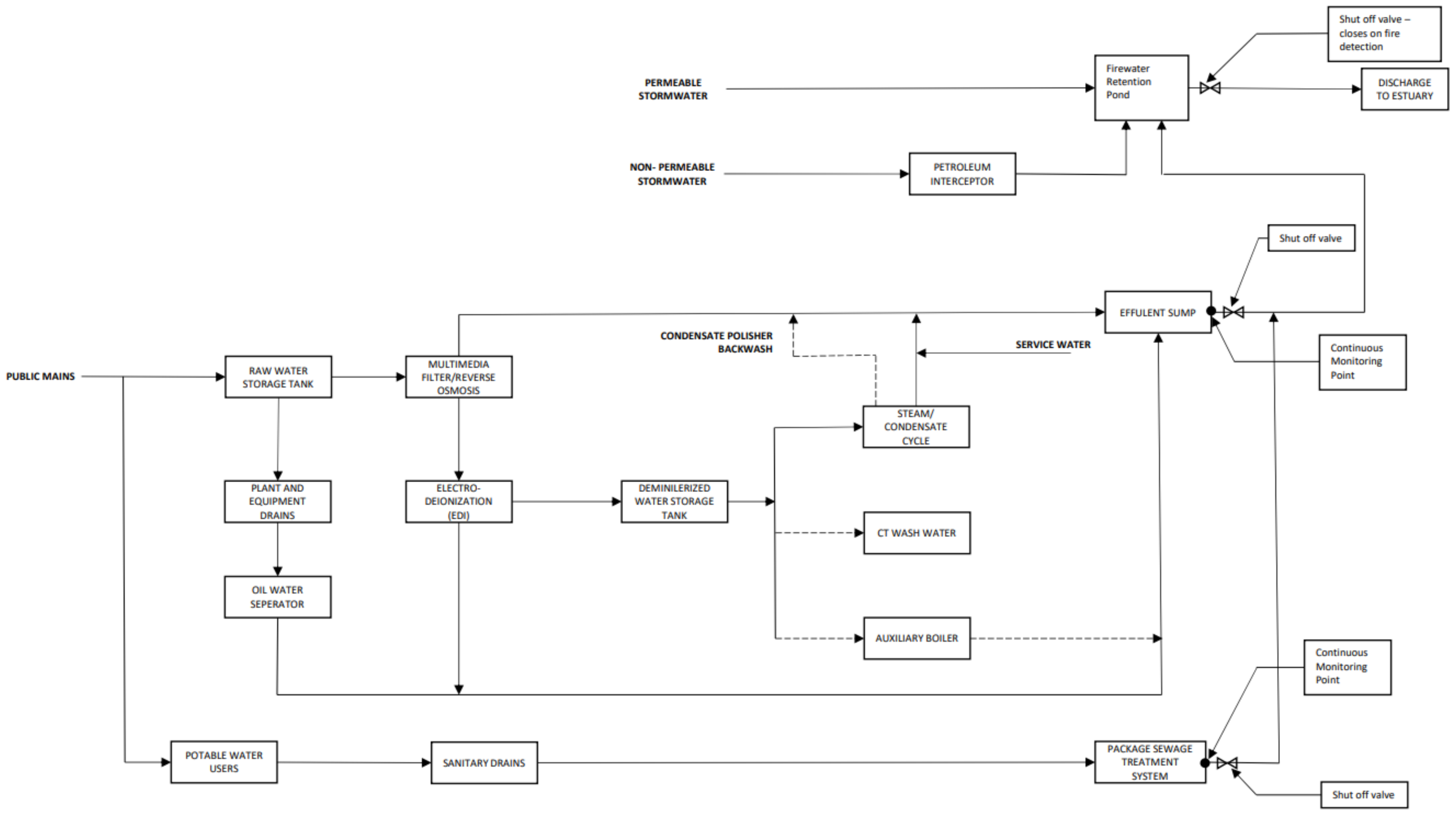

Figure 2-24 Proposed Development Water Flows

2.5.1.1.1 Water Treatment Plant Effluent

A wastewater stream will be produced by the water treatment plant. The effluent streams arising from these activities will contain inorganic dissolved solids as well as negligible traces of dilute solutions of acid, caustic, sodium bisulfite and antiscalant. The water treatment plant effluent will be directed to the effluent sump before discharge into the Shannon Estuary.

2.5.1.1.2 Steam Cycle Blowdown/ Drains

In the case of the Heat Recovery Steam Generator (HRSG), a continuous stream of water approximately 2% of the volume, called blow-down, will be removed from the otherwise closed water systems. It will be necessary to remove this water to maintain the level of dissolved solids in the steam at an acceptable level in order to minimise corrosion and deposition in the boiler water circuits, as well as maintaining steam quality. The boiler water will be dosed to ensure it will stay within the operating limits of the Power Plant. As a result, the blow-down will contain salts and will be alkaline with a pH typically up to 9. The blowdown will be collected in a blowdown tank, cooled with service water to a temperature between 25 °C and 40°C, and then pumped to the effluent sump.

Other intermittent effluent streams from the steam cycle are process steam drains and backwash of the condensate filter. During normal operation, superheated steam from the steam turbine will be sent to the HRSG; however, during start-up and shutdown when the steam piping is heating and cooling the steam will condense and be drained to the process effluent sump via the blowdown tank. There will also be intermittent backwash of the condensate polisher that will be sent to the effluent sump.

2.5.1.1.3 Auxiliary Boiler Blowdown

Similar to the heat recovery steam generator, a continuous stream of water approximately 2% of the volume, called blow-down, will be removed from the auxiliary boiler. It will be necessary to remove this water to maintain the level of dissolved solids in the steam at an acceptable level in order to minimise corrosion and deposition in the boiler water circuits, as well as maintaining steam quality. The boiler water will be dosed to ensure it will stay within the operating limits of the Power Plant. As a result, the blow-down will contain salts wthi a typical up to 9 (i.e. alkaline). The blowdown will be quenched with service water to a temperature of approximately 60° C and pumped to the effluent sump.

2.5.1.1.4 Drain Down of Feed Water and Heat Recovery Steam Generator System

During maintenance it may be necessary to drain the feed water and HRSG or auxiliary boiler systems and dispose of the water contained within these systems. This water will be sent to the effluent sump.

2.5.1.1.5 Turbine Hall Floor Drains

There will be floor drains in the turbine hall to collect water from floor washing and process equipment. The effluent from the floor drains will be collected and sent through an oily water separator. The water discharged from the separator will be sent to the effluent sump. The oily waste will be collected and removed offsite to an appropriate waste licensed facility.

2.5.1.1.6 Other Process Liquid Wastes

There will be other liquid wastes from the process equipment that will not be sent to the effluent sump but will be collected and removed offsite to an appropriate waste licensed facility. These other waste streams are as noted below:

- Gas turbine water wash – Collected in wash water tanks one per CTG (~2 m^3 each);
- Closed cycle cooling water system drain down – Collected by tanker truck or frac tank; and
- Sludges from petroleum interceptors – Collected in situ.

2.5.1.1.7 Outfall Discharge to Estuary

Process water effluent leaving the effluent sump will be continuously monitored for pH before discharging to the estuary. The automatic control system associated with the effluent sump will sound an alarm if the pH goes outside a pre-set range – typically 6 to 10. This will alert the operator to take corrective action to remedy the problem. If the pH continues to go outside the pre-set range, this will automatically close the discharge valve and open the associated re-circulation valve and will then start the re-circulation process during which period the sump will be dosed with either acid or caustic soda to return the pH to between 7 and 8. At this stage the automatic discharge valve will re-open and the re-circulation valve will close.

Regular visual checks will be undertaken for oils and greases in the sump to ensure that the discharge will be free of these contaminants before discharge.

The process effluent in the sump will be monitored for compliance with the IE licence limits and then discharged, via the storm water outfall pipe, to the Shannon Estuary. See Chapter 06 – Water for more details.

Table 2-9 below summarises the process effluents generated from the Power Plant and provides estimated quantities.

Table 2-9 Estimate of Water Discharges from Power Plant

System	Source	Characteristics	Monitoring	Rate
Boiler water treatment plant	Filter effluent. Effluent from treatment plant stages and back wash/ regeneration/ concentrate as appropriate to system installed.	High/ Low pH prior to treatment. Negligible traces of salt, dilute solution acid, caustic, sodium bisulfite and anti scalant. Effluent treated to give a pH at outlet of 6-9.	Effluent sump. Monitoring of pH and visual checks of oil and grease contamination	8.6
HRSG and Auxiliary Boiler blowdown	Outlet from blowdown vessel via a cooler. Water from drain header.	High purity water with traces of ammonia, and phosphate. pH 6 to 9. Temperature about 60°C. Trace salt in the form trisodium phosphate 5-6 ppm and silica 3-5 ppm, BOD 20 mg/l.	Effluent sump	14
Drain down of plant	Occurs during maintenance when necessary to drain feedwater and HRSG system.	High purity water with traces of ammonia, and phosphate.	Effluent sump	Maintenance activity
Turbine hall floor drains	Wash down of floor drains and equipment process drains form turbine hall.	Traces of oil.	Removed offsite for disposal at licensed facility, approximately once per year	0.03
Gas turbine washing	At intervals it is necessary to wash the gas turbine compressor blades.	Traces of oil detergent.	Removed offsite for disposal at licensed facility	N/A
Drain down of closed cooling water system	Occurs during maintenance of these systems (based upon operating hours, typically 2-3 years).	High purity water containing traces of sodium molybdate.	Removed offsite for disposal at licensed facility	N/A
Disposal of Oil	Various (bunds, site interceptors, oil/ water interceptor).	Oil and sludge.	Removed offsite for disposal at licensed facility, approximately once per year	N/A

Table 2-10 summarises the characteristics of the process effluent discharge.

Table 2-10 Characteristic of Process Effluent Discharge

Parameter	Typical Range of Emissions (min to max)
Maximum flow rate	774 m^3/day
pH	6 – 9
Temperature range	40°C
BOD	20 mg/l
Suspended Solids	30 mg/l
Total Dissolved Solids	5000 mg/l
Mineral Oil	20 mg/l
Total Ammonia (as N)	5 mg/l
Total Phosphorous (as P)	5 mg/l

2.5.2 LNG Terminal

Liquid waste from the FSRU, tugs and LNGCs is expected to total 240m^3 per year. When in port all waste will be stored in suitable containers onboard and periodically transferred to shore to be taken to a licensed waste management site by a licensed waste contractor. Waste from visiting LNG carriers will be managed as International Catering Waste and securely transferred to a designated and licensed disposal site.

All sanitary effluent from the FSRU and tugs will be retained onboard and transferred to via vacuum lorry to a licensed facility. Emissions of water from the FSRU are included in the total waste quantities above.

2.5.3 Air and Noise Emissions

During its operation, the Proposed Development will produce air and noise emissions from a number of different sources.

2.5.3.1 Noise Emissions

The operation of the Proposed Development will include a number of noise emission sources as outlined below:

- Noise generating mechanical plant associated with the Power Plant and LNG Terminal including Air Intake Filter House and Generator Cooling Outlet (air cooled);
- Three CTGs to be installed within the LNG Terminal (two operational and one back up);
- FSRU and LNGC equipment; and
- Tugs engines and generators.

In addition, there are noise sources which will operate intermittently. These intermittent sources are:

- Firewater Pumps;
- Firewater Jockey Pumps; and
- Black Start Diesel Generator.

Noise generating plant associated with the AGI will comprises the following:

- Odorant New Blend Pump Unit;
- Package Boiler Units;
- Gas Fired Generator; and
- Pressure Regulating Stream.

The noise levels from the aforementioned sources are outlined in Chapter 09 – Airborne Noise and Groundborne Vibration (both for the construction and operational phases). A list of construction vehicles and plant is provided in Appendix A2-7, Vol. 4.

2.5.3.2 Air Emissions

The operation of the Proposed Development will include a number of sources with emissions to air associated with combustion plant, to generate heat and power for onsite activity. Emissions to air associated with such plant vary with the type of plant and its purpose, the thermal capacity of the plant and the fuel used to enable combustion.

Natural gas will be the primary fuel source for all non-emergency plant at the Proposed Development site. Emissions from natural gas-fired plant predominantly include the pollutants NO_X and CO but may also include other pollutants to a lesser extent for some sources, including THC, some of which will comprise of VOC, including CH_2O.

Liquid fuel will also be utilised. Onshore, this fuel is limited to generators that will only ever be operational in the event of an emergency and for limited periods of testing and maintenance[5]. Offshore, liquid fuel is required as the pilot fuel for the main power engines on the FSRU and the operational facility's tug-boat fleet. Liquid fuel may also be likely as the engine fuel for a small proportion of the LNGCs delivering to the operational facility. Emissions from liquid fuel-fired plant include the same pollutants associated with natural gas, plus PM_{10} and SO_2 (although SO_2 emissions are generally lessened by the use of low and ultra-low sulphur content fuels). The Proposed Development will be operated under the conditions of an Industrial Emissions (IE) Licence, the terms of which will require that any fugitive emissions are controlled at source through appropriate mitigation and monitoring measures, possibly set out as part of an Operational Emissions Management Plan, or a specific Odour Management Plan.

Additional information can be found in Chapter 08 – Air Quality.

2.5.4 Lighting

Down angle lighting will be installed with the Proposed Development site to illuminate the LNG Terminal, including the vessel / onshore interface areas to ensure activities can be safely conducted during periods of darkness.The Power Plant will have area lighting installed on a down angle to cover the facility and the car parking areas while minimising impact to surrounding neighbours.

The height of the proposed light columns has been kept to a minimum throughout the Proposed Development site, and light temperatures reviewed to minimise the content of blue light. Light columns will be fitted with focused luminaires to avoid glare, sky glow and light spill to the estuary. Figure F2-7 in Volume 3 present lighting design drawings.

An uninterruptible power supply for emergency lighting shall be provided to allow for safe escape of staff from accessible areas of the plant in the event of a power and essential lighting failure or an emergency.

[5] As noted in Section 2.4.1.7 after consultations between the CRU and the Applicant, the CRU has agreed that the Power Plant does not need to combust liquid fuel to comply with CRU rules on Secondary fuel obligations.

2.6 Site Management

2.6.1 Staffing

Once operational the Proposed Development will employ approximately 101 permanent staff, some of whom will work in shifts as the plant will be operational 24 hours per day for seven days a week. This number excludes the FSRU and tug crews. The maximum number of staff onsite during normal working hours (excluding the FSRU and tug staff) is anticipated to total 67 employees. Additional contract staff and service personnel will be utilised as needed. The LNG Terminal and the Power Plant will be operated with integrated staffing. Personnel will perform the following functions:

- Management and administration;
- Operations;
- Maintenance;
- Marine operations;
- Health, Safety, Security and Environment;
- Finance and accounting; and
- Sales and marketing.

Managerial staff will be experienced personnel from the energy industry. Apart from the FSRU complement of approximately 35 crew members, who will be international marine crew employed by the Ship's operator, operations, maintenance and support personnel employed for the Proposed Development will be recruited locally to the extent possible. Staff will be given extensive training which will include in-plant training or experience in another operating LNG facility or Power Plant. All key personnel to work on the LNG Terminal will be trained in the properties of LNG and natural gas, , proper operation of all equipment, workplace safety and incident response, including leaks, spills, and fires.

The Applicant will operate and maintain the LNG Terminal and the Power Plant to meet or exceed all applicable European Union and Irish employment regulations and requirements. The Applicant will prepare, maintain and update a comprehensive set of operations, maintenance, safety, and emergency response manuals for the combined operations. All operations and maintenance personnel will be trained in accordance with the procedures in these manuals.

Maintenance staff will carry out routine inspections, maintenance, and repairs, as well as major equipment overhauls, where applicable. Certain major overhauls and maintenance will be handled by contract maintenance personnel. Security personnel, pilots, tug and mooring personnel, and catering/ cleaning personnel will be provided by third parties. Warehouse personnel are anticipated to be contract staff.

After the start of operations, operating and maintenance personnel will be involved in ongoing safety, operating, and maintenance training. Operating, maintenance, and emergency response procedures and manuals will be subject to regular review and will be updated to reflect best industry practices, or to reflect the addition of new procedures, equipment or other facilities at the Terminal and Power Plant.

2.6.1.1 Liquid Natural Gas Terminal

The LNG Terminal will be designed to operate 24 hours per day using a rotating shift schedule. The actual shift schedule has yet to be determined; however, it is anticipated that the following manpower levels will be provided.

It is anticipated the FSRU will have up to 35 crew onboard. This will include a Master, 4 deck officers, Cargo engineer, Chief Engineer and 4 engineering officers. The remainder of the crew will be working on deck, in the engine room, LNG process and in catering. The crew typically work on 3- or 6-months rotation, i.e. the officers and supervisory staff work 3 months on and 3 months off, while the remainder of the crew typically work 6 months onboard and 6 months off. When onboard, the crew normally work a 12-hour shift pattern, and they will be stay onboard for the duration for their rotation except when granted shore leave.

The majority of the crew members on the FSRU are anticipated to originate outside of Ireland, and crew changes will be managed by the Ship's Operator, who will make available suitable transport for the crew to travel to and from Shannon or Dublin Airports as required for journeys to and from their homes countries. Appropriate Covid-19 protocols will be in place and adhered to at all times.

The tugs will normally have a working crew of 4 onboard. One of the tugs will be fully mobilised at all times, and a full complement of crew will be onboard for immediate response. A second tug's crew will be on call for immediate callout and must be ready to be onboard within 30 minutes of being called. Crews for tugs 3 and 4 will be available on 2-hours' notice.

The onshore receiving facility and jetty are anticipated to have approximately 20 personnel working during the day (09:00 – 17:30). In addition, there will be 5 shifts of 3 staff working on a 24-hr shift pattern as follows: (08:00 – 16:00), (16:00 – 00:00) and (00:00 – 08:00).

2.6.1.2 Power Plant

The Power Plant is designed to operate 24 hours a day using a rotating shift schedule. It is anticipated that a total of 34 staff will be required for the operation of the Power Plant, as follows:

- 26 day staff (08:30 – 17:00); and
- 40 shift staff – 5 shifts of 8 employees.

Additional contract staff and service personnel will be engaged in the Power Plant as needed.

2.6.1.3 Above Ground Installation

The AGI is a normally unmanned facility, operated by GNI. GNI personnel will visit the AGI as and when required for inspection and maintenance purposes.

2.6.1.4 Training

The Proposed Development, through its training regime, will ensure every employee is aware of his/ her responsibility to work safely, adhere to safety rules and work procedures, use safety equipment provided, is environmentally responsible, and play an active role in the Proposed Development's drive for continual improvement in health, safety and environmental (HSE) performance.

Pre-operational training and regular refresher courses, using simulators, will be undertaken, involving all relevant parties, including SFPA, KCC's Fire Department and the Proposed Development employees.

2.6.1.4.1 LNGC and FSRU Emergency Response and Crew Training

The IMO has developed standards for the design and construction for all classes of ships. These standards, published as specific codes, govern design, materials, construction, equipment, operation and training, and include a code covering 'Ships Carrying Liquefied Gases in Bulk' with specific reference to LNG.

Safety and crew training are addressed in IMO Conventions such as Safety of Life at Sea (SOLAS) and Standards of Training, Certification & Watchkeeping for Seafarers (STCW). These are further supplemented by any additional training provided by the vessel owner/ operator over and above statutory requirements.

The FSRU and arriving LNG Ships will be self-sufficient in their fire detection and fire-fighting capability. All FSRU and LNG ship crew members will have completed extensive training in dealing with shipboard fire response as is required under SOLAS and STCW.

IMO codes covering LNG Ships require them to have fire detection and firefighting equipment in excess of that required by conventional shipping. In addition to the gas detection systems surrounding the LNG cargo containment, there will be gas detectors in compressor rooms, motor rooms, the main engine room and accommodation areas. Heat and/ or fire detectors will be located at cargo tank domes, at the cargo transfer manifolds, in the main engine room and in accommodation spaces.

Conventional firewater mains and hydrants will be supplemented by a self-contained dry chemical powder system covering all cargo areas with a combination of fixed and hand-held monitors. The LNG ships will also be fitted with a water deluge system for fire prevention, or in the rare event of fire, for cooling the LNG ship structure and for crew protection. The deluge system will cover all cargo domes, cargo transfer manifolds and all deck houses and the super structure, accommodation block facing the cargo area. The pumps and valves can be operated remotely, and the system capacity is capable of deluging the accommodation and cargo areas simultaneously.

Sufficient quantities of personal protective equipment (PPE) will be carried in the form of self-contained breathing apparatus, fireman suits and protective suits to permit personnel to enter a cold gas atmosphere. All LNG ship crew members will receive extensive training in fighting shipboard fires as is mandated under IMO codes, flag state requirements and owner's response plans. In addition to monthly drills onboard the vessel, the vessel will also participate in terminal drills covering such areas as gas release, pool fire, electrical fire, confined space extraction.

2.6.1.4.2 Tugs Emergency Response

The firefighting capabilities required of the tugs will be as a minimum that they be equipped to FiFi 1 Class standard. The class notation FiFi 1 means that the tug is equipped with a minimum of 2 fire monitors, which will be able to throw water to a minimum distance of 120 m from the vessel and to a height of minimum 45 m. The monitors will be controlled remotely from the wheelhouse of the tug.

2.7 Process Control and Monitoring

2.7.1 LNG Terminal

The process and utility systems will be automated to support centralised monitoring and operations. Local controls to start, stop, or adjust instrumentation setpoints will be provided where local operations are desired. All actions will be under the supervision of the MCR operations staff. All critical process operations will be monitored and recorded. An integrated control and safety system (ICSS) will be provided. It is anticipated that some process equipment will operate with its own distributed control system hardware and software which will be integrated into the overall ICSS and is discussed in the following section. Refer to Section 2.5 for more information on emissions from the Proposed Development.

2.7.1.1 Integrated Control and Safety System

The ICSS will be a distributed control system that will provide process control, fire and gas detection, event logging, and emergency shutdown (ESD) functions. The functions will be fully integrated and standardised hardware and software will be utilised throughout the system as far as possible. The system is intended to minimise the need for communication gateways or bridges between software systems, thus improving the system reliability and increasing operational flexibility.

The equipment chosen will be well proven but of an up-to-date design.

The primary objective in the design of the ICSS is to provide high reliability and availability. The system will provide safe, efficient and reliable equipment of proven design. The system will use current technology with modern diagnostic capability to increase failure reporting and reduce maintenance requirements.

Dual redundant architecture will be used to avoid common mode failure points and increase availability.

The ICSS should comprise the following sub-systems:

- Process Control System (PCS);
- Process Safety System (PSS);
- ESD; and
- Fire and Gas System (FGS).

The PCS will function to produce on specification product. It will automatically correct disturbances caused by changing process conditions. The safety system is mainly composed of the ESD, FGS and PSS.

Unsafe process and operational conditions in any part of Terminal can be detected and will activate the FGS, PSS and/ or ESD, systems accordingly. The FGS, PSS and/ or ESD, system will provide a controlled shutdown of the facilities. The shutdown system could be initiated manually or automatically. The ESD will provide a reliable response to the process and fire and gas detection systems and will take the necessary executive action to avoid escalation of the event.

2.7.1.2 Alarm Management Overview

The alarm system will form an essential part of the operator interface with the ICSS. Within the alarm management framework determining the roles and responsibilities of facility operations and maintenance support personnel is paramount to ensuring that the alarm system is operated, managed and improved to obtain optimum plant efficiency through the management of abnormal conditions. The alarm system will provide vital support to the operators managing complex systems by warning them of situations that need their attention. The alarm system warns the operator that the process is moving from a Normal to an Abnormal state.

To prevent alarm flooding a robust method of alarm management and rationalisation is required. Each alarm must alert, inform and guide the operator. The information presented to the operator will, where possible, present an indication of what has gone wrong and why it may have occurred. Each configured alarm will be unambiguous and not duplicated by other alarms. Sufficient time should be allowed for the operator to analyse the situation and carry out the defined response. Operator response time includes the time to diagnose the problem and perform the corrective actions (such as shutdown). Alarm documentation and rationalisation is a consistent, logical process used to identify, prioritise and document alarms. The objective of alarm rationalisation is to create an alarm system with the correct number of alarm activations (not necessarily fewer configured alarms) and acceptable alarm rates. All changes to the alarm system must be controlled by management of change procedures. Testing and training of operators will be carried out at the implementation stage of the alarm lifecycle and continue to be performed throughout the life of the asset.

2.7.1.3 Jetty

Active and passive fire protection will be installed on the jetty including a firewater ring main to provide firefighting capability at the jetty. The firewater will have the function of providing protection from incident thermal radiation and for cooling equipment purposes. This will include the following:

- Firewater curtain to enable personnel to escape via gangway tower and/ or trestle;
- Jetty firewater curtain to reduce incident thermal radiation on the FSRU hull;
- Elevated firewater monitor(s) to provide sufficient cooling water coverage to the GLAs and/ or FSRU manifolds;
- Firewater coverage of piping for cooling purposes; and
- Onshore fire pumps with remote and local start/ stop functionality, each capable of delivering full cooling of the pierhead area and the hull of the FSRU.

The firewater system will have a capacity of approximately 800 m^3/hr. Additional information on fire safety policies and procedures can be found in Section 2.8.1.

2.7.2 Power Plant

The Power Plant will be monitored and controlled from the central control/ operations building. This building will include a control room, meeting room and offices for the operations personnel stationed at the Power Plant.

2.7.3 Above Ground Installation

The AGI, which is normally unmanned, is operated and controlled from GNI's central control system. Personnel at the LNG Terminal will be in frequent contact with GNI, who through nomination determine the offtake rate of gas from the LNG Terminal. Refer to Figure 2-16 for the proposed AGI layout and Section 2.4.2.6 for a description of components that will be included in the AGI.

2.8 Health, Safety and Environmental Aspects

The Applicant recognises and accepts its moral and legal responsibilities for ensuring the health, safety and welfare of its employees, contractors, visitors and members of the public who could be affected by its activities; it is committed to compliance with all applicable Irish health, safety and environmental laws and regulations.

The Directors and Senior Management of the Proposed Development have overall responsibility for the implementation of its HSE policies. These policies will be reviewed periodically to ensure that they remain relevant and appropriate to the Proposed Development's operations and business.

The Applicant will implement a HSE Management System, which will include setting of objectives and targets, measuring progress, reporting results as a commitment for continual improvement, and fostering a culture where incidents are reported and investigated and lessons learned are shared through the organisation. It will use regular audits to ensure its controls are effective. It will provide appropriate health, safety and environment training and guidelines to employees and contractors to enable them to meet the required standards of performance.

The Applicant aims to minimise the health, safety and environmental impacts of its activities and prevent pollution by utilising a structured risk management approach, which includes emergency preparedness and contingency planning. All new activities will be assessed for environmental impact and appropriate health and safety provision, and ongoing activities will be subject to periodic review. Health, safety and environmental protection will be given equal priority to the business objectives of the company.

The Applicant is committed to effective communication and consultation on health, safety and environmental matters with all interested parties and will make its policies available to them subject to appropriate privacy and business confidentiality protections. The Applicant will routinely monitor, assess and report on its health, safety and environmental performance with data on the rate of lost time injuries and occupational injuries. Fire and gas detection systems and associated alarm processes are summarised in Sections 2.7.1.1 and 2.7.1.2 above.

The Applicant will ensure that operating, maintenance, and emergency response procedures and manuals will be subject to regular review and will be updated to reflect best industry practice, or to reflect the addition of new procedures, equipment or other facilities.

2.8.1 Internal Fire and Rescue Plan

Safety is the main consideration in the Proposed Development design. The main fire hazards on the Proposed Development are identified from the quantitative risk assessment (QRA), which was undertaken by Vysus (previously Lloyds Register) for the Proposed Development on behalf of the Applicant (Appendix A2-5, Vol. 4). The QRA includes hydrocarbon flash fires, jet fires and pool fires. To limit the consequences of fire scenarios and to cope with any potential domino effects, the Proposed Development will be partitioned into fire zones, which are areas within the installation where equipment is grouped by nature and/ or homogeneous level of risk attached to them. The partition of an installation into fire zones will result in a significant reduction of the level of risk. The consequences of a fire, flammable gas leak or an explosion corresponding to the credible event likely to occur in the concerned fire zone shall not impact other fire zones.

In order to mitigate or control these hazards, the proposed ESD coupled with the PCS and the FGS, are crucial to ensure the safety of the plant. Should there be a loss of containment and/ or subsequent fire, the FGS will activate. The potential hydrocarbon release to be detected is a clean non-toxic single-phase gas in a well-ventilated area. On confirmed FGS detection, the active fire protection system will operate. A voting logic will be implemented to avoid spurious trips.

The fire hazards associated with the Proposed Development will be mitigated by the use of passive and active fire protection. Passive fire protection (PFP) is aimed to protect personnel and ensure that escape, evacuation and rescue (EER) systems can enable safe evacuation in all scenarios linked to hydrocarbon fire hazards at the Proposed Development site. PFP is mandatory on equipment and structures that could be exposed to a fire that could lead to loss of integrity.

Active fire protection (AFP) aims to control fires and limit escalation, reduce the effects of a fire to enable personnel to undertake emergency response actions or to evacuate, extinguish the fire where it is considered safe to do so, and limit damage to structures and equipment. The AFP equipment at the Proposed Development site will include a combination of:

- Fire water mains network, with hydrants and monitors;
- Water spray systems;
- Water curtains/ hydro shields;

- Portable dry chemical powder systems;
- Firefighting vehicle(s); and
- Portable/ mobile fire extinguishers.

An appropriate firefighting and rescue trained crew will be available/ provided onsite and ready at all times. Employees will be trained in all emergency response actions including natural gas leak and fire situations. Fire safety certificates will be required from the Chief Fire Officer of KCC prior to construction of the facility for each building on the site. The plant shall be operated in a safe and efficient manner compliant with national health and safety legislation.

The activation of firefighting equipment could be manual by push buttons located locally or control room to initiate extinguishing agent, or automatically through the FGS.

The jetty with the FSRU moored will contain primary and secondary escape routes. The primary escape route connects the jetty area via the trestle to the jetty landfall area where a muster point will be located. The jetty primary escape route also interfaces with the FSRU which has its own muster area, temporary refuge (TR), embarkation area or means of escape to the sea.

The primary route will have sufficient lighting along the jetty, floor painted markings (yellow/ black zebra lines), an anti-slip coating, illuminated signs (white with a green background) to identify the muster point which will be located at the jetty landfall, illuminated signs (white with a green background) to identify the escape route(s), a plan of the escape route(s) on the jetty, and life buoys along the escape route(s), etc.

For the onshore installation, the onshore primary escape route will lead to the muster area(s). The onshore secondary escape routes or paths from modules/ locations outside the main fire zones will lead personnel to the primary escape route. An alternative muster point will be provided for should access to the main muster point be impaired. Muster areas are safe places where all personnel normally muster while investigations, emergency response and evacuation pre-planning are undertaken. The main functions of the mustering are to protect personnel, to number and identify personnel, to provide first aid, and to provide information.

An emergency plan will be drawn up in consultation with the port authority, fire brigade, gardai, etc., and shall integrate with any other relevant plans, such as the port emergency plan. The plan will include as a minimum:

- The specific action to be taken by those at the location of the emergency to raise the alarm;
- Initial action to contain and overcome the incident;
- Procedures to be followed in mobilising the resources of the LNG Terminal, as required by the incident;
- Evacuation procedures;
- Assembly points;
- Emergency organisation, including specific roles and responsibilities;
- Communications systems;
- Emergency control centres; and
- Inventory and location of emergency equipment.

The Proposed Development will have an emergency team whose duties include planning, implementing and revising emergency procedures, as well as executing them. The emergency plan, when formulated, will be properly documented in an ‘Emergency Procedures Manual’, which will be available to all personnel whose work relates to the present facilities.

Both vessels – the FSRU and any visiting LNGC – will be advised of the LNG Terminal's emergency plan, as it relates to the ship, particularly the alarm signals, emergency escape routes, and the procedure for a ship to summon assistance, in the event of an emergency onboard.

The tugs will also be designated as firefighting craft, which enables them to supplement the LNG ships and LNG Terminal's firefighting capabilities and to act as an integral part of the overall response team and equipment at the facility.

Article 13 of the Seveso III Directive requires that: '*the objectives of preventing major accidents and limiting the consequences of such accidents for human health and the environment are taken into account in their land-use policies or other relevant policies*'. As reflected in the Chemicals Act (Control of Major Accident Hazards Involving Dangerous Substances) Regulations 2015 (S.I. 209 of 2015), this is to be achieved through controls on the siting of new establishments, modifications to existing establishments and new developments in the vicinity of such establishments. The regulations take into account the long term need to maintain appropriate distances between establishments and residential areas, buildings and areas of public use, recreational areas, major transport routes as far as possible, and areas of particular natural sensitivity or interest. Technical advice on the risks from an establishment must be made available to the planning authority. The Planning and Development Regulations 2001 to 2021 specify when planning authorities should seek technical advice in this area and the information that must be supplied to the HSA when seeking the advice.

A quantitative risk assessment (QRA) was undertaken by Vysus (previously Lloyds Register) for the Proposed Development on behalf of the Applicant. The major accident hazards at the establishment were identified. A summary of the major accident scenarios, together with the measures in place to prevent them or mitigate their consequences, is presented in the summary of the QRA.

QRA (Qquantitative Risk Assessment) has been carried out for the purposes of Land Use Planning (LUP) in accordance with draft HSA Technical Land use planning guidance 2021 (HSA, 2021). The land use planning zone boundaries are defined as:

- Zone 1 (inner): within the 1 x 10^{-5} /y individual risk of fatality contour;
- Zone 2 (middle): between the 1 x 10^{-5} /y and 1 x 10^{-6} /y individual risk of fatality contours; and
- Zone 3 (outer): between the 1 x 10^{-6} /y and 1 x 10^{-7} /y individual risk of fatality contours.

The criteria for new establishments are:

- The individual risk of fatality at the nearest residential property should not exceed 1 x 10^{-6} /y; and
- There should be no incompatible land uses existing within any of the three zones.

Details of the QRA study for the establishment will be described in the Predictive Elements section of the Safety Report. QRA provides a quantification of the risks associated with the reasonably foreseeable major accident scenarios identified. The method involves calculating the frequency of a representative range of sizes of releases from equipment using suitable available published data.

The physical consequences of these releases are modelled (e.g. level of thermal radiation), as well as the impact on people, considering a range of weather conditions. This information is combined to give a numerical representation of the risk from the scenarios considered, in terms of 'individual risk' to site workers and members of the public offsite, and also 'societal risk' to the public population as a whole.

The QRA results are compared against tolerability criteria to demonstrate that the risk levels associated with the operations of the LNG Terminal are tolerable. Risk is traditionally defined as the product of a level of harm (severity) and the frequency of that level of harm occurring. Some risks (e.g. personal safety, slips, trips) have a relatively high frequency with low severity; others (e.g. major hydrocarbon fire) have a relatively low frequency with high severity.

Similarly, the level of risk ranges from relatively low to relatively high. At the lower end of the risk spectrum, the risks are comparable with those we are exposed to as part of our everyday activities and, as such, the risk is deemed 'broadly tolerable'. At the opposite end of the risk range, the risk is so high that it cannot be tolerated. Between these two extremes, there is a mid-range of risk values where the risk can be tolerated if it is demonstrated that it has been reduced to a level which is ALARP.

2.8.2 Pollution Mitigation and Response

The risk of marine pollution from the operation of the Proposed Development has been considered and reduced as far as possible. Specifically, the assessment of likelihood and consequences of release events from the Proposed Development are set out in the relevant sections of the following documents:

- Marine Navigation Risk Assessment (see Appendix A2-2, Vol. 4);
- OCEMP (see Appendix A2-4, Vol. 4);
- Quantitative Risk Assessment (QRA, summarised in Section 2.8.1) and associated Major Accidents to the Environment (MATTE) (Appendix A2-5, Vol. 4); and
- Environmental Impact Assessment Report (EIAR) for the Proposed Development (*this Report*).

Additionally, as discussed in Chapter 01 – Introduction, the operation of the Proposed Development will be controlled and regulated by the following bodies:

- Environmental Protection Agency;
- Commission for Regulation of Utilities;
- Health and Safety Authority; and
- Local Planning Authority (KCC).

The Shannon Foynes Port Company has statutory jurisdiction over marine activities, as detailed in Chapter 01 – Introduction.

In consultation with Shannon Foynes Port Company and the Shannon Estuary Anti-Pollution Team (SEAPT), Shannon LNG Limited has prepared an Oil and Hazardous and Noxious Substances (HNS) Spill Plan Development Framework for the Proposed Development. This document describes the framework in which Shannon LNG Limited will develop plans to provide a graduated, tiered and coordinated response to release incidents in the unlikely event they should occur. The developed plans will follow international best practice guidelines of the International Maritime Organization (IMO), The Society of International Gas Tanker and Terminal Operators (SIGTTO), and International Petroleum Industry Environmental Conservation Association (IPIECA) while taking into account relevant Irish legislative and regulatory approval requirements. In particular the plans will follow the requirements made within the National Maritime Contingency Plan Oil and HNS Spills 2019 (National Contingency Plan, NCP) and the National Framework for the Management of Major Emergencies. The plans will be developed to cover both In-Land (onshore) and Marine based releases and shall cover the Construction and Operational Phases of the project.

2.8.2.1 The Shannon Estuary Anti-Pollution Team (SEAPT)

The Shannon Estuary Anti-Pollution Team (SEAPT) is a Mutual Aid Group and the primary response organisations for oil and HNS spills within the Shannon Estuary. The SEAPT consists of the Shannon Foynes Port company, Kerry, Limerick and Clare Local Authorities and commercial and industrial entities operating within the Shannon Estuary. SEAPT was initiated to form a unified coordinated response to pollution incidents on the Shannon Estuary. SEAPT is a member's organisation. Members contribute annually to maintain equipment, carry out exercises and training and purchase new and replacement equipment. SEAPT holds a significant stockpile of equipment. This equipment is available to respond to any pollution incident or threat thereof. The Proposed Development will also be able to avail of spill dispersion modelling capability held by SEAPT. SEAPT are also the custodians of the Shannon Estuary Oil/ HNS Contingency Plan developed in accordance with the NCP and approved by the Irish Coast Guard. Shannon LNG Limited has consulted extensively with SEAPT and the intention is to join the SEAPT organisation on successfully receiving development consents and prior to commencement of the construction phase. The Proposed Development has (provisional to project go-ahead) been accepted as a member of the Shannon Estuary Anti-Pollution Team (SEAPT). Membership of SEAPT will enable the Proposed Development to interface directly with the approved Shannon Estuary Oil/ HNS Plan and access additional response equipment to augment that held within the LNG Terminal. Through the membership process, the Proposed Development will additionally be contributing to the ongoing development and strengthening of the SEAPT organisation.

2.8.2.2 Incident Response

In accordance with the requirements of the NCP Standard Operation Procedure 05, and the final STEP Oil and HNS Spill Plan, there will be the five operational phases of an incident response:

- Phase 1 – Discovery and Notification, Evaluation, Identification and Activation;
- Phase 2 – Development of an Action Plan;
- Phase 3 – Action Plan Implementation;

- Phase 4 – Response Termination and Demobilisation; and
- Phase 5 – Post Operations, Documentation of Costs/ Litigation.

The Proposed Development will manage the response to any Tier 1 (Local – within the capability of the operator on site) and Tier 2 (Regional – beyond the in-house capability of the operator) incident for any pollution on the water within their area of jurisdiction with the full cooperation and integration of the response with the Shannon Foynes Port, the Shannon Estuary Anti-Pollution Team (SEAPT) mutual aid group which includes the three local authorities of Kerry, Clare and Limerick and other agencies as appropriate. The developed plans will identify realistic Tier 1 and Tier 2 scenarios and the resources required to effectively response to and mitigate these. The plans will further describe any escalation to Tier 3 (requiring national resources) and as discussed above, interface with the National Marine Oil/ HNS Spill Contingency Plan. A training and exercising program forms part of the plans. The completed plans will be submitted to the Irish Coast Guard and EPA for appropriate approvals. Further detail can be found in the Oil and Hazardous and Noxious Substances (HNS) Spill Plan Development Framework for the Proposed Development (Appendix A2-6, Vol. 4). Additional technical guidance can be found in the NCP and annexes.

2.9 Construction Phase

This section describes the construction activities associated with the Proposed Development including the following phases:

- Construction schedule and working hours;
- Enabling, earthworks and site preparation;
- Construction of LNG Terminal, Power Plant and AGI;
- Construction of drainage outfall;
- Utilities;
- Environmental protection measures; and
- OCEMP.

There is no requirement for any additional temporary land take to support the construction phase; all laydown areas will be accommodated within the footprint for the Proposed Development site. The jetty construction will also be within the foreshore lease area.

2.9.1 Construction Schedule

Subject to planning consent and other approvals an arbitrary start date of Jan 2023 is taken as a construction start date (however this is subject to change). The construction programme is anticipated to take 32 months, subject to seasonal and other planning constraints. This is the basis of the impact assessment contained within this EIAR. The whole construction project is broken into 5 sections as per Table 2-11 which gives the outline of construction period for each section.

The above sections provide more detail on the proposed construction works.

Table 2-11 Indicative Construction Schedule

Area	Start On Site	Duration (months)	Completion	Duration From Start Date (Months)
Enabling, Earthworks and Site Preparation	Jan 23	10	Oct 23	10
LNG Terminal	+6 months	12	Jun 24	18

Area	Start On Site	Duration (months)	Completion	Duration From Start Date (Months)
220 kV and medium voltage (10/ 20 kV) connections[6]	+8 months	14	Sep 24	21
CCGT - 2 Blocks	+9 months	21	Jun 25	30
CCGT - 1 Block	+ 11 months	18	Aug 25	32

Note that the LNG Terminal will be constructed as part of the first phase of construction, followed by the Power Plant. An additional period of up to six months will be required for commissioning prior to operation as described in Section 2.10.

The proposed construction manpower and vehicle traffic profile projections based on the dates above are provided in Figure F2-8, Vol. 3.

2.9.2 Working Hours

Excluding the jetty construction works, it is anticipated that normal working hours during the construction phase will be as follows (Table 2-12):

Table 2-12 Working Hours

Start	Finish	Day
07:30	18:00	Monday to Friday
08:00	14:00	Saturday

It is proposed to stagger the various shift starting and ending times within the construction complex (for example civil employees 07:30 – 18:00, or 07:45 – 17:45). This small stagger in shift start and ending times could lessen the impact of traffic peaking.

Construction of the jetty will be undertaken over approximately 15.5 months, on a 24 hour basis, 6 days a week with maintenance works on Sundays. Security arrangements will also be in place full time.

Please see Chapter 07 – Biodiversity for further details.

Other areas of construction may also be required to work outside of these hours to perform certain tasks such as mechanical testing, inspection duties and commissioning. Reasons for working outside the normal hours would include considerations of safety, weather, tides and subcontractor availability. Every effort will be made during the detailed project execution planning to minimise the number and duration of night-time activities. Working outside normal hours will be agreed in advance with KCC.

2.9.3 Enabling, Earthworks and Site Preparation

2.9.3.1 Pre-Construction Environmental Surveys

A pre-construction environmental survey will be undertaken in advance of the enabling works. Following the survey, licences will be sought from the National Parks and Wildlife Service (NPWS), as appropriate. Exclusion works will be carried out in the appropriate season in line with the information presented in Chapter 07 – Biodiversity.

An extensive programme of pre-development licensed archaeological testing will be undertaken in the areas of the site which will be subject to development. Refer to Chapter 14 – Cultural Heritage for more details on archaeological, architectural and cultural heritage. This will include the demolition of a small farm complex and remains associated with a pillbox (see Figure F12-5, Vol. 3 for the location of all

[6] While the 220 kV and medium voltage (10/ 20 kV) connections are outside the Proposed Development, number and traffic from their construction is included in this EIAR. This includes the associated onsite Eirgrid 220 kV and ESBN 20 kV substations.

structures to be demolished). It is anticipated that archaeological survey and investigation works will commence in advance of the main enabling works in accordance with the relevant licenses. Enabling works will only be carried out on areas where archaeological survey and investigation works have been completed.

Prior to the start of works onsite areas to be protected (such as ecologically sensitive habitats or notable trees) will be fenced off to protect from accidental damage.

2.9.3.2 Earthworks and Site Preparation

Enabling, site preparation and earthworks activities are common to the LNG Terminal, Power Plant and ancillary facilities will comprise:

- Construction of safe access and temporary site roads;
- Erection of perimeter and environmental protection fencing;
- Installation of pre earthworks drainage;
- Establishment of the laydown construction area; and
- Earthworks to create level platform at +18 m OD for the main footprint of the development excluding AGI and jetty.

2.9.3.3 Site Access

The contractor will begin by setting out the site entrance as early as possible in the programme consistent with seasonal environmental restrictions and constraints. This operation will begin with the clearance of existing hedgerows and vegetation at the site entrance on the L1010 and progress along the route of the access road to the construction laydown area. This will be followed closely by the excavation of vegetation and topsoil for the access road which follows the existing ground levels and then the placement of crushed stone (to create a 6 m wide access road) to create an initial access and roadway to the construction laydown and jetty area. All topsoil will be retained onsite for future use. Topsoil will be placed in temporary stockpiles at various locations throughout the site for re-use on slopes, with any excess material placed in the vicinity of the contractor's compound (see Figure 2-3). Approximately 26,000 tonnes of imported aggregate will be delivered from local quarries along the L1010 from the Tarbert direction. Sources of material could include:

- Ardfert Quarries, Ardfert, Co. Kerry;
- O'Mahoney Quarries, Tralee, Co. Kerry;
- Roadstone, Foynes, Co. Limerick; and
- Liam Lynch, Adare, Co. Limerick.

It is anticipated that the creation of this initial access will take approximately 2 to 3 months. Apart from the delivery of materials, the operation will all take place within the site boundary with personnel using mobile plant.

Traffic management measures approved by KCC and An Garda Siochana will be implemented prior to the commencement of works to ensure the site access is safe for all road users.

Following the construction of the site access, a perimeter fence will be erected around the site boundary. Fencing will be installed to protect the Rallapane stream. Temporary car parking and site office and other facilities will be established to support the early works which will primarily comprise earth moving. Temporary surface water drainage and silt ponds will be constructed to control runoff from the earthworks stages. Areas within the Proposed Development site, which are not to be disturbed during the construction stage, will be fenced off. The environmentally designated areas are outside the site boundary and will therefore be fenced off by the perimeter fence.

Some hedgerows, bushes and trees, and disused buildings, will also be removed during this phase.

2.9.3.4 Fencing

Fencing will be erected along the perimeter of the site as early as possible (see Section 2.4.5 for details of the height and materials). Particular care will be taken at the boundary between the development site and the cSAC, SPA and pNHA so that construction activities do not cause damage to habitats in this area. These habitats will be securely fenced off early in the construction phase. The fencing will be clearly visible to machine operators and include relevant areas in which works are planned, such as utilities. To prevent incidental damage by machinery or by the deposition of spoil during site works, hedgerow, tree and scrub vegetation which are located in close proximity to working areas will be clearly marked and fenced off to avoid accidental damage during excavations and site preparation.

2.9.3.5 Pre Earthworks Drainage

To prevent the risk of contaminating surface water and groundwater, temporary surface water drainage (including dewatering measures) and silt ponds will be constructed to control runoff from the earthworks stages. This will flow through a filtration system (such as hay bales) to slow down flow to an acceptable level. Silt traps will be placed at crossing points to avoid siltation of watercourses. Attention will also be paid to preventing the build-up of dirt on road surfaces, caused by lorries and other plant entering and exiting the Proposed Development site, via wheel washes and road sweepers as required. The layout of the temporary surface water drainage system will incorporate the mitigation and monitoring measures outlined in this EIAR and conform to the requirements of the OCEMP, Waste Management Plan (WMP) and Outline Construction Traffic Management Plan (OCTMP) (see Section 2.9.12.1), Natura Impact Statement (NIS) and planning conditions.

Rainwater runoff will be diverted away from the construction areas into the Shannon Estuary. Rainwater runoff will passed through an attenuation system including ponds with straw bales or silt bags to prevent sediment from entering the estuary. Discharge water quality targets will be agreed with KCC and included in the OCEMP. Regular water inspection and sampling regimes will be put in place via the OCEMP on the foreshore during construction activity onsite to monitor compliance with the discharge conditions.

2.9.3.6 Laydown Construction Area

A construction compound, or laydown area, for the construction activities will be established to provide for storage of construction equipment and materials, as well as for offices, parking and welfare facilities for staff (for the duration of the construction phase. The locations and extent of the construction compounds are presented in Figure 2-3.

The laydown area will be constructed by stripping back the topsoil (which will be used later in the landscaping), and placing a layer of stone over a layer of geotextile membrane as required. The laydown areas will be suitably drained and any areas which will involve the storage of fuel and refuelling will be paved with bunding and hydrocarbon interceptors to ensure that no spillages percolate into the surface water or groundwater systems. During the removal of the topsoil and placement of the stone for the laydown areas precautions will be taken to minimise runoff into ditches, drains or the stream (this is addressed in Section 2.9.3.7 below).

Additional mitigation and monitoring measures as required will be implemented in OCEMP including the WMP and OCTMP (see Section 2.9.12).

The construction compound units will incorporate canteens, offices, medical, changing, and welfare facilities and drying rooms.

Following completion of construction, the laydown area will be cleared and re-instated, temporary buildings and containers, parking areas and material such as stone, aggregates and unused construction materials will be removed as appropriate. As much of this material as possible will be re used onsite as part of landscaping and construction works.

2.9.3.7 Earthworks

The LNG Terminal and Power Plant will be constructed to a finish grade platform with an elevation of 18 m. In order to create this platform, approximately 475,000 m³ of overburden soils and rock will be excavated and moved within the site (Table 2-13). Some of the rock t will need to be broken up before it can be excavated. This will be done either by percussive rock breaking equipment mounted on tracked excavators or by blasting depending on the hardness and depth of the rock to be removed. The soil and rock will then be excavated using tracked excavators. Excavated material will be stockpiled for use as engineering fill, landscaping and other uses throughout the Proposed Development site. Stockpiles will be no more than 2 – 3 m high and will be seeded with an appropriate seed mix. All excavated material will be reused onsite, within the development area, and no import of soil is expected.

Table 2-13 Estimated Material Volumes

	Excavation (m^3)	Backfill (m^3)
Topsoil	35,000*	35,000
Soil excavation	356,054	437,115
Rock excavation	81,062	
Total	472,115	472,115

*Excess topsoil will be placed on the laydown area or spread onsite

The overburden will be, in places, quite thin, and to create the level platforms for the facilities. It is expected that blasting will be required to excavate some of the rock, which cannot be removed by rock breaking equipment mounted on tracked excavators. The blasting will be carried out in a controlled manner in accordance with a pre-approved plan, and in a controlled manner to minimize the noise and ground vibrations. This is done by designing a blast pattern with a small charge in many holes drilled in to the rock at close spacing; the individual charges are then set off in a sequence using an electronic relay so that the maximum charge going off at any instant (this is referred to as the 'maximum instantaneous charge') is only the small amount of charge in any one of the holes. This causes cracks in the rock which allows the rock to be broken up further using mechanical rock breakers; the rock is then excavated using tracked excavators. No more than three blasts are envisaged to occur in any given day and associated noise and vibration levels will be transient and very short lived. Refer to Chapter 09 – Airborne Noise and Groundborne Vibration for further details.

Excavated material will be stockpiled for use as engineering fill, landscaping and other uses throughout the site.

Earthworks are expected to be completed within four months, with two to three months of blasting. Piling for the construction of the jetty will also commence during this period, initially from onshore (approximately four and a half months) followed by 11 months from the water.

Monitoring of dust, noise and vibration levels will be undertaken during blasting operations at appropriate locations around the boundary in accordance with the measures outlined in the OCEMP. Piling activities will also comply with ecological constraints such as breeding mammals (June to September) and wintering birds (October to March). Refer to Chapter 07 – Biodiversity for more information.

The OCEMP will also identify mitigation and monitoring measures required to protect watercourses from pollution associated with the earthworks operations and set out the specific arrangements for the strict control of erosion and generation of sediment or any other pollutants. It will detail appropriate sediment control temporary works and plant, including silt curtains, settlement lagoons, flow control arrangements etc. to ensure no pollutants are discharged to watercourses or the sea (see Section 2.9.12.1 and Appendix A2-4, Vol. 4).

2.9.3.8 Traffic and Transport

For the purposes of the EIAR, a worst-case construction scenario of the LNG Terminal, Power Plant and medium voltage (10/ 20 kV) connection has been assumed. This scenario will result in a maximum site headcount and consequently the highest amount of traffic.

The traffic associated with the earthworks and site preparation phase will be managed such that the impact on public roads will be minimised. This is achieved by the implementation of the OCTMP which will be agreed by KCC in advance of the works. The traffic volumes on the public road will largely comprise HGV deliveries and arrival of personnel to the Proposed Development site.

Refer to Chapter 11 – Traffic and Transport for how the deliveries will be co-ordinated with the planned L1010 road upgrade works, which is anticipated to overlap with the enabling works phase. These activities will be completed at about the same time to allow the main construction works to proceed.

2.9.4 LNG Terminal Construction

The LNG Terminal construction activities will commence once the main earthworks activities have been completed. The construction of the LNG Terminal will include the following:

- Construction of jetty; and
- Construction of onshore receiving facilities
- Construction of AGI (see Section 2.9.4.3 below).

Typically, the construction equipment required will include floating plant (for the jetty), compressors, mobile cranes, tower cranes, generators, hoists, gantries, and various types of excavators, loaders, trucks, trailers, vans, etc. Other equipment required will include a rock crusher and screening plant, diesel fuel tanks, gas storage cages, electric power supply, mechanical repair shops, etc. Hard standings will be established for these by pouring concrete in the relevant locations.

Fuel will be required for the diesel generators and equipment. To minimise the numbers of fuel deliveries, one or more double skinned diesel fuel tanks (maximum 20,000 l) will be installed onsite to supply fuel for the diesel generators and construction vehicles and equipment. The diesel fuel tanks will be positioned on a temporary bunded concrete plinth (constructed at the start of the works), away from sensitive watercourses.

2.9.4.1 Jetty Construction

Construction of the jetty will include (over approximately 15.5 months):

- Installation of the jetty trestle supported on steel piles with a concrete deck and access roadway to the jetty head;
- Installation of a jetty head with unloading arms;
- Installation of mooring dolphins;
- Installation of breasting fender dolphins;
- Installation of permanent docking location for four tugs; and
- Installation of topside equipment and facilities.

Topside facilities and equipment construction will include:

- Installation of welded pipework and electric supply and instrument cables along the trestle to the jetty head and berthing facilities; and
- Installation of major equipment such as loading arms, gangway towers, firewater pumps, elevated fire monitors, lighting, safety systems, including the berthing monitoring systems.

Typically, the construction of the jetty will be undertaken from the water using floating barges and self-elevating platforms (jack-ups), manned with teams of specialist marine construction personnel, divers, operators, and labourers plus supervision. Tugs will be on hand for moving the floating equipment around. Other smaller equipment such as compressors, generators, and land-based machines will also be used.

The construction materials for the jetty consist of 203 steel tubular piles, structural steel, precast concrete elements, reinforcing steel and concrete. Up to 163 m^2 of cSAC habitat is expected to be lost as a result of the jetty piles. It is anticipated that the initial steel piles for the jetty will be delivered by road from Foynes port (within the first 3 months of enabling works) with subsequent pile deliveries supplied directly by barge once the first part of jetty is constructed. The piles will be up to 50 m long x 1067 mm in diameter and will be delivered out of hours as an abnormal load.

The majority of the piles supporting the jetty will be driven, with some piles drilled and socketed into the underlying rock to ensure stability of the jetty. This operation will require a jack-up platform supporting a large crane-mounted drill and a large barge-mounted support crane. Spoils from the drilling operation will be conveyed to the surface via reverse-circulation through the drill stem and contained within designated scows or other vessels. Approximately 1000 m^3 pile arisings are anticipated from the socketed piles (approximately 80 no.), none of which will be from onshore piling operations. The spoils will be placed on a barge, dried, then transferred to shore for drying and reused in general earthworks or in landscaped bunds. Pile installation is anticipated to advance outward from shore. It is anticipated that between 0.5 and 2 piles will be drilled per day during the construction of the jetty.

Once the pile installation is underway, one or two additional floating spreads will follow in sequence to lift and set the precast pile caps, beams, and deck planks. These spreads will comprise one or two large floating cranes and materials barges. All works will be carried out within the foreshore lease area.

The work will also involve in-situ grouting of precast members at the pile tops and other connections. The access roadway to the jetty platform will be constructed of reinforced concrete and will be 5 m wide. This work will advance outward from shore using land-based concrete transit mixers, pre cast concrete, and other paving equipment.

The jetty construction contractor will be required to liaise closely with SFPC Harbour Master and Pilotage Superintendent in relation to scheduling of activities. Support barges will be moored and anchored so as not to interfere with traffic in the navigation channel and in accordance with guidelines established by the Harbour Master and SFPC.

The use of pre-cast concrete will be maximised, while the pouring of wet concrete onsite will be minimised to reduce any potential environmental impacts on the Shannon Estuary. Any in-situ concrete work will be staged in a manner to prevent concrete from entering the water. This will be achieved by installing shuttering to contain the concrete, with all concrete pours supervised by the Environmental Manager. Refer to the OCEMP in Appendix A2-4 for further detail. Piles will be pre-fabricated as much as possible to minimize in-water construction.

2.9.4.2 Onshore Receiving Facilities Construction

Onshore, LNG Terminal facilities construction will follow the sequence below, consistent with gas industry practices, over a period of 12 months following the enabling works phase, namely:

- Placement of concrete foundations, drainage system, power and instrumentation conduits;
- Installation and erection of process and utility equipment, piping and instrumentation;
- Construction of buildings; and
- Site landscaping.

Initially, drainage systems and power and instrumentation conduits will be installed along with the placement of concrete foundations, followed by the building superstructures (including metal frames, cladding and additional finishes). Following this the fit out of the major mechanical and electrical equipment, instrumentation and process piping will be completed. The fit out and completion of the buildings, and completion of site access roads with landscaping, using stockpiled topsoil material, will then take place. The facilities will be tested and commissioned, prior to commencing operations.

Where possible, equipment will be modularised for some of the facilities, and components will be standardised and pre-fabricated in order to reduce onsite construction time and to minimise local disruption during the construction phase. Pre-fabricated materials will be delivered to the site via the road network and may require out of hours abnormal load delivery.

2.9.4.3 AGI Construction

The construction of the AGI will be undertaken following enabling works over a period of 12 months and will encompass the following activities:

- Placement of concrete foundations, drainage system, power and instrumentation conduits;
- Installation and erection of process and utility equipment, piping and instrumentation;
- Construction of buildings; and
- Site landscaping.

Buildings to house the AGI will mostly be steel framed with infill construction and cladding. Structural steel for buildings is anticipated to be delivered by road and assembled onsite.

The majority of the building materials for the AGI will be purchased as complete units, where practicable, and delivered to the site for installation. Pipe work and ducting will be assembled onsite.

Drainage system power and instrumentation conduits will be installed along with the placement of concrete foundations, followed by the building superstructures (including metal frames, cladding and additional finishes. Later stages of the initial phase will see the installation of the major mechanical and electrical equipment, instrumentation and process piping. Final stages of the initial phase will see the fit out and completion of the buildings, and completion of site access roads, with landscaping. The facilities will be tested and commissioned and the facility will commence operations.

2.9.5 Power Plant Construction

Construction of the Power Plant will begin after the platform level has been excavated to 18 m AoD and the surface prepared, as outlined in the enabling works section (2.9.3). Typically, the construction equipment required for the Power Plant includes compressors, mobile cranes, tower cranes, generators, hoists, gantries, and various types of excavators, loaders, trucks, trailers, vans, etc. Other equipment required will include diesel fuel tanks, gas storage cages, electric power supply, mechanical repair shops, etc. A number of tower cranes may be required. Hard standings will be required for these and will be located away from environmentally sensitive sites.

It is currently anticipated that the Power Plant construction will commence shortly after the commencement of the construction of the LNG Terminal.

2.9.5.1 Power Plant Construction Works

The construction works for the Power Plant will be be sub-divided into four main packages:

- Civil and structural works;
- Mechanical and electrical installation;
- Gas Infrastructure; and
- Connection to the EirGrid 220 kV substation.

Foundation construction will include excavating to a depth of approximately 2 to 3 m, installation of concrete forms, fixing of steel reinforcing, and the pouring of concrete. Pile foundations could be necessary for parts of the Power Plant, depending upon soil conditions and loading.

Buildings to house the Power Plant are expected to be steel framed with infill construction and cladding. Structural steel for buildings is anticipated to be delivered by road and assembled onsite.

The majority of the building materials for the Power Plant will be purchased as complete units, where practicable, and delivered to the site for installation. Pipe work and ducting will be assembled onsite.

The mechanical activities will include the installation of:

- Gas turbine generators;
- Steam turbine generators;
- Heat recovery steam generator;
- Air cooled condenser;
- Auxiliary cooling water system;
- Feed water/ condensate system;
- Fuel gas supply system;
- Water supply/ treatment system; and
- Fire protection system.

The main electrical activities will include the installation of the following:

- Transformers;
- Distributed control systems;
- Switchgear;
- Low and medium voltage and control and instrument systems;

- Batteries and Uninterruptible Power Supply systems;
- BESS; and
- 220 kV GIS substation.

2.9.6 Drainage Outfall Construction

A drainage outfall into the Shannon Estuary will be constructed (see Figure F2-6, Vol. 3). Within the Proposed Development site, surface water from paved and impermeable areas and groundwater will be collected by an underground drainage system and will discharge to either, the existing stream and/ or drainage ditches within the site, or to the Shannon Estuary. via the drainage outfall pipe which will extend across the foreshore to below the low water mark.

All discharges through the drainage outfall will pass through a Class 1 Hydrocarbon Interceptor. Any bunded areas within the site will have valve-controlled discharge points as part of their connection to the outfall drainage network. Drainage runoff from these areas will be tested for contamination prior to release to the outfall drainage network.

The drainage outfall pipe will be buried as it crosses the shoreline and will extend approximately 5 m beyond the low water mark. A check valve will be installed at the end of the outfall drainage pipe to prevent ingress of water from the estuary back into the drainage system.

It is anticipated that the construction of the drainage outfall pipe will be an open cut trench technique as follows:

- Excavate a trench across the foreshore to a maximum depth of approximately 2.4 m;
- Install a 900 mm diameter concrete drainage pipe in trench and backfill with concrete; and
- Reinstate the foreshore and shoreline.

The outfall trench will be excavated above the low water mark using a hydraulic rock breaker mounted on a tracked excavator. This operation will be carried out in the dry at all times working above the tide during a suitable period of spring tides.

Where the outfall extends beyond the low water mark into the estuary, excavation of rock will be undertaken using an expanding grout placed by divers into drilled holes to pre-split the rock to the required levels and facilitate its removal by long reach excavator bucket.. Trenches excavated across the shoreline will be backfilled with concrete suitable for underwater use and the surface will be embedded with cobbles and stone excavated from the trench to minimise the visual impact. The excavated material will be removed from the foreshore and incorporated as part of the earthworks and landscaping for the Proposed Development. Below the low water mark, the trench will remain open, and the sides of the trench will be battered back to avoid creating a pocket for siltation. Additionally, the cliff face will be armoured with rock to prevent erosion and maintain the integrity of the foreshore. Disturbance of the seabed below the low water mark will be small, arising primarily from the excavation of the trench and clearing and levelling of the ground to install the outfall pipe. This will result in temporary habitat loss of approximately 90m^2 of Annex I habitat above the low water mark and 10m^2 below the low water. Loss of Annex I habitat Estuaries habitat is estimated to be approximately 100m^2, while the loss of Reef habitat is approximately 65m^2. Installation of the pipe will result in the loss of 0.000041% and 0.000030% of the Annex I habitats 1130 Estuaries and 1170 Reefs respectively. This is discussed further in Chapter 07A Marine Biodiversity.

All refuelling of equipment and machinery will take place at designated refuelling areas on the site. No refuelling will take place on the foreshore. Arisings from trenching, or other works, will either be used for reinstatement. Details on this will be outlined in OCEMP.

2.9.7 Construction Utilities

2.9.7.1 Electricity

During the construction phase of the Proposed Development, electricity will be supplied via a series of portable site units prior to the medium voltage electricity connection becoming available.

2.9.7.2 Water Supply

Water will be required for consumption by the construction personnel, for general construction works, hydrotesting of tanks and pipework, for the construction of the concrete elements, and for wheel wash facilities and for dust suppression. It is anticipated that water supply for the construction phase will be obtained from a water main along the L1010. The Applicant has submitted a pre-connection agreement application to Irish Water for this supply. If this supply is not available, water will be delivered by road and stored in a temporary tank onsite.

The maximum potable water demand for construction will be 98 m^3/day. The Proposed Development will incorporate water efficiency measures such as collection of grey water to minimise water consumption as far as possible.

2.9.8 Drainage

2.9.8.1 Sewerage Drainage for Construction

Sewage effluent will arise from the site offices, canteens, toilets and showers. The effluent will be collected in tanks and self-contained toilet units for removal by tanker by a licensed haulier to a licensed facility.

2.9.8.2 Stormwater and Surface Water Drainage during Construction

Surface water and groundwater on or adjacent to the site could become contaminated with silt or debris during the construction phase. Therefore, temporary surface water drainage and silt ponds will be constructed to control runoff from the earthworks stages. Water will be reused onsite where possible, for example grey water will be used for wheel washing activities. Surface water will flow through a filtration system (such as hay bales) to slow down flow to an acceptable level. Silt traps will be placed at crossing points to avoid siltation of watercourses. Attention will also be paid to preventing the build-up of dirt on road surfaces, caused by lorries and other plant entering and exiting the Proposed Development site, via wheel washes and road sweepers as required. The layout of the temporary surface water drainage system will incorporate the mitigation and monitoring measures outlined in this EIAR and conform to the requirements outlined in the OCEMP, WMP and OCTMP (see Section 2.9.12), Natura Impact Statement (NIS) and planning conditions.

2.9.9 Construction Management

A construction management team will be onsite for the duration of the construction phases of both the LNG Terminal and the Power Plant. The team will supervise the construction of the Proposed Development, including monitoring the contractors' performance to ensure that the proposed construction phase mitigation and monitoring measures are implemented, and that construction impacts and nuisance are minimised. KCC will be notified of the identified point of contact onsite for the duration of the construction programme. Further details on the construction management structure, environmental management, site audit system, and community feedback arrangements are contained within the OCEMP (see Appendix A2-4, Vol. 4).

2.9.10 Construction Employment

It is envisaged that the initial construction phase will last approximately 32 months, with an additional 6 months commissioning prior to operation. During the initial phase, approximately 975 people will be employed onsite at peak. While some of the construction personnel will be specialists who will travel from outside the area, it is intended that many of the jobs will be filled by personnel recruited locally, with appropriate training provided as necessary. The project will therefore provide both employment opportunities as well as training during this phase. Where required, construction personnel will be accommodated locally in hotels and guesthouses.

The coordination of people and materials onsite will be one of the key activities throughout the construction phase.

2.9.11 Materials Sourcing and Transportation

Construction materials will be sourced locally from authorised quarries, where possible to minimise the environmental impact of transportation. It is intended that this will include all suitable stone recovered on during the enabling works will be reused as hardcore. For this purpose, rock crushing and screening plant will be provided. Additional rock, stone and sand materials could be procured from local quarries as required including the following:

- Ardfert Quarries, Ardfert, Co. Kerry;
- O' Mahoney Quarries, Tralee, Co. Kerry;
- Roadstone, Foynes, Co. Limerick; and
- Liam Lynch, Adare, Co. Limerick.

All the materials will be transported to the Proposed Development site by road, except those specified above in Section 2.9.11. It is anticipated that up to 26,000 t of imported aggregates will be required for the Proposed Development.

There may be periods in the early stages of construction where onsite haul roads are not surfaced. To reduce dust these routes can be dampened down (including the reuse of water from the wheel washing facilities) and maximum speed limits will be signposted and imposed.

Some of the process equipment and structural elements will arrive onsite as complete units or sub-assemblies, which may be larger than normal construction loads. It is anticipated that all the units will be delivered by ship to Foynes, and from there transported to the Proposed Development site by road. Some of the units could be 'extra-large loads' and a Garda escort may be required when they are on the road network. The timing of their transport to the Proposed Development site will be chosen to minimise disruption to other roads users. For example, the jetty piles will be up to 50 m long x 1067 mm in diameter and will be delivered out of hours as an abnormal load, subject to prior agreement with KCC. This will be managed in accordance with the OCTMP, see Appendix A11-1, Vol. 4.

2.9.12 Environmental Protection Measures

2.9.12.1 Outline Construction Environmental Management Plan (OCEMP)

An OCEMP has been produced as part of this planning submission. A detailed CEMP will be produced by the successful Contractor prior to the main construction works. The CEMP will detail the Contractor's overall management and administration of the works. The CEMP will also include any commitments included within the statutory approvals.

The CEMP will set out the necessary approach to managing the environmental aspects and impacts associated with the construction of the Proposed Development. It will also contain details of the monitoring and reporting system which will be implemented to document compliance with the following:

- Environmental commitments identified in the EIA studies; and
- The conditions of the relevant statutory consents including the planning consent and the foreshore licence associated with the Proposed Development.

The Contractor will be required to include the following information:

- Project details and the scope of works (including the locations of construction compounds and information on construction periods and phasing);
- A summary of relevant policy and project and environmental aims;
- The planning and foreshore licence conditions relevant to the construction activities and a summary of how and where they will be addressed within the CEMP;
- Information on the roles and responsibilities of key individuals, including the environmental management and reporting structure (as provided by the contractor or as available at the time of writing the CEMP);
- An outline communication strategy, making recommendations to the contractors, for example such as the implementation of toolbox talks (environmental discussion on issues encountered onsite) by the contractor relating to environmental constraints and procedures to be adhered to onsite;
- Methods to identify non-conformances, details of non-conformances and breaches of environmental limits and reporting measures;
- A summary of the potential environmental effects as identified by the EIAR, the schedule of mitigation and other existing documentation;

- The schedule of identified potential environmental impacts, risks and mitigation and monitoring measures;
- Method statements and work programmes for specific tasks such as the management of concrete washout onsite;
- Requirements for and maintenance of concrete washout areas;
- Requirements for fencing off of any protected environmental sites such as areas of ecological or archaeological importance;
- Protection of vegetation including hedgerows, trees etc.;
- An environmental monitoring programme and details of monitoring locations as required;
- An outline emergency response plan and procedure for environmental incidents including accidental spills;
- Requirements for inspection and auditing; and
- An outline reporting programme and procedure to be updated by the appointed contractor.

The CEMP will be a living document and periodically reviewed and updated as required during the course of construction.

As a minimum, the CEMP will be reviewed every six months. Notwithstanding the above requirements, the CEMP will also be reviewed at least two weeks prior to the construction stages listed below:

- Start of works;
- Start of each succeeding stage of the works;
- Start of any site activity that may potentially have an effect on sensitive habitats/ species; and
- Start of the landscaping works.

2.9.12.2 Outline Construction Traffic Management Plan (OCTMP)

An OCTMP has been prepared as part of this planning application (Appendix A11-1, Vol. 4). A detailed CTMP will then be produced by the appointed Contractor as part of the contractual agreements for the construction of the Proposed Development and will be updated as needed during the construction period. This CTMP will be agreed with KCC prior to commencement of works and shall apply to all traffic to and from the Proposed Development site including those works carried out by the Contractor and any subcontractors, as well as have regard to traffic associated with works associated with the construction of the jetty, the AGI and the gas export pipeline, the electricity substations and connections. The plan will include measures to direct construction traffic (including site access), as much as practicable, along the upgraded road from Tarbert to the Proposed Development site rather than along the road from Ballylongford to the Proposed Development site.

2.9.12.3 Waste Management Plan (WMP)

The Contractor will be responsible for developing a WMP and an OCTMP related to the construction activities. The WMP will establish a waste recording system to test and track all waste loads going offsite for appropriate disposal. This includes Waste Acceptance Testing (WAC) to determine the appropriate disposal route for the waste.

The WMP will also contain details of waste permits and hauliers who will be authorised to remove waste from the site and it will detail waste audits to be carried out.

2.10 Commissioning Phase

Following completion of construction and installation of equipment, and before the LNG Terminal commences operations, there will be a testing and commissioning phase. This phase will comprise:

- Installation compliance checks;
- Commissioning tests; and
- Performance demonstration tests.

2.10.1.1.1 Installation Compliance Checks

This will be a process of systematically checking that all systems and equipment have been constructed, assembled, aligned and installed correctly, in accordance with the design specifications and drawings, and that all interconnecting pipe work, cabling and wiring has been installed in compliance with the design specifications and drawings.

2.10.1.1.2 Commissioning Tests

The function of each item of equipment and each system will be tested and verified, in a systematic manner, as being in accordance with the design and specifications. All the alarm and control systems and instrumentation will be tested to demonstrate that they are functioning correctly. Following these tests, each system will be checked to ensure that it is ready to be commissioned under operating conditions including using real materials, temperatures, pressure, and voltages.

2.10.1.1.3 Performance Demonstration Tests

In this commissioning phase the individual items of equipment and systems will be tested under operating conditions using the materials, temperatures, pressure, and voltages to which they will be subjected when in operation. Once the operation of all equipment and systems has been tested and verified individually, they will be integrated and the operation of complete systems will be tested.

The Proposed Development's safety and fire prevention systems and the Operational Emissions Management Plan will be subject to the same rigorous testing protocols as the other systems.

2.11 Decommissioning Phase

The Proposed Development is expected to have a design life of 50 years, but this could be extended by maintenance, equipment replacement and upgrades or by the transition of the site to use hydrogen capability (which will be subject to a future planning application). It is expected that it would be a condition of the industrial emissions licence for the Proposed Development that a closure and residuals management plan, including a detailed decommissioning plan, be submitted to the EPA for their approval.

Decommissioning activities will include, as a minimum:

- All wastes at the facility at time of closure will be collected and recycled or disposed of by an authorised waste contractor, as appropriate;
- Utilities will be drained of all potential pollutants such as lubricating oils or sealed to prevent leakage if being moved offsite or reused elsewhere;
- All raw materials, oils, fuels, etc. onsite at the time of closure will be returned to the supplier, or collected and recycled or disposed of by an authorised waste contractor, as appropriate,
- All buildings and equipment will be decontaminated, decommissioned and demolished in accordance with a phased demolition plan, and either sold for reuse or recycled, or disposed of by an authorised waste contractor, as appropriate. In general, specialist equipment, pipelines and storage tanks will be sold for reuse, where possible, or disposed of offsite;
- Roadways to be broken up and removed and security fences dismantled;
- All hazardous and non-hazardous process substances to be removed;
- All roads and hardstanding areas to be removed and recycled or disposed of by an authorised waste contractor, as appropriate;
- Landscaped will be reinstated in accordance with a landscape reinstatement plan; and
- On completion of safe decommissioning of equipment, the potable water, fire water and electrical power supplies could be disconnected, and removed or abandoned in place.

When operations have ceased, and assuming confirmation from the monitoring programme that all emissions have ceased, it is expected that there would be no requirement for long-term aftercare management at the Proposed Development site.

2.12 References

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CHAPTER 03
Need and Alternatives

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park
Environmental Impact Assessment Report

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3. Project Need, Site Selection and Consideration of Alternatives

3.1 Introduction

This chapter outlines the need for the Power Plant, the Battery Energy Storage System (BESS), and the LNG Terminal that encompass the Proposed Development. It also discusses the siting of the Proposed Development, the main layout options as well as the main alternatives considered in respect of the technologies and processes. Each of these can be found in the following sections:

- Need for the Proposed Development (Section 3.2);
- Alternative locations (Section 3.3);
- Alternative designs (Section 3.4);
- Alternative layouts (Section 3.5); and
- Alternative processes/ technologies (Section 3.6).

3.2 Need for the Proposed Development

This section outlines Ireland's needs for:

1. Diversity and security of natural gas supply;
2. Natural gas to backup intermittent renewable generation; and
3. Additional modern, flexible and efficient gas fired power plant to resolve a predicted generation capacity shortfall.

The Proposed Development addresses Ireland's security of energy supply risks, supports intermittent renewable generation, and resolves a predicted generation capacity shortfall.

3.2.1 The Need for Natural Gas

As electricity from renewable sources increases, a simultaneous increase in electricity demand, and closure of coal, oil and peat-fired electricity generation, means that natural gas is predicted to play an increasingly important role as a backup fuel.

Specifically, natural gas demand from now to 2040 is forecast in the National Energy and Climate Change Plan (NECP) 2021 to 2030 (Department of the Environment, Climate and Communications (DECC), 2020b) (Figure 3-1). The NECP considers Irish energy and climate policies, the levels of demographic and economic growth identified in the Project 2040 process and includes the climate and energy measures set out in the National Development Plan 2018-2027. The NECP was prepared to incorporate all planned policies and measures that were identified up to the end of 2019 and which collectively deliver a 30% reduction by 2030 in greenhouse gas emissions (from 2005 levels), excluding emissions associated with the EU Emissions Trading System (ETS). Specifically, it considers the objective for 70% of Ireland's electricity to come from renewable sources by 2030. Combined with the imminent closure of coal and peat fired generation units, gas fired generation is identified as the principal source of back up available for intermittent renewable regeneration. As can be seen in the NECP forecast (Figure 3-1), natural gas demand is forecast to increase from current demand levels of 4.69 million tonnes of oil equivalent (MTOE) to 6.38 MTOE by 2040.

DECC confirmed the long term need for gas in November 2020 by noting that (DECC, 2020a):

- '*Ireland's demand for electricity is expected to increase in the coming years due to increased electrification in the heat and transport sectors and growth in demand from large energy users such as data centres;*
- *Following the phasing out of peat and coal use for electricity generation, Ireland's security of electricity supply is expected to become much more dependent on natural gas which is likely to be*

the principal source of non-variable generation supporting variable renewable sources such as wind and solar.

- *There will be a significant reduction in indigenous supplies of natural gas due to production at the Kinsale fields having ceased in July 2020, and the planned tapering decline in production from Corrib over the next decade;*
- *Ireland's gas import dependency is predicted to increase from over 50% in 2019 to approximately 80% by the middle of the decade and to over 90% import dependency by 2030;*
- *All of Ireland's natural gas imports are sourced (via the two pipelines) from a single supply point at Moffat in Scotland with no alternative import routes;*
- *There is no natural gas storage in Ireland; and*
- *The UK has left the European Union which will lead, at the end of the withdrawal period[1], to difficulties for Ireland in meeting the requirements of EU law in relation to gas security of supply including potential challenges for future compliance with EU law including the 'N-1' infrastructure standard and the supply standard.'*

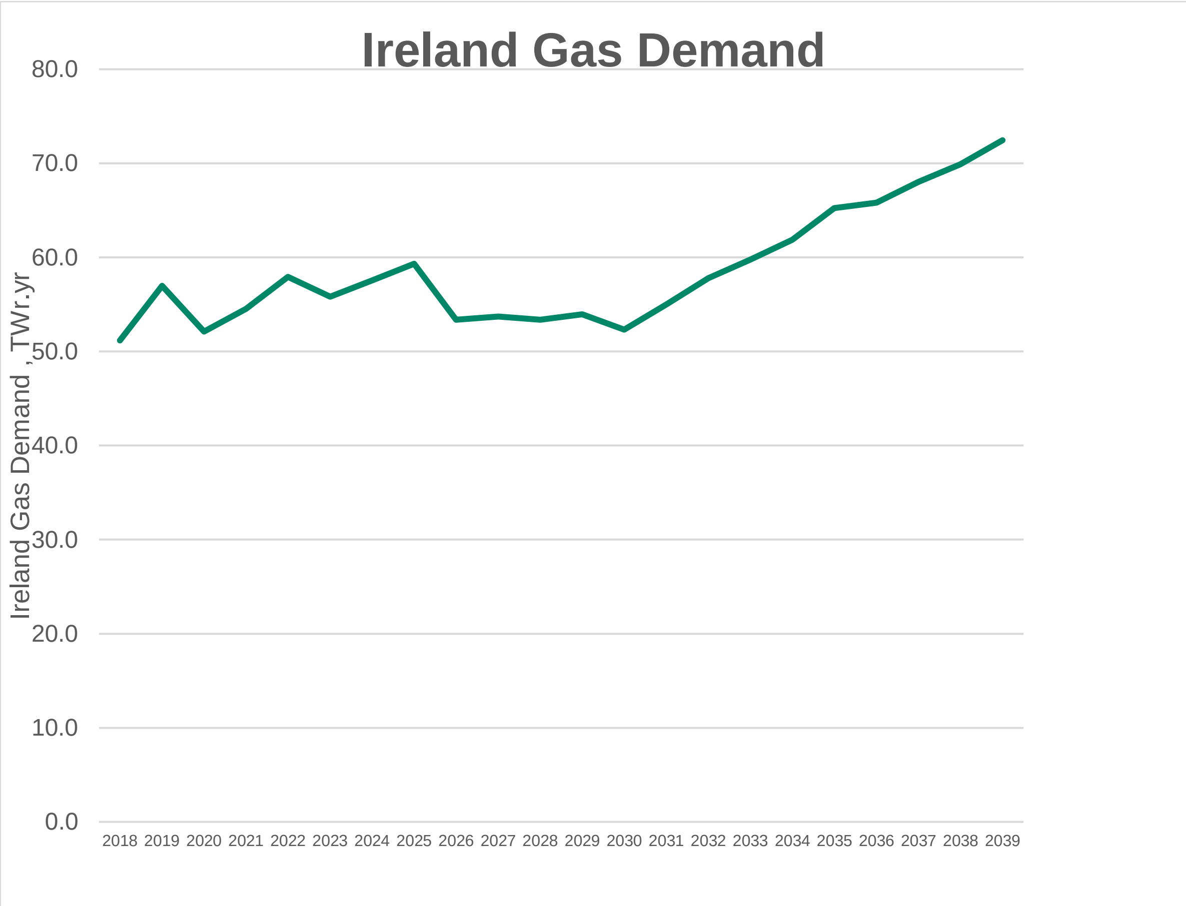


Figure 3-1 Gas Demand in Ireland (to 2040) (DECC, 2020b)

[1] The withdrawal period ended 31st December 2020.

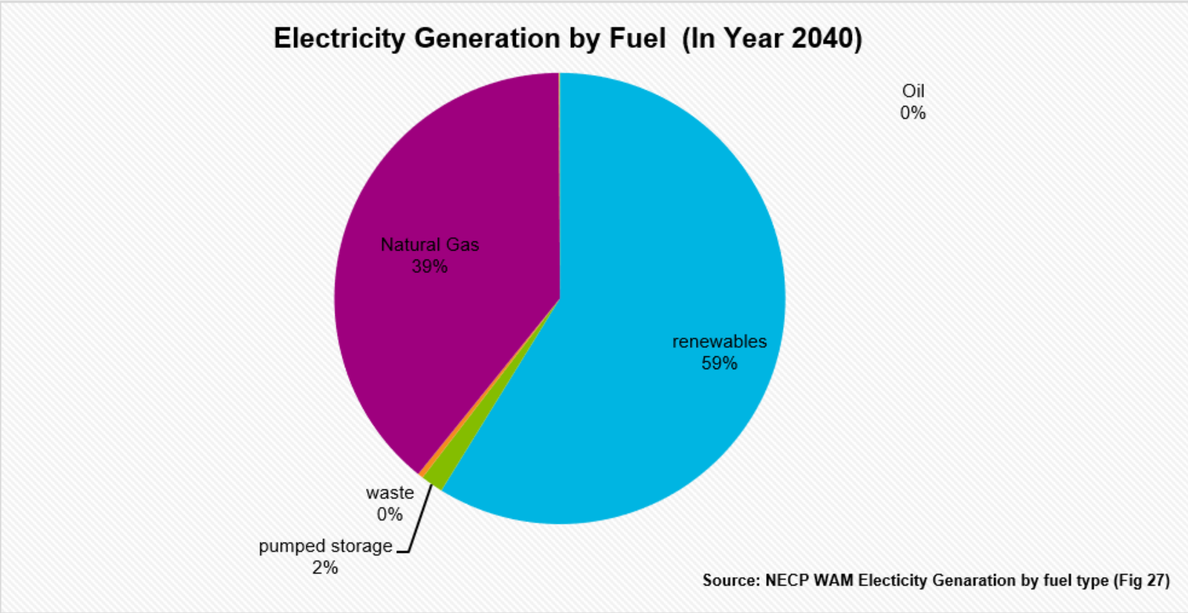


Figure 3-2 Projected Electricity Generation by Fuel in 2040

3.2.2 Shortfall in Power Generation Capacity

The Proposed Development contains a 600 MW gas fired Power Plant. The Power Plant will provide additional and flexible power generation capacity to support intermittent renewable generation and resolve a predicted generation capacity shortfall.

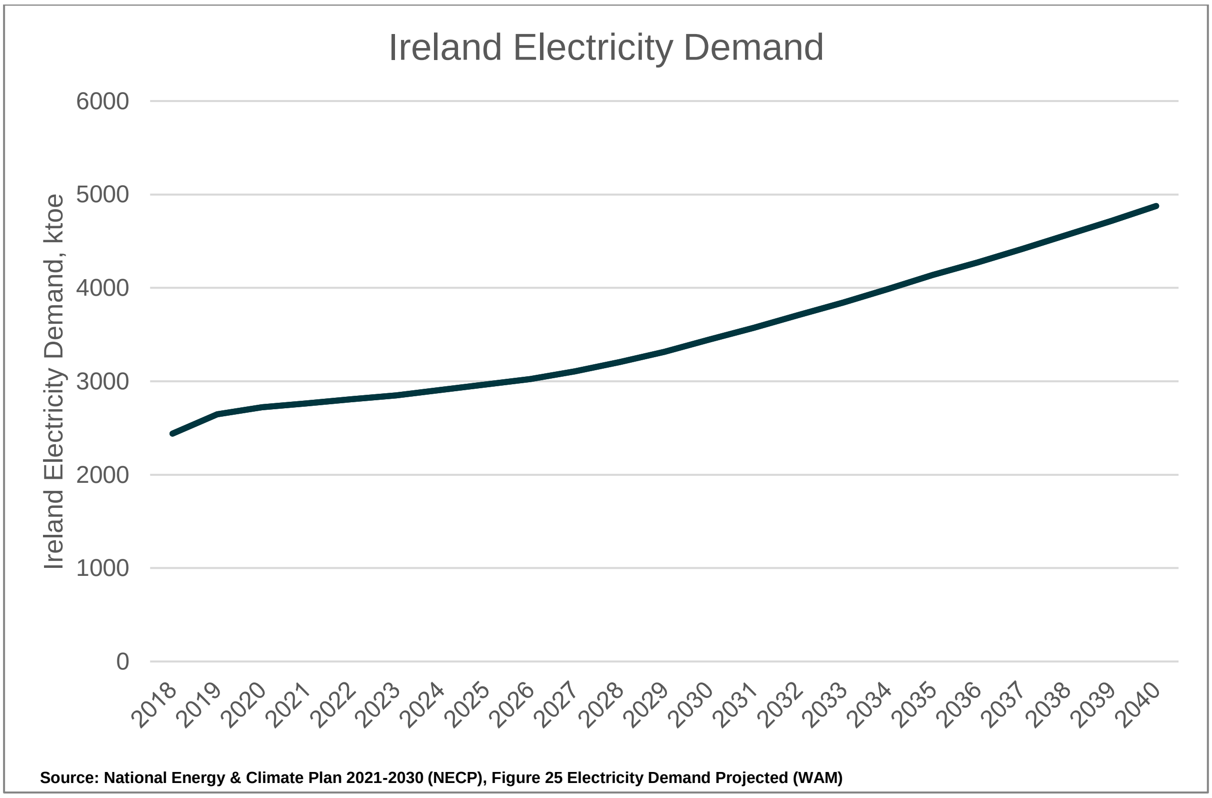


Figure 3-3 Ireland Electricity Demand, National Energy and Climate Plan 2021-2030 (DECC, 2020b)

The NECP (DECC, 2020b) forecasts that for the year 2025, natural gas will provide 52% of electricity in Ireland, with renewables providing 46%, pumped storage 1%, and waste and back up oil providing the remaining 1% of electricity (Figure 3-4). By 2040, the NECP forecast gas generating 40% of electricity in Ireland, with renewables providing 58%. The NECP also forecasts that with increasing intermittent renewable generation, and increasing electrical demand, the amount of electricity produced from gas fired generation will increase by 30% from 2025 to 2040.

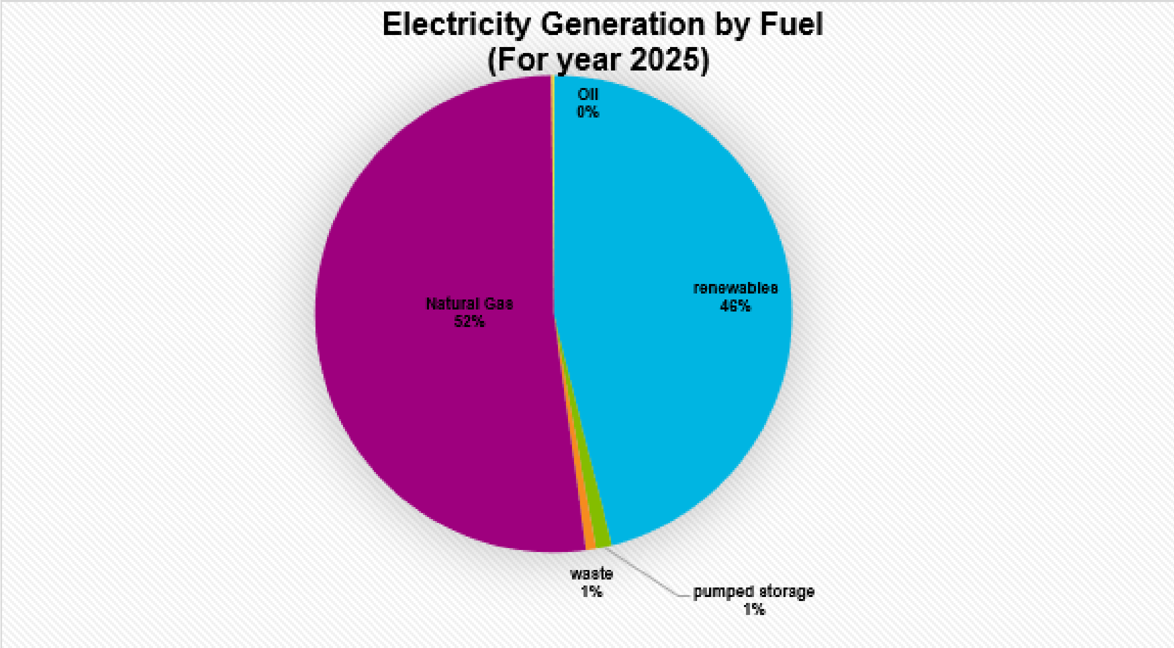


Figure 3-4 Projected electricity generation by fuel for the year 2025 (DECC, 2020b)

Therefore, even with a future significant increase capacity of renewable power being connected to the grid, there is a predicted shortage of conventional power generation. EirGrid has forecast a shortfall in generation capacity of up to 570 MW by 2026 and advised that new additional gas fired conventional power plants are urgently required (EirGrid and Soni, 2020). The 600 MW Power Plant can be delivered within the timeframe to counteract this predicted shortage. In this regard, the Applicant is currently awaiting an imminent grid connection offer having been successful in the Enduring Connection Policy Stage 2 (ECP-2.1) process in 2020.

To encourage new generation capacity onto the grid, the Single Electricity Market Operator (SEMO) holds periodic auctions for new and existing capacity for delivery up to four years in the future (SEM Committee, 2021). The capacity payments achieved by new (and existing) generation via these auctions have been reducing in recent years as the market design moves towards the delivery of system services to support the drive for increased renewables on the system (DS3) (EirGrid, 2021a).

'*The Capacity Remuneration Mechanism (CRM) is designed to ensure that the demand for electricity is always met. The overall aim of the CRM is to ensure security of supply, as well as ensuring that consumers don't pay for more capacity than is needed. The CRM was implemented as part of the revised SEM arrangements which went live on 1st October 2018, and replaced the Capacity Payment Mechanism under the previous arrangements. Capacity providers sell qualified capacity to the market, based on generation capacity required in a future capacity year. This takes place in the form of capacity auctions. Auctions are normally held by the Transmission System Operators between one and four years ahead of delivery.*'

A number of new build gas power station projects which had successfully cleared the auctions in recent years, and were awarded 10 year CRM contracts have withdrawn/ terminated their contracts due to their inability to deliver in the required timeframe (EirGrid and Soni, 2021). This failure to attract new modern, efficient, baseload generation may lead to a sub-optimal future electricity system where aging, inefficient, unreliable peaking power stations, that run on coal and oil, may remain on the system (Nord Pool, 2021).

In the absence of new additional power generation, and with the closure of coal, peat and oil fired power plants, a generation capacity shortfall is forecast by 2026. If realised, this shortfall will mean that that electricity demand exceeds supply, and the system operator(s) will be required to reduce demand on the system (known as load shedding). The Proposed Development can counteract this issue and provide sufficient system capacity to prevent a shortfall from occurring.

Many of the plant that currently run on the margins of the electricity system in times of peak demand are oil and coal fired plant that are increasingly unreliable with multiple faults reported in recent time.

3.2.2.1 System Alerts

System Alerts are issued by the Single Electricity Market Operator (SEMO) during periods when there is an elevated risk of not being able to meet electricity system demand. The number of system alerts warning of potential electricity shortages on the national grid has risen in the last 12 months, with the most recent being on 17th May 2021. In the last year the SEMO has issued six system alerts to warn of capacity shortages on the electricity grid and has warned customers to expect more alerts in the coming months. During System Alerts, dormant coal and oil generators can be instructed to start up to manage the mismatch between supply and demand. Large energy demand users can also be requested to reduce their energy use.

There has been a notable increase in generation outages in recent years. The thermal generation fleet in Ireland (and Northern Ireland) is ageing and many of the existing units were not designed for the current highly variable operation conditions associated with backing Ireland's high penetration of non-dispatchable renewables in the generation mix. The sub-optimal operating conditions relative to the original design are leading to increased reliability, operating, and maintenance issues, as well as the associated costs for operators. The Power Plant is optimised to operate within the current and future SEM system design, being capable of low minimum load and rapid ramping up and down of output thanks to its modular design.

The BESS will also provide fast (<5 sec) response power for system stability services caused by sudden changes in the supply/ demand balance, mainly as a result of intermittent renewable generation. Refer to Chapter 02 – Project Description for more information.

The Commission for Regulation of Utilities (CRU) is extremely cognisant of the urgent need for additional gas fired generation to safeguard electricity security of supply. In August 2021, the CRU published details of specific directions given to both Eirgrid and GNI in order to prevent serious adverse impacts on the electricity system in both the short and medium term (CRU, 2021):

'*The CRU, working closely with System Operators, has recently progressed a number of measures to support both medium term and short-term electricity supply and demand balance, in light of unexpected generator outages and delays in the delivery of new gas-fired generation capacity.*

Some of these measures, such as the proposed decision on a direction on data centre connections, are subject to public consultation while other measures are not. Given the importance of these measures and in the interests of transparency and openness, the CRU is today publishing a number of letters related to recent directions to EirGrid and GNI in support of electricity security of supply.

The CRU will continue to engage with the system operators and the Department of Environment, Climate and Communications and other stakeholders on the transition to a secure, low-carbon future.'

The specific measures included a direction to EirGrid to secure temporary emergency firm generation capacity for Winter 2021/ 22 due an acknowledged 'likely and substantial risk of a security of supply emergency in respect of which is not practicable in the time available to otherwise ensure security of supply'.'

This direction required the consent of Minister Eamonn Ryan. In his letter to the CRU (DECC, 2021a), the Minister stated that:

'*Ensuring a continued secure supply of electricity is vital for the proper functioning of society and the economy. It is also necessary to ensure people and businesses have confidence in switching to electrified solutions such as heat pumps and electric vehicles, which are core elements of the Government's Climate Action Plan.*'

At the end of his letter, the Minister stated that:

'*In parallel with the request pursuant to Regulation 28(10) to provide emergency generation, I acknowledge that the CRU and EirGrid are engaged in a range of measures to mitigate the risks to security of supply.*

In its report, EirGrid noted a number of these measures such as improvements of the performance of existing conventional generators and engagements with the demand side units to improve their performance.

It is important that the CRU also consider why the current electricity market structure and the regulatory measures in place are not delivering the required level of new generation capacity necessary to ensure security of supply in Ireland and thus support the Government's emission reduction targets. It would seem appropriate that the CRU would review and evaluate the performance of the market and the regulatory measures in place and consider if changes to the market and/or additional measures are required.'

GNI wrote to the CRU in June 2021 to highlight that it has received a significant number of connection enquiries from potential new electricity generation plant. GNI highlights that:

'*Despite the high number of enquiries and the successful completion of the T-4 capacity auction by EirGrid, all but one connection offer remains outstanding with developers reluctant to commit to a connection agreement at this time. The on-going delays with developers committing to a gas connection means the proposed timelines for the delivery of these projects can no longer be met and GNI is concerned that the security of supply may be impacted as a result.*'

GNI's proposal, which was approved by the CRU, was that GNI would progress with detailed design for some or all of the 16 identified projects without receiving a contractual commitment from the prospective connecting parties (as is typically required under the GNI Connections Policy) (EirGrid, 2021b).

The Proposed Development, including the CCGT, is significantly advanced relative to other gas fired electricity generators. For example, the 26 km Shannon Pipeline has already been permitted. The level of advanced work undertaken by the Applicant, along with GNI to this juncture, puts the Proposed Development in a very strong position to contribute to meeting the challenges of safeguarding Ireland's electricity supply in the timelines identified by the CRU.

3.2.3 Intermittency of Renewable Generation

Renewable generation is weather dependent, and its output fluctuates considerably. For this reason, conventional power plants are required to fill the fluctuating gap between electricity demand and renewable generation. Natural gas is the only major energy source currently available to back-up renewable generation and thereby maintain a resilient electricity supply to the country while supporting the transition to 70% renewable generation by 2030.

As an example, the wind generation profile on 6th December 2020 provides an insight into the vulnerability of wind power to weather conditions (EirGrid, 2021c). On this day, there was installed wind generation capacity of over 4,000 MW. However, at 2:45 PM wind produced only 1 MW of power with the system requiring over 5000 MW of power at that time. Most the power generation at that moment was delivered by gas fired power generation. The low level of wind generation continued to the next day, 7th December, when Ireland experience a system record peak day electrical demand (see Figure 3-5).

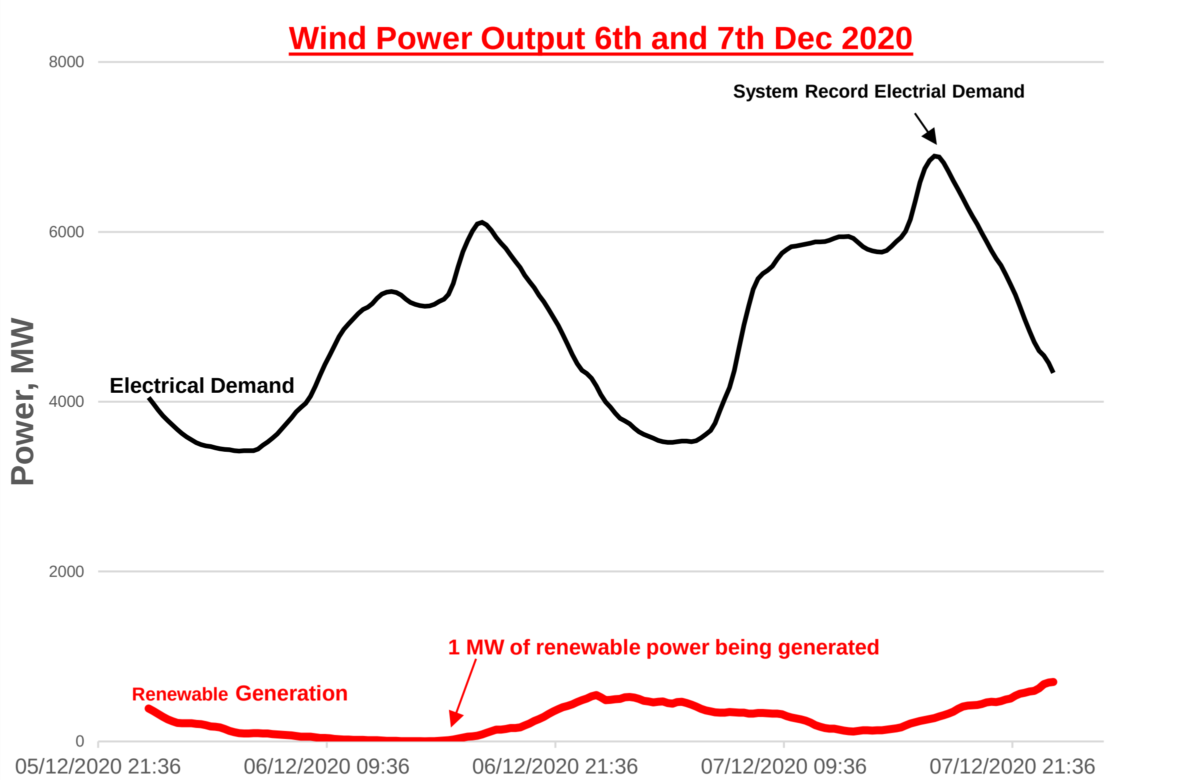


Figure 3-5 Wind Power Output and Electrical Demand on 6th and 7th December 2020

The Irish Academy of Engineering (2021) notes the following:

'*Like other climatic phenomena annual mean wind speeds are subject to significant variations from year to year. The winter of 2010 was characterised by an exceptionally cold spell over Western Europe. Such weather patterns are unusual over Western Europe but when they do occur, they are accompanied by exceptionally low wind speeds and the patterns survive for prolonged periods. During the five week period from mid-November 2010 to the final week in December, wind output, at peak demand period, was less than 10% of installed wind generation capacity. There was a 10 day period in this very cold spell where wind output was close to zero.*

In these conditions it is questionable as to whether a significant infeed could be obtained through interconnectors with GB and France. Scotland, which has much of GB's wind generation capacity, was even more affected by the same climatic conditions and France has a high dependence on electric heating, which was promoted to complement its nuclear programme and thus has high domestic electricity requirements when temperatures are extremely low. The key to understanding the challenges posed by such weather patterns is to acknowledge their extent –not just Ireland or GB, but most of Western Europe.

It has been suggested that storage technologies might be used to manage such multi week periods of low renewable generation and high demand. While such technologies could indeed contribute to solving daily intermittency problems, the cost of implementing such solutions (pumped hydro, or battery storage for example) to provide power over many days makes them entirely unfeasible for the foreseeable future.'

3.2.4 Security of Supply of Gas

Please refer to Chapter 04, Section 4.1.3.7 Security of Supply for a detailed policy discussion.

As the year-on-year production from the Corrib gas field declines, Ireland will increasingly rely on imports of gas via a single supply point from the UK, predicted to provide 90% of gas by 2030. Due to the decline in North Sea production, the UK itself is expected to import up to 75% of its gas supply by 2030 (from Norway, Russia, Qatar and various countries outside Europe). Therefore, the gas supply route to Ireland will be longer than at present with a greater risk of supply disruption (Irish Academy of Engineering, 2018). The impact of losing this single gas supply point from the UK has been assessed by the Commission for Regulation of Utilities (CRU) (2020), as being a '*major*' risk for electricity production in Ireland. An interconnector to France, discussed further in Section 3.2.6, would not provide sufficient capacity for the loss of the UK gas interconnector. Figure 3-6 notes the expected gas demand and supply to Ireland to the year 2040.

Pipeline infrastructure failures and supply disruptions occur and the potential consequences must be planned for. For example in 2017, gas supplies from the Corrib Gas Terminal at Bellanaboy were interrupted for 21 days. Gas supplies can also be vulnerable to mechanical failure, man-made events and cyber-attacks such as ransomware. In May 2021, the US's largest fuel pipeline, Colonial Pipeline, was disabled after a ransomware attack.

The Department of Communications, Climate Action and Environment, with support from the Commission for Regulation of Utilities (CRU) commissioned Gas Networks Ireland (GNI) and EirGrid to complete a Security of Supply review in 2018, called the Long Term Resilience Study 2018 (GNI and EirGrid, 2018). The Long Term Resilience Study concluded with a key recommendation to *'Conduct a detailed cost benefit analysis for a floating LNG terminal. The most economically advantageous option to improve the resilience of Ireland's gas supply is a floating LNG terminal. A floating LNG terminal would provide a direct connection for Ireland to the global LNG market and would allow Ireland to diversify its gas supply'.*

Separately, the International Energy Association (IEA) in their report *'Ireland 2019 Review of Energy Policies of IEA Countries'* recommended that the government of Ireland should: *'Optimise the role of gas in the transition to a low-carbon-energy system, including encouraging, through appropriate regulation and policy, the development of an LNG import facility and seasonal gas storage. A cost benefit analysis should be used when deciding on any public infrastructure investments and developing programmes for gas demand in the heating and transport sectors.'*

A concrete example of the dependence on Moffat has been seen this year when flows at Corrib were curtailed by issues at an offshore well control valve (REMIT Inside Information Platform, 2021), at the same time as GNI were undertaking planned works at the Beattock Compressor Station in Scotland (European Network of Transmission System Operators for Gas, 2021). The Beattock Compressor Station connects directly to the National Grid Transmission Network at Moffat, and feeds the 2 subsea gas interconnectors into Ireland as well as offtakes to Northern Ireland and the Isle of Man. The works at Beattock limited the capability of the Entry Point to approximately 57% of its technical capacity, for approximately 6 weeks. During the period in question, there were no restrictions on downstream gas usage due to the low heating demand associated with the time of year as well as long term outages associated with unplanned maintenance at four large CCGT power stations (Whitegate, Huntstown 1, Tynagh and Dublin Bay) (EirGrid, 2021d). In this period the electricity system relied heavily on coal and oil plant to replace the missing gas generation. If the gas power stations had been available and a sustained period of low wind conditions had prevailed, which would not be unusual in an Irish summer, there would likely have been a need to implement load shedding of the gas power stations, which could also have impacted additional industrial users.

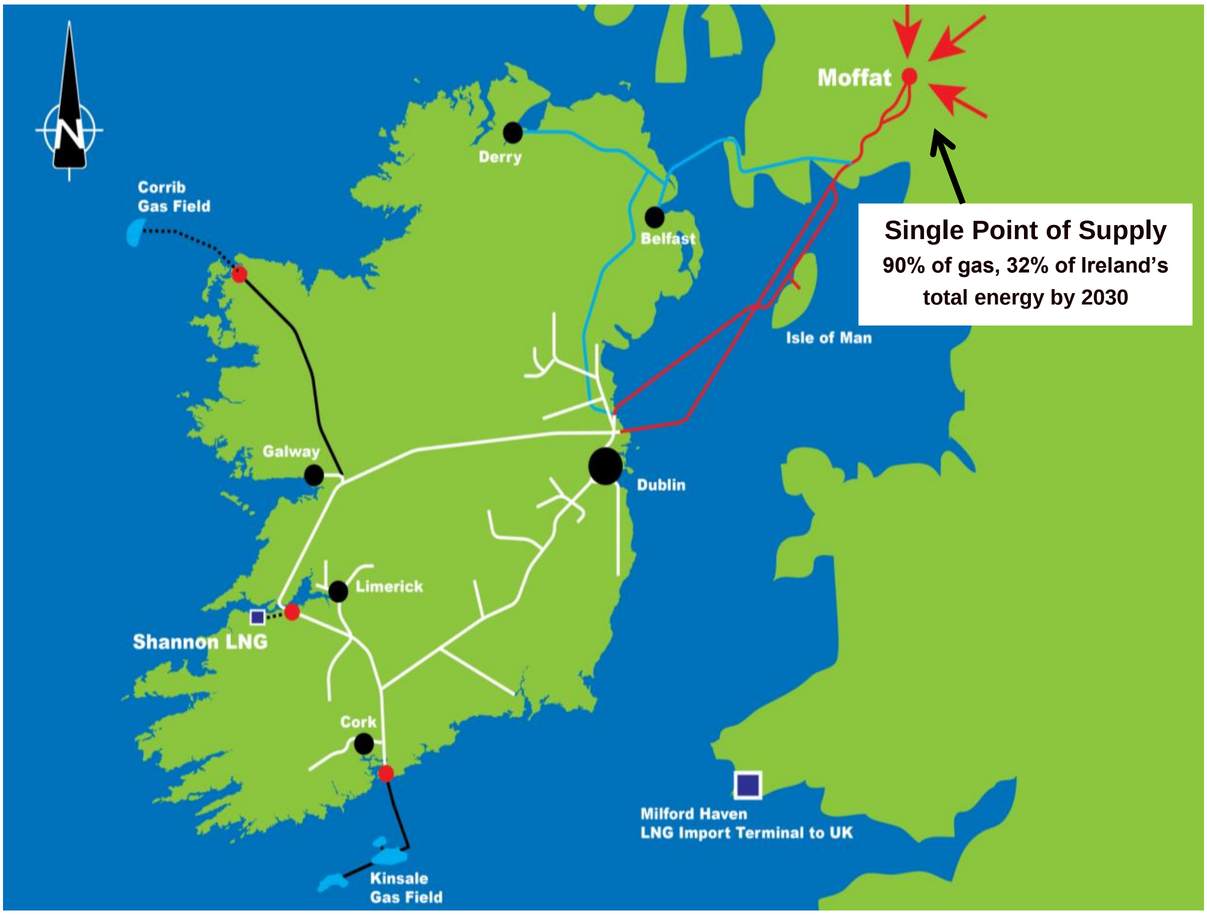
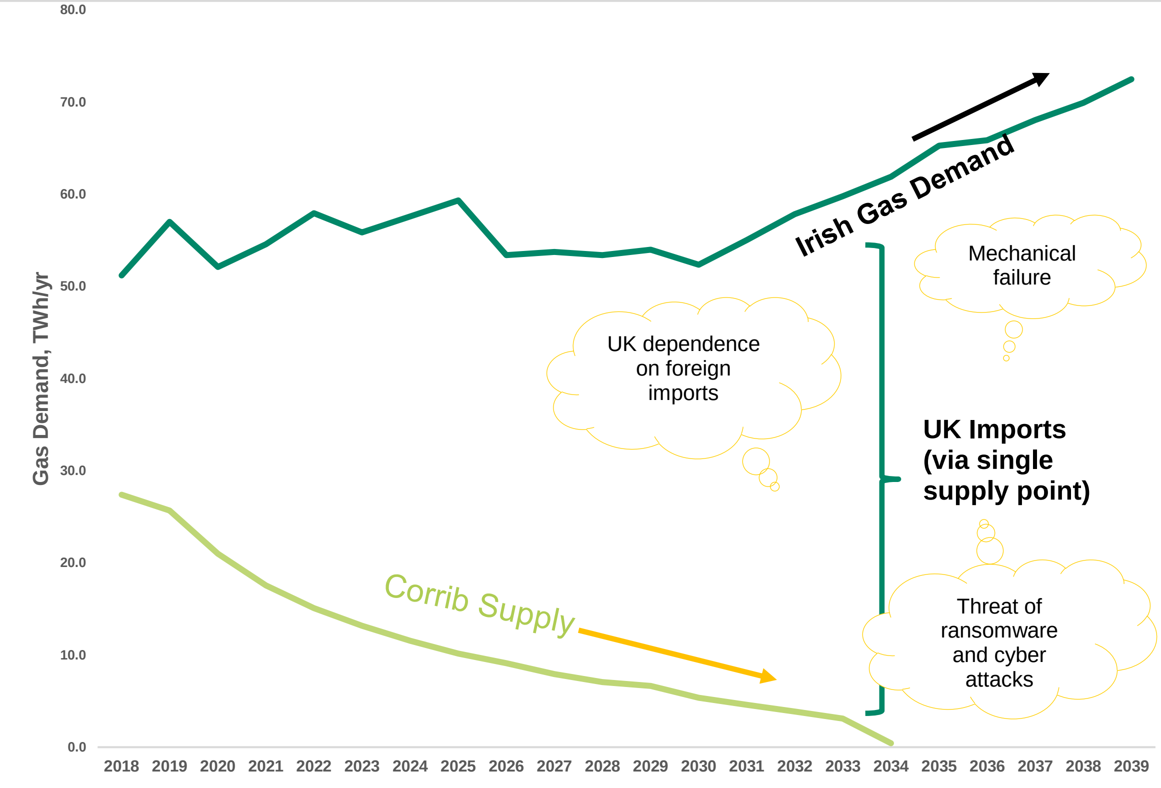


Figure 3-6 Single Point of Gas Supply to Ireland



Source: *The National Energy and Climate Change Plan 2021 to 2030 (NECP), Figure 23 Total Primary energy requirement by fuel (WAM) Figure 23 and CRU18105 Copy of Corrib Linkline Element Calculation 2018/19*

Figure 3-7 Irish Gas Demand vs Supply

Another key element of security of supply for Ireland is diversity of supply sources. The UK's domestic reserves are in decline, as are those of the Netherlands, which is the only major domestic producer of natural gas within the EU. Russia supplies approximately 40% of the EU's gas, though the reliability of supply can be subject to political constraints. In Q2 and Q3 2021, despite requirements for additional supplies into Europe in order to fill storage facilities, Gazprom (which has a monopoly on Russian pipeline exports) did not use additional transit capacity via Ukraine to meet the demand.

In the event of a supply deficit in Europe, Ireland would likely be the last country with access to supplies of gas following each country along the supply route. EU Regulation (EU) 2017/1938, the security of gas supply law, provides for a solidarity mechanism between member states. Recital 38 of the Regulation states '*The solidarity mechanism is designed to address extreme situations in which supply to solidarity protected customers as an essential need and a necessary priority is at stake in a Member State. Solidarity ensures cooperation with more vulnerable Member States'.*

As Ireland relies on a single supply route from the UK, which is not governed by the EU Regulation, issues with security of supply may not be easy to resolve. The Proposed Development increases the options available to Ireland to request solidarity from any member states, through either reload of LNG from an EU terminal or diversion of inbound cargoes to Ireland, along with commercial measures to ensure cargoes arrive and maintaining strategic reserves of LNG (in the same way as the National Oil Reserves Agency (NORA) manages fuel stocks (NORA, 2021).

Other European countries, which would have been considered 'energy islands' similar to Ireland, have used the development of LNG terminals to diversify and secure their gas and electricity supply. These developments have been significantly financially supported by the European Commission (see Chapter 2.1.2). The development of the Klaipaèda LNG terminal in Lithuania is a prime example of the way in which an LNG terminal (particularly an FSRU-based terminal) can deliver significant diversity and security of supply to a previously isolated country. Germany is also investigating the potential for LNG as a means to diversify its gas supply (see Appendix A3-1). The positive outcomes achieved by Lithuania, as recognized by the IEA, are pointed to by the same organization in its 2019 review of Ireland: *'The development of LNG import facilities would substantially improve gas supply security in Ireland by providing direct access to the global LNG market.'*

It is clear that there is policy support at national and Commission level in Europe for the benefits that LNG terminals bring to the function of the internal energy market, in terms of security and diversity of supply as well as increased market competition. This is further examined in Section 2.1 of Chapter 04.

3.2.5 Failure to comply with EU regulations

EU Regulation (EU) 2017/1938 is an EU law that requires member states to assess the security of their gas supplies. The assessment is in the form of a simple calculation which removes the technical capacity of the single largest piece of gas infrastructure on a peak day with a view to determining whether the remaining gas infrastructure can meet 100% of peak day gas demand. Ireland currently fails to comply with EU Regulation (EU) 2017/1938. Specifically, according to the CRU (2018):

'*The N-1 calculation removes the technical capacity of the single largest piece of gas infrastructure on a peak day with a view to determining whether the remaining gas infrastructure can meet 100% of peak day gas demand. To pass, the calculation must equate to 100% or more.* ***Ireland failed the Infrastructure Standard meaning that after losing the single largest gas infrastructure the technical capacity of the remaining infrastructure cannot meet demand*** …

It can be seen that the result of the N-1 calculation is 85%36 and that Ireland fails to meet the criteria (i.e. if the supply of gas via Moffat is partially disrupted ***Ireland will be unable to deliver sufficient gas from other entry points to meet total demand on a 1 in 20 year peak-day)****.*' **[emphasis added]**

The Minister for the Environment, Climate and Communications has also recently noted (DECC, 2020b):

'*The UK has left the European Union which will lead, at the end of the withdrawal period[2], to difficulties for Ireland in meeting the requirements of EU law in relation to gas security of supply including potential challenges for future compliance with EU law including the 'N-1' infrastructure standard and the supply standard.*'

The Proposed Development provides gas supply diversity and will allow Ireland to comply with the EU Regulation on security of supply, the N-1 Infrastructure standard (CRU, 2018 and Regulation (EU) 2017/1938 concerning measures to safeguard the security of gas supply).

In the absence of the Proposed Development, Ireland will remain non-compliant with the EU Regulation on security of supply and the N-1 infrastructure standard to 2040 and beyond. The European Commission may launch infringement proceedings for failure to comply with this EU regulation. The LNG Terminal will protect Ireland in the event of a major gas supply disruption from the UK.

3.2.6 Alternatives to the Proposed Development

Alternative natural gas supplies are either insufficient to satisfy demand (pipeline from France and biomethane), technically not mature (hydrogen), or contrary to Irish legislation (offshore exploration). The Proposed Development gives Ireland direct access to global gas markets and therefore greater control over the source of Ireland's gas supplies.

3.2.6.1 Biomethane and Hydrogen

The injection of renewable gas including Biomethane into the gas network has commenced. Together these will make a relatively small contribution to Irish gas supply in the short to medium term and as such they cannot be considered as a significant substitute for imported gas (Irish Academy of Engineering, 2018). For reference, under GNI's Path to Zero, by 2050 the gas network contains 37% renewable gas (biomethane), 13% hydrogen gas, with the remaining natural gas abated by carbon capture and storage.

3.2.6.2 Indigenous Exploration

The Climate Action and Low Carbon Development (Amendment) Bill 2021 (DECC, 2021b) contains a provision to end the issuing of new licences for the exploration and extraction of gas, to help meet the national climate objective to transition to a climate resilient, biodiversity rich, environmentally sustainable, and climate neutral economy by 2050. The DECC is no longer accepting new applications for exploration licences for natural gas or oil, nor will there be any future licensing rounds.

[2] The withdrawal period ended 31st December 2020.

The DECC (2021) notes the number of authorisations has dropped from 55 at end September 2019 to 30 at end December 2020, a decrease of 45%. It is expected that the number of authorisations will decline further as authorisations continue to expire or are relinquished, with no new authorisations for new exploration and extraction replacing them. It is therefore increasingly unlikely that any new gas supply from indigenous production will be brought to market.

3.2.6.3 Alternative Import Routes for Pipeline Gas

A gas pipeline between Ireland and France was assessed by the Department of Communications, Climate Action and Environment, with support from the Commission for Regulation of Utilities (CRU) in the GNI/ EirGrid Long Term Resilience Study 2018.

When considering a pipeline to France, it should be noted that France is dependent upon LNG and inter-connecting pipelines for its domestic gas demand (CRE, the French Energy Regulatory Commission, 2021). Indeed, all countries in Northwest Europe are forecast to see declining indigenous gas production and will need to import gas to meet their long-term supply needs. A significant portion of the imported gas will be sourced from LNG (see Figure 3-5).

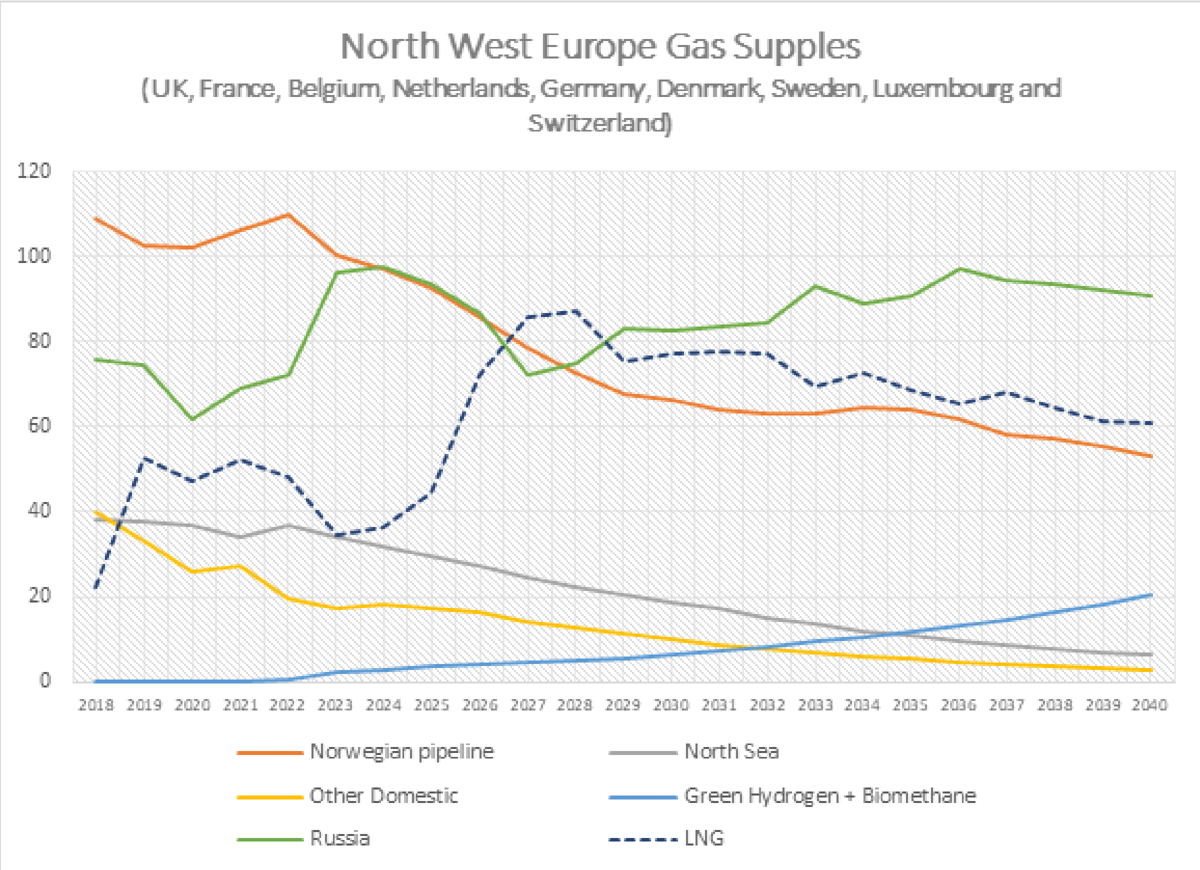


Figure 3-8 North West Europe gas supplies (Platts, n.d.)

The pipeline capacity in the study was estimated at 100 GWh/day. This capacity represents only 39% of Irish peak day gas demand for 2020/ 21, which is forecast at 255 GWh/day. The Proposed Development can supply up to (approximately) 256 GWh/day.

The Long Term Resilience Study notes: *'A gas interconnector to France, while having a positive impact in terms of security of supply and diversification, would have less impact than either of the LNG options. Building a gas interconnector would not on its own result in Ireland meeting the required EU infrastructure standard. This option requires the largest capital investment of the mitigation measures under consideration.'*

By contrast, the Proposed Development, which is a domestic LNG terminal, gives Ireland direct access to global LNG markets and greater control over these factors, thereby enhancing security of supply. Moreover, it is also unclear whether an interconnector from France would satisfy Irish policy regarding the source of supply of natural gas, further reducing its benefits to the Irish people. In contrast to the Proposed Development, the interconnector to France would not support the future integration of hydrogen into the Irish energy system.

3.2.6.4 Natural Gas Storage

There is only one location considered suitable in geological terms for large scale gas storage on the Island of Ireland (Irish Academy of Engineering, 2021). This is at Islandmagee in Co. Antrim. Efforts have been underway for the past decade to licence and finance a large-scale storage project at the site, however this appears unlikely to materialise in their short to medium term. The market dynamics that previously made the development of new storage projects viable no longer exist, namely low wholesale gas prices during the summer months when gas would be injected, followed by high winter prices when stocks would be withdrawn. The facilities associated with the Kinsale Energy gas reservoir have now been decommissioned, but even when in operation the reservoir was not sufficient to satisfy Ireland's total demand requirements under the N-1 infrastructure standard.

3.3 Alternative Locations

3.3.1 Selection of the Preferred Site

3.3.1.1 Site Selection

A site selection process has been carried out (Refer to AECOM's 2021 Site Selection Assessment Report (AECOM, 2021) (Appendix A3-2, Vol. 4). It considered the following key requirements:

- A large landbank zoned for industrial purposes with access to or adjacent to the foreshore;
- Access to deep water greater than 13 m;
- Uniform cross sectional depth navigational channel with minimum width five times the beam of Qmax (260 m);
- A turning circle twice the length of Qmax (690 m);
- 150 m control zone surrounding the LNGC and FSRU;
- Significant wave heights less than 1.5 metres; and
- Peak wave periods less than 9 seconds.

The scope of the study included a review of potential coastal locations across Ireland. In total, sixty-seven locations were identified. The site selection process, which included several phases of screening under specific technical criteria, gradually narrowed this down to five, see below. The selection criteria and headings were derived from policy and from European and international standards.

An important selection criterion was the eligibility of any site to receive a grid connection offer from EriGrid in 2021, to allow power to be generated before the forecast capacity shortfall in 2025. EirGrid has notified the Applicant that the Proposed Development site will receive a grid offer in 2021.

Phase 1

The initial stage of the Phase 1 screening included a planning and practical context that assessed the location, land use character and context, with due regard to relevant specific local planning policies and zoning/ land use designations and surrounding areas. In conjunction with the respective statutory planning policies, the selected criteria for each location specifically assesses land parcel sizes.

From the sixty-seven locations identified during Phase 1, eleven were deemed suitable under the Phase 1 screening criteria. These locations (listed below) were then brought forward to Phase 2 screening:

1. Arklow (Co. Wicklow);
2. Aughinish (Co. Limerick);
3. Ballylongford/ Tarbert (Co. Kerry);
4. Castletownbere (Co. Cork);
5. Dunmore East (Co. Waterford);
6. Greenore (Co. Louth);
7. Killybegs (Co. Donegal);

8. Moneypoint (Co. Clare);
9. Ringaskiddy (Co. Cork);
10. Whiddy Island (Co. Cork); and
11. Whitegate (Co. Cork).

The Phase 1 screening process is summarised in the screening matric provided in Table 3-1 below.

Table 3-1 Phase 1 Screening Matrix

Site Location	> 20 ha Site (Zoned Industrial)	> 40 ha Site (Zoned Industrial)	> 80 ha Site (Zoned Industrial)	Water Depth (> 13 m)
Aranmore Island	x	x	x	x
Ardmore (Rams Head)	x	x	x	✓
Arklow	✓	✓	x	✓
Aughinish	✓	✓	✓	✓
Ballycotton Harbour	x	x	x	x
Ballylongford/ Tarbert	✓	✓	✓	✓
Ballyhack	x	x	x	x
Baltimore	x	x	x	x
Bantry	✓	x	x	x
Belview Port	✓	✓	✓	x
Bere Island	x	x	x	✓
Broadhaven Bay	x	x	x	x
Bunbeg	x	x	x	x
Burtonport	x	x	x	x
Callanafersy	x	x	x	x
Castletownbere	✓	x	x	✓
Cape Clear	x	x	x	✓
Clare Island	x	x	x	✓
Clew Bay	x	x	x	x
Cleggan	x	x	x	x
Clogher head	x	x	x	x
Doolin	x	x	x	✓
Dublin Port	✓	✓	✓	x
Dún Laoghaire	x	x	x	✓
Dunmore East	✓	x	x	✓
Dundalk	x	x	x	x
Drogheda	✓	✓	x	x
Fenit	x	x	x	x
Foynes Island	x	x	x	✓

Site Location	> 20 ha Site (Zoned Industrial)	> 40 ha Site (Zoned Industrial)	> 80 ha Site (Zoned Industrial)	Water Depth (> 13 m)
Foynes Port	✓	✓	✓	x
Galway Port	✓	x	x	x
Greenore	✓	x	x	✓
Inishboffin	x	x	x	✓
Inisheer	x	x	x	✓
Inishmaan	x	x	x	✓
Inishmore	x	x	x	✓
Killala Bay	x	x	x	x
Killary harbour	x	x	x	✓
Kinsale	x	x	x	x
Killybegs	✓	✓	✓	✓
Labasheeda	x	x	x	✓
Lough Swilly	x	x	x	✓
Malahide Inlet	x	x	x	x
Magheraroarty	x	x	x	x
Marino Point	✓	x	x	x
Moneypoint	✓	✓	✓	✓
Mount Trenchard	x	x	x	✓
New Ross	✓	✓	✓	x
Passage East	x	x	x	x
Quigley's Point	x	x	x	✓
Reenard Point	x	x	x	✓
Ringaskiddy	✓	✓	✓	✓
Roonagh Quay	x	x	x	x
Rossaveel	✓	x	x	x
Rosslare Port	✓	x	x	x
Rosses Point	x	x	x	x
Schull	x	x	x	x
Shannakea	x	x	x	✓
Sheep Haven Bay	x	x	x	✓
Sherkin Island	x	x	x	✓
Strandhill	x	x	x	x
Tory Island	x	x	x	✓
Valentia	x	x	x	✓
Whiddy Island	✓	✓	x	✓
Whitegate	✓	✓	✓	✓

Site Location	> 20 ha Site (Zoned Industrial)	> 40 ha Site (Zoned Industrial)	> 80 ha Site (Zoned Industrial)	Water Depth (> 13 m)
Wicklow Town	✓	✓	x	x
Youghal Estuary	x	x	x	✓

Phase 2

Phase 2 of the site selection then assessed the selected eleven locations against the Phase 2 criteria which included specific navigation channel widths, as well as specific turning circle and control zone requirements, resulting in five locations which passed both the Phase 1 and 2 screening criteria (note the cells highlighted in blue in Table 3-2 below):

1. Arklow (Co. Wicklow)
2. Ballylongford/ Tarbert (Co. Kerry);
3. Dunmore East (Co. Waterford);
4. Moneypoint (Co. Clare); and
5. Whiddy Island (Co. Cork).

The final findings of the preferred criteria requirements for the Phase 2 appraisal are summarised in Table 3-2.

Table 3-2 Phase 2 Screening Matrix

Site Location	Navigation Channel	Turning Circle	Control Zone
Arklow	✓	✓	✓
Aughinish	x	x	x
Ballylongford/ Tarbert	✓	✓	✓
Dunmore East	✓	✓	✓
Greenore	x	x	x
Moneypoint	✓	✓	✓
Ringaskiddy	x	x	x
Whiddy Island	✓	✓	✓
Whitegate	x	x	x

Phase 3

Five locations remained after Phase 2 screening.

Moffatt & Nichol (M&N) were commissioned to consider wave conditions at the selected locations for the Phase 3 screening. This final phase of the site selection applied critical criteria for LNG transfer operations set out in SIGTTO guidance '*Site Selection and Design for LNG Ports and Jetties*' including significant wave heights less than 1.5 metres and peak wave periods less than 9 seconds.

The comparison of the five selected locations after Phase 2 screening against Phase 3 criteria led to the identification of Ballylongford/ Tarbert and Moneypoint as the most suitable locations to accommodate and safely operate the LNG Terminal and Power Plant.

The final findings of the preferred criteria requirements for the Phase 3 screening are summarised in Table 3-3.

Table 3-3 Phase 3 Matrix Screening

Site Location	Hs>1.5 m	Tp < 9s	Hs>1.5m or Tp < 9s
Arklow	x	x	x

Site Location	Hs>1.5 m	Tp < 9s	Hs>1.5m or Tp < 9s
Ballylongford/ Tarbert	✓	✓	✓
Dunmore East	x	x	x
Moneypoint	✓	✓	✓
Whiddy Island	x	x	x

An 840 MW coal-fired power plant is currently located at the Moneypoint site, which is owned and operated by the ESB. Under the Climate Action Plan 2019 (DECC, 2019), power generation from coal at Moneypoint will stop no later than 2025.

In April 2021, the ESB announced their 'Green Atlantic' plan for the future use of the Moneypoint site (ESB, 2021). Green Atlantic is a multi-billion euro programme of investment over the next decade which will transition the Moneypoint site from coal-fired electricity generation to renewable generation. Specifically, Green Atlantic proposes the following investments at Moneypoint:

- A *Sustainable System Support* facility to provide a range of electrical services to the electricity grid.
- *Moneypoint Floating Offshore* wind farm of 1,400 MW capacity to be developed off the coast of Counties Clare and Kerry.
- *A wind turbine construction hub:* Moneypoint will become a centre for the construction and assembly of floating wind turbines. This hub will require modifications to the existing jetty at the site.
- Hydrogen production, storage and generation facility at Moneypoint site towards the end of the decade.

ESB confirmed that *'Moneypoint has played a critical role in the country's energy supply for almost 40 years. We are proud that it will continue to have a crucial role in Ireland's energy future with many benefits for the local community and wider society.'*

Additionally, while not considered in the initial screening criteria, access to high-capacity power and gas transmissions systems is a core requirement for the Proposed Development. Both Moneypoint and Ballylongford/ Tarbert enjoy access to high-capacity electricity transmission networks. However, only the Ballylongford/ Tarbert landbank has a consented gas transmission pipeline connecting it with the GNI gas transmission network at Foynes.

Therefore, in light of ESB's Green Atlantic plans, and the lack of a consented interconnecting gas pipeline, the Moneypoint site was ruled out. The site selection assessment concludes that the Ballylongford/ Tarbert location should be deemed the most suitable location to accommodate the Proposed Development. Additional information on the site selection assessment can be found in the 2021 Site Selection Assessment Report (AECOM, 2021) (Appendix A3-2, Vol. 4). The advanced status of the Proposed Development provides an advantage over other power or terminal projects in the context of the planning process.

3.4 Alternative Designs

3.4.1 LNG Terminal Concept

There are three main types of LNG terminals that can be developed (Figures 3-9 to 3-11):

(a) **Onshore Terminals**, where LNG is transferred to onshore storage tanks and regasified as required;

(b) **Floating Terminals**, where LNG storage and regasification is completed on a ship or barge, referred to as a floating storage and regasification unit (FSRU); and

(c) **Hybrid Terminals,** where LNG is stored on a vessel, a floating storage unit (FSU), but the regasification occurs onshore.

Onshore Terminal

Floating Terminals

Hybrid Terminals

Figures 3-9, 3-10 and 3-11 Three main types of LNG Terminals.

3.4.1.1 Onshore Terminal Design

Onshore LNG terminals, of a scale required for the capacity of the Proposed Development, typically have large onshore tanks of a diameter up to 100 m and approximately 50 m tall. Each LNG tank has a capacity of around 200,000 m^3 of LNG. LNG is delivered to the terminal via an LNG carrier (LNGC) unloading into the tanks. Once emptied the LNGC departs. LNG regasification is via onshore vaporisation equipment. Additional tanks can be built to provide more storage capacity.

The LNG storage capacity of onshore terminals is normally larger than floating or hybrid terminals. Because the onshore tanks are large, these terminals have a significant onshore footprint, higher environmental impact and longer construction time than floating terminals.

3.4.1.2 Hybrid FSU Design

Hybrid terminals have LNG storage onboard a ship or barge, called a floating storage unit (FSU). Typically, capacity of the FSU is up to 180,000 m^3. LNG is delivered to the FSU via an LNGC unloading into the FSU's tanks. Once emptied, the LNGC departs. The FSU is permanently moored at the terminal site. LNG is pumped onshore to onshore regasification vaporisation equipment.

As hybrid terminals do not have onshore storage tanks, they have a reduced onshore footprint and environmental impact compared to onshore terminals, but greater than floating terminals, as more onshore development is required than where FSRUs are used. Construction time is less than onshore terminals but more than FSRUs.

3.4.1.3 Proposed FSRU Design

Since 2013, floating terminals have become the preferred type of LNG terminal for development in Europe. Specifically, in Europe there are thirty-seven LNG import terminals operational or being built. Of the thirty-seven, eight have been built since 2013. Of the eight built since 2013, six have been FSRU-based, including the most recent example in Croatia.

Floating terminals, of scale required for the capacity of the Proposed Development, have LNG storage onboard a ship or barge, the FSRU. Typically, capacity is up to 180,000 m^3. LNG is delivered to the FSRU via an LNGC unloading into the FSRU tanks. Once emptied, the LNGC departs. The FSRU is permanently moored at the Proposed Development site. No LNG is pumped onshore. LNG regasification is completed onboard the FSRU via onboard vaporisation equipment, which is permanently operating.

As FSRUs do not have onshore storage tanks or onshore vapourisation, they have a reduced onshore footprint and environmental impact compared to onshore terminals and FSU's. Construction time is less than for onshore terminals and FSUs. Additionally, FSRU terminals are easier to re-purpose to transition to less carbon-intensive fuel sources in the future, such as hydrogen if and when that technology matures.

A summary of the above discussion is presented in Table 3-4 and Table 3-5 below. In conclusion, the Applicant looked at the three types of terminals and the FSRU-based terminal approach was determined to best match the objectives.

Table 3-4 Rank Order for Each Terminal

Rank Order for Each Terminal (1 is the Best)			
	Land Based	FSRU	Hybrid
Environmental	3	1	2
Construction time	3	1	2
Hydrogen transition	3	1	1

Table 3-5 Technical Solutions Considered

Item	Onshore Terminal	FSU	Proposed FSRU Design
Jetty required	Yes	Yes	Yes
Total developed area (Acres)	230 acre	175 acre	110 acre
Storage	800,000 m^3 via 4 x 200,000 m^3 landed tanks	Up to 180,000 m^3 via 1 LNG Carrier acting as a Floating Storage Unit	Up to 180,000 m^3 via FSRU
Delivery Options	LNG Carriers up to Q-max (266,000 m^3)	LNG Carriers up to Q-max (266,000 m^3)	LNG Carriers up to Q-max (266,000 m^3)
Ability to Land LNG	Yes	Yes	No
Construction Time	4 years	2 years	1.5 years

3.5 Alternative Layouts

3.5.1 Power Plant

The site layout for the Proposed Development has been condensed since the previous 2012 CHP Plant EIS and 2007 LNG Terminal EIS (Arup, 2007). The previously consented CHP Plant was located on Knockfinglas Point (Figure 3-12).

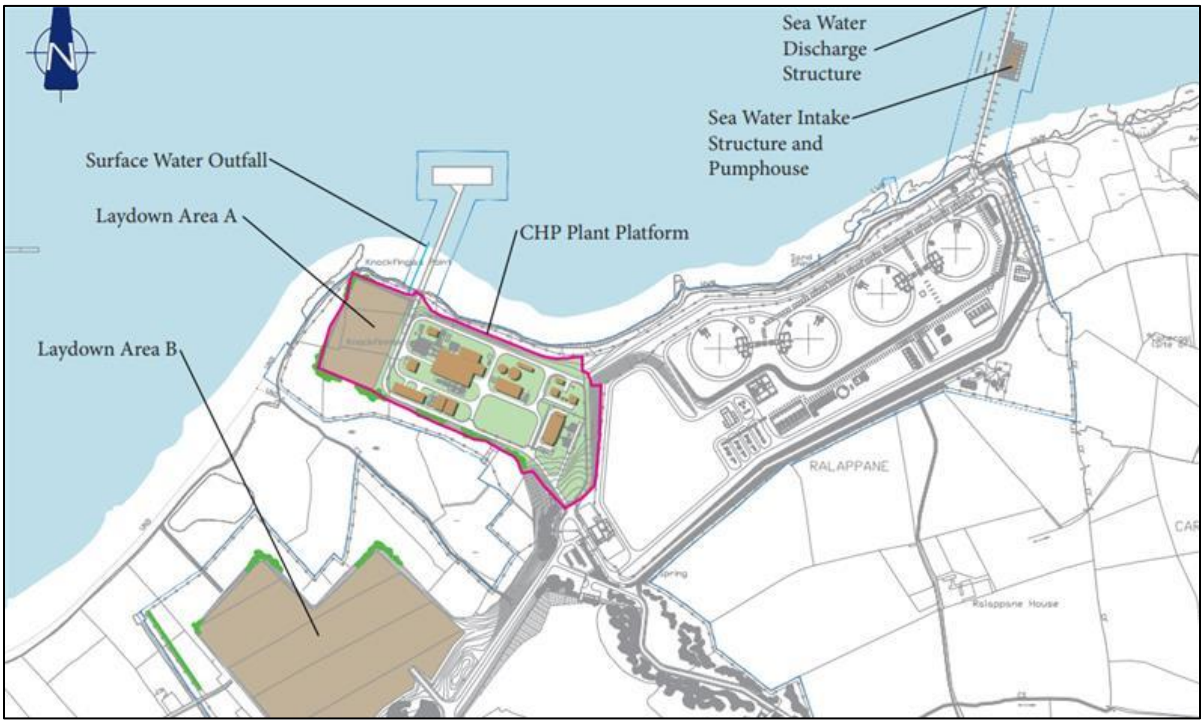


Figure 3-12 Location of Previously Consented CHP Plant

It is now located to the east of Knockfinglas Point. This layout is more efficient and minimises the total site footprint. The Proposed Development site layout and the associated design minimises visual impacts by utilising natural screening and avoiding designated sites (cSAC, SPA, NHAs).

The location of the Power Plant was selected to minimise overall land take and to minimise environmental impact including:

- Reduced impacts on biodiversity by reducing the overall footprint;
- Reduced visual impact;
- Optimised platform level at 18 m OD by balancing cut/ fill requirements;
- Reduced impacts on Cultural Heritage assets; and
- Reduction in carbon sequestration.

3.5.2 LNG Terminal

The jetty is located at point of deep water (22 m) which is ideally suited for marine operations. The deep water at this point, which does not require dredging, is one of the main reasons why the landbank is zoned for marine/ industrial development. Alternative locations and layouts for the jetty would not have satisfied marine navigation risk assessments or would have required significant dredging in environmentally designated sites.

Once the location of the jetty was determined, the onshore receiving facility was located in the eastern part of the Proposed Development site as close as possible to the landfall of the jetty in order to minimise the length of piping through which the gas is transferred from the FSRU. This is considered the optimal location in term of efficient process plant layout, minimising visual impacts by utilising natural screening and avoiding the environmentally designated sites.

The main site platform is at an elevation of 18 m above Ordnance Datum (OD), which will result in less cut and fill (and associated release of stored carbon) compared to lower elevations.

3.6 Alternative Processes/ Technologies

3.6.1 Power Plant

3.6.1.1 Power Plant Technologies

Alternative Power Plant technologies were considered. Technology options considered against the proposed multi-shaft combined cycle configuration included:

- Combined heat and power CHP;
- Open cycle gas turbines;
- Single-shaft; and
- Multi-shaft.

In determining the optimum configuration, specialised studies and extensive consultation were carried out to identify the key functional requirements of the power generation capability to be developed:

1. Be capable of fast response to sudden instructions from the System Operator to support intermittent wind generation.
2. Enable low minimum stable generation to allow the System Operator to keep units on the system at a minimum level to ensure a sufficient level of system inertia is maintained.
3. Be natural gas fuelled to meet with national Climate Change Policies and objectives.
4. Be able to accommodate faster or slower than forecast development of renewables power generation, and consequently be flexible in build out.
5. Support transitioning to deliver Ireland's net zero carbon emission by 2050 ambition.

In summary, the proposed Power Plant is the most efficient, flexible and reliable option with the lowest CO_2 emissions profile of the alternatives considered.

Combined Heat and Power (CHP) Plant

The Applicant considered the option of combined heat and power (CHP). CHP is the recovery of waste heat from the CCGT for the LNG regassification (i.e. Combined Heat and Power).

Waste heat generated by the CHP plant would have been delivered to the LNG terminal and would have been used to regasify the LNG. This CHP plant would have generated power for its own needs, for the needs of the LNG terminal and for sale to the Single Electricity Market (SEM) via the national electricity grid.

Upon detailed review, it was determined that heat supply from the CHP plant to the LNG terminal would be unreliable and insecure. It should be noted the LNG terminal requires heat all the time. Frequent interruptions of the waste heat supply from the CHP plant, with potentially very little or no notice, would be operationally very challenging for the FSRU. Specifically, the Applicant's detailed electricity market modelling has shown that with increasing wind penetration, the Power Plant will be frequently instructed to shut down, and potentially with very little or no notice, by EirGrid during periods of high wind generation. This would result in a sudden loss of the heat supply for the LNG Terminal and would be operationally very challenging for the FSRU to react to.

Furthermore, in November 2020, the CRU approved a decision to eliminate priority of dispatch for new high efficiency CHP plants (SEM, 2020). This means that new CHP plants could be shut down with very little notice by EirGrid without regard to the fact that the CHP plant would be sending waste heat to the LNG terminal. This effectively means that the LNG terminal's heat supply would not be secure or protected.

Pursuing such a terminal design in Ireland, at the Proposed Development site location under current grid rules, would be highly speculative and would dramatically increase the risk of economic and technical failure.

Due to the increased risk of economic and technical failure, and the unreliable and insecure nature of the heat supply, the CHP option was not considered further.

Open Cycle Gas Turbine

An Open cycle gas turbine (OCGT) plant is where a gas turbine generates power and the exhaust gases from the turbine are exhausted to air without heat recovery. An OCGT was proposed and was considered as an alternative design option. These facilities have relatively low capital costs and low thermal efficiencies: about 40%, compared to the Proposed Development with an efficiency of approximately 54%. Given their low efficiencies, electricity produced from OCGTs has a much higher CO_2 emission factor than electricity from CCGTs. Refer to Chapter 15 – Climate Change for a discussion and comparison on this.

With these performance characteristics, OCGT plants only dispatch in the electricity market during periods of peak demand or low wind. Given their low efficiencies and much higher CO_2 emission factors, OCGT were discounted.

Single-Shaft

As part of the Applicant's detailed electricity market modelling, the Applicant considered a larger single-shaft CCGT compared to the proposed multi-shaft unit. The larger single shaft unit was discounted because it was less flexible than the multi-shaft unit.

Specifically, as Ireland transitions to 70% renewables by 2030, the System Operator will require gas thermal units to be flexible. Units that have very low minimum stable generation will be kept running more than units with high minimum stable generations. A single shaft 600 MW would suffer from a minimum stable generation of about 176 MW compared to 41 MW for the multi- shaft unit. Given its high minimum stable generation, a single shaft unit was discounted.

Multi-Shaft

The Applicant has chosen a flexible modular Power Plant, which will comprise up to three blocks of CCGT, each block with a capacity of approximately 200 MW, for a total installed capacity of up to 600 MW. Each CCGT block will comprise two gas turbine generators, two heat recovery steam generators, a steam turbine generator, and an air cooled condenser. This configuration enjoys higher efficiency, lower CO_2 emission factor, greater flexibility, and is more reliable than the alternatives considered above.

Future Grid Requirements

The Power Plant will not operate at 100% capacity all year round. The actual operation of the plant will be determined by many factors such as power demand itself, the amount of renewable generation on the system, its bid price into the market compared to other generators, and the rules of the grid to ensure priority is given to renewable generation. The grid also needs to remain stable and secure with increased levels of renewable generation.

EirGrid has advised the Applicant in pre application consultations, to ensure grid stability with increased renewables, the future grid requires flexible gas fired power plants with high inertia[3], low minimum stable generation and fast response capability. Other stakeholder consultations and information support this advice.

The Applicant commissioned a detailed market analysis (*the Baringa Shannon Wholesale & Ancillary Revenue Report*) to consider these issues and model the future operation of the Power Plant from 2023 to 2050. Other power plant configurations were also modelled. The model assumes the Government's 70% renewable by 2030 target is met. It also considers the detailed requirements of the system operator (EirGrid) to keep the grid stable and secure.

As previously outlined, the design of the Power Plant and the BESS have been chosen for flexibility and efficiency. All future energy scenarios show gas power plant being required in the period to 2050 and beyond.

The operation of the Power Plant in the Single Electricity Market (SEM) is discussed in Chapter 15 (Section 15.4.4). In summary, the SEM takes into account the cost of emissions under the EU ETS, which therefore dictates that the most efficient and least emitting plant will be dispatched first for energy generation and system stability. The efficiency of the Power Plant, combined with its ability to operate

[3] One of the challenges with increased renewable (wind) generation on the system is a potential for an increased rate at which the grid frequency falls. This is known as the rate of change of frequency (RoCoF). Events that result in high RoCoF levels can potentially lead to instability in the power system. All power systems, including the Irish power system, have inertia. Inertia is a resistance to change in motion. The inertia on the power system resists the RoCoF and helps maintain system stability.

at a low minimum generation capacity, means that the Power Plant will be dispatched ahead of a less efficient OCGT power plant. It will provide lower direct emissions and also provide system inertia (and other system services) at a lower output, allowing for higher instantaneous renewable (non-synchronous) generation than would otherwise be the case if the Power Plant was not developed.

As discussed earlier, as the level of renewable generation on the system at any one time increases, thermal power plant has their dispatch quantities decreased by EirGrid to facilitate the output of the renewable power plants. However, a certain number of dispatchable plants must remain on the system to provide the services mentioned above. 'Positioning' is when the grid operator keeps a power plant running so as to be on standby to provide these services to the grid operators in real time. This is a vital process for grid stability; however, with inflexible power plants it can lead to larger than necessary power plants being positioned. This causes increased emissions, increased curtailment of renewables (to make room for the positioned power plant) and increased costs.

The ability of the Power Plant to operate at a 50% blend of hydrogen by design offers the potential for the Power Plant emissions to become even more efficient over the period to 2050, as and when the required policies and supply chains for hydrogen are implemented.

Both the Power Plant and the Terminal are 'future-proofed' and have the ability to transition to hydrogen fuel once the technology and public policy are fully developed, thereby achieving a 'zero emission' facility. The location of the Proposed Development site will provide access to future offshore renewable projects around the world, combined with facilities for the production and landing of hydrogen. This would contribute to the decarbonisation of Ireland's energy system by providing long term hydrogen energy storage (produced onsite or into the national gas transmission network), renewable energy storage (through the BESS) and direct electricity generation at the Power Plant. The modular Power Plant offers flexibility to incorporate alternative fuels, and the modern nature of the LNG Terminal will ensure it can easily be adapted in future.

This capability is acknowledged by the CRU in their contributions to the Oireachtas Committee on Environment and Climate Action on 7th July 2021:

> '*Ms MacEvilly said there was not necessarily a contradiction between building new gas infrastructure and quitting fossil fuels as it was expected that biomethane and green hydrogen would eventually replace natural gas in the supply chain.*
>
> *CRU chairperson, Aoife MacEvilly told the committee: Gas-fired generation will play a pivotal role in underpinning electricity security of supply and the secure electrification of heating and transport.*
>
> *Commissioner Jim Gannon added: It's not beyond the bounds of commercial or technical possibility that gas terminals that will help us supply security and diversity of supply couldn't also be designed to be converted over time to using hydrogen.*'

Refer to New Fortress Energy Inc.'s 'A Step Towards a Zero Carbon Future' policy for further details.

In conclusion, the flexibility of the Power Plant, including the BESS, is ideally aligned with a high renewable market from now to 2050. In particular, the Power Plant offers the market high inertia, very low minimum stable generation, and fast response capability with an ability to transition to hydrogen when the required policies and supply chains are implemented.

3.6.1.2 Cooling Processes

Alternative processes for cooling were considered as CCGT power generation produces waste heat. The methods considered of providing condenser cooling for the Power Plant are listed below. The Air-Cooled option was selected.

- **Indirect Wet Cooling:** In an indirect wet cooling system, cooling water is circulated around a loop circuit with waste heat from the Power Plant being transferred into the water, raising its temperature. This hot water is then directed to a cooling tower where the water is in direct contact with the atmosphere. In the cooling tower a significant proportion of the cooling water evaporates and, as a result, must be replaced with 'make up' water so the water stream can be re-circulated to the proposed Power Plant and used to generate more electricity. For a power plant of the size and cooling system design proposed, large volumes of fresh water will be required for make-up. In addition, the cooling tower will be a large structure with a visible plume of water vapour emanating from it during some atmospheric and plant operating conditions.

- **Direct Wet Cooling:** In a direct wet cooling system, heat from the Electric Generation Facility is transferred into water. This requires large volumes of water to be drawn from a nearby water body. This warm water would be returned directly to the nearby water body at a higher temperature. Typically, the water intake structure and discharge structures in the water body are separated by some distance so that the warm water from the discharge structure does not circulate back to the inlet structure. Direct wet cooling is best suited to locations where there is a large body of cooling water available, such as a lake, river or estuary with strong tidal flows. It offers better condenser performance and cycle efficiency than Direct Air Cooling or Indirect Wet Cooling, and the lower condenser temperatures that can be achieved generally result in higher power Generation Efficiency.

  A seawater cooling system was identified as the preferred direct wet cooling method for the Power Plant. This would include separate water inlet and outlet structures in the Shannon Estuary and associated pumps and piping to convey seawater between the water-cooled condenser, the LNG Terminal, Power Plant and the estuary. However, this would also entail a significant seawater intake structure located within the Lower River Shannon cSAC, hence it has been discounted.

- **Heat Extraction**: This option would have consisted of extracting heat from the atmosphere, which has been proven effective in hot climates. However, this option was discounted in the 2012 EIS (Arup, 2012) as the location of the project does not have the necessary air temperatures during the year to make this process efficient or feasible.
- **Air Cooled Condenser**: Steam exiting the steam turbine would enter the steam condenser and pass through air-cooled fin tubes. The steam would not be in direct contact with the air. The heat is transferred from the steam to the surrounding ambient air resulting in the steam being condensed. This produces a cooler condensed steam, i.e. water condensate which is boiler quality feed water. The key advantage of air cooled steam condensers is that large volumes of cooling water are not required. Another advantage is that the water intake and discharge structures are not required to be built in the estuary, minimising the impact on the cSAC.

3.6.2 LNG Terminal

3.6.2.1 FSRU Regasification Alternative Processes

LNG regasification will take place onboard the FSRU. As described in Chapter 02 – Project Description, the heat required for regasification will be from seawater (‘open loop’) or a combination of seawater and gas-fired heaters (‘combined loop’), depending on the season and the associated seawater temperatures. When the FSRU is regasifying and sending out gas, boil-off gas (BOG) will be recovered and used as a fuel source in the generators on the FSRU, with any excess being recondensed back into a liquid and stored as LNG.

A ‘closed loop’ option for LNG regasification was considered. In ‘closed loop’, 100% of the heat for LNG regasification comes from gas fired heaters and no heat from the seawater is used. This is not proposed due to its low energy efficiency and much higher emissions of greenhouse gases (GHGs).

3.6.3 Other Alternative Processes

3.6.3.1 Wastewater Treatment Discharge

The sanitary wastewater treatment plant, which will be used for both the LNG Terminal and Power Plant, has been designed to discharge to sea via an outfall. The effluent waste stream will be monitored for compliance with the Industrial Emissions (IE) licence limits before being discharged.

The option of discharging the sanitary effluent from the Proposed Development to ground was considered in the context of the EPA (2011) Guidance on the Authorisation of Discharges to Groundwater and EPA (2014) Guidance on the Authorisation of Discharges to Groundwater. The 2014 guidance states that discharges to surface water should always be considered as a first option in the process, if technically and economically feasible. Furthermore, the Proposed Development site is considered unsuitable for indirect or direct wastewater effluent disposal to ground/ groundwater for the following reasons:

- The clay and silt dominated subsoils on the northern area of the Proposed Development site are thin (<1 m in the LNG Terminal and Power Plant area) and characterised by poor drainage and low infiltration properties, with low subsoil permeability (typically <4 x 10-6 m/s in the upper 900 mm of soils (Upper Till) with the lower till being of lower permeability where present). Groundwater vulnerability beneath the Proposed Development site is classified as 'High to Extreme' due to the limited subsoil thickness in areas of the Proposed Development site;
- The underlying sandstone and shale bedrock aquifer of the Proposed Development site is also of low permeability (from 1.05 x 10-5 to 1 x 10-6 m/s) and therefore does not have sufficient ability to 'accept' and move the effluent away from the Proposed Development site;
- Both the subsoil and bedrock have a high water table, with depth to groundwater in February 2020 typically being less than 1 m; and
- The construction of the 18 m OD platform will involve removal of subsoils, extensive blasting and excavation of bedrock and use of excavated material (largely crushed rock) as engineering fill to construct the northern part of the platform. These activities will result in an operational site founded either on fractured rock or granular rock fill, resulting in little effluent attenuation capacity.

These soil and bedrock characteristics would result in inadequate attenuation of pollutants, making the Proposed Development site unsuitable for onsite effluent discharge to ground, resulting in the design decision to use a packaged wastewater treatment plant for treatment of the effluent prior to discharge under licence via the combined surface water discharge.

3.7 References

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CHAPTER 04
Energy and Planning Policy

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park
Environmental Impact Assessment Report

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4.1 Energy Policy

4.1.1 Introduction

Taking account of recent developments in Ireland's response to climate change, including an objective for 70% of Ireland's electricity to come from renewable sources by 2030, the Proposed Development supports the resilient transition of Ireland's electricity system to renewables.

The Proposed Development consists of a new flexible 600 MW Power Plant and a natural gas import facility. The natural gas facility can protect Ireland in the event of a major gas supply disruption from the UK. The Power Plant addresses Ireland's looming shortage of conventional power generation. Natural gas will play an increasingly important role in Ireland's climate change plans as coal and peat-fired electricity generation is phased out and the amount of electricity from renewable sources increases.

The Proposed Development is aligned with European Union (EU) and Irish policy on energy and climate action as follows:

- <u>Enhance Ireland's energy security:</u> The Corrib gas field is rapidly depleting and it is predicted that Ireland will be reliant on UK imports from a single supply point for 90% of its gas by 2030. The impact of losing this single gas supply from the UK has been assessed by the Commission for Energy Regulation (CRU) as being 'disastrous' for electricity production in Ireland (CRU, 2020). The Proposed Development provides import route diversity and that can protect Ireland in the event of a supply disruption from the UK. It would also allow Ireland to comply[1] with the N-1 Infrastructure standard (see Chapter 03 – Need and Alternatives).
- <u>Address power capacity shortfalls:</u> EirGrid has forecast a shortfall in generation capacity of up to 570 MW by 2026 and advised that new additional gas fired conventional power plants are urgently required on the grid (EirGrid and Soni, 2020). The Proposed Development's 600 MW Power Plant can be delivered in a realistic timeframe to address the looming shortage. The Power Plant was successful in the recent Enduring Connection Policy (ECP 2.1) process and is preparing for an imminent grid connection offer.
- <u>70% renewables by 2030:</u> Ireland's Climate Action Plan sets a target of 70% of electricity to be generated from renewable sources by 2030 (Department of the Environment, Climate and Communications (DECC), 2019). It also commits to an early and complete phase-out of coal and peat-fired electricity generation. The Climate Action Plan confirms that natural gas is the only long term reliable backup for intermittent wind generation for the foreseeable future[2].

4.1.2 Energy Policy (European Union) General Principles

The EU Member States are facing significant challenges in the field of energy, including issues such as increasing import dependency, limited diversification, high and volatile energy prices, growing global energy demand, security risks affecting producing and transit countries, the growing threats of climate change, decarbonisation, slow progress in energy efficiency, challenges posed by the increasing share of renewables, and the need for increased transparency, further integration and interconnection in energy markets. A variety of measures aiming to achieve an integrated energy market, security of energy supply and a sustainable energy sector are at the core of the EU's energy policy (EU, 2021).

In recognition of the challenges outlined above, the European Commission has directly given support to numerous member states to construct LNG facilities with a view to contributing to the security and diversification of energy systems. Examples include:

- Croatian LNG terminal at Krk Island; (Regulation (EU) 2017/ 1938 concerning measures to safeguard the security of gas supply);

[1] The National Preventative Action Plan 2018 to 2022 notes that Ireland fails to the N-1 Standard, meaning that after losing the single largest gas infrastructure the technical capacity of the remaining infrastructure cannot meet demand.
[2] The Climate action plan forecasts gas demand as far as 2040.

- Commissioner Margrethe Vestager, in charge of competition policy, said: '*The new LNG terminal in Croatia will increase the security of energy supply and enhance competition, for the benefit of citizens in the region. We have approved the support measures to be granted by Croatia because they are limited to what is necessary to make the project happen and in line with our State aid rules.*'

- Klaipeda LNG terminal in Lithuania (European Commission (EC), 2013)
  - Commission Vice-President in charge of competition policy Joaquín Almunia stressed: 'The aid will reduce Lithuania's dependence on a single source of gas supplies and enhance its security of supply. By diversifying the gas supply sources, the terminal will also stimulate competition between gas suppliers, which in turn will benefit consumers.'
- LNG terminal in Cyprus (EC, 2020)
  - The terminal will also improve Cyprus' security of energy supply and diversification of imported energy sources and fuels by increasing energy reliability and flexibility and by giving the country access to the global LNG market.

4.1.2.1 General Policy Framework

The current EU policy agenda sets out to achieve the following targets by 2030:

- A reduction of at least 40% in greenhouse gas emissions compared to 1990 levels;
- An increase to 32% of the share of renewable energies in energy consumption;
- An improvement of 32.5% in energy efficiency; and
- The interconnection of at least 15% of the EU's electricity systems.

Table 4-1 Policy Publication

Provision/ Strategy	Published by	Topic
COM(2015)0080	EU Commission	Building an energy union that gives EU households and businesses a secure, sustainable, competitive and affordable energy supply.
COM(2016)0860	EU Commission	**'Clean energy for all Europeans' package (COM(2016)0860).** (EC, 2015). It consists of eight legislative proposals covering governance: 1. Governance of the Energy Union Regulation ((EU) 2018/ 1999); 2. Electricity market design (the Electricity Directive ((EU) 2019/ 944); 3. The Electricity Regulation ((EU) 2019/ 943); 4. The Risk-Preparedness Regulation ((EU) 2019/ 941)); 5. Energy efficiency (Energy Efficiency Directive ((EU) 2018/ 2002); 6. Energy Performance of Buildings Directive ((EU) 2018/ 844)); and 7. Renewable energy (Renewable Energy Directive ((EU) 2018/ 2001)). Rules for the regulator, the EU Agency for the Cooperation of Energy Regulators (Regulation (EU) 2019/ 942 establishing ACER) the Governance of the Energy Union Regulation, was finally adopted on 4th December 2019. Under the regulation, EU Member States need to establish 10-year integrated national energy and climate plans (NECPs) for the period from 2021 to 2030, submit a progress report every two years, and develop consistent national long-term strategies to meet the goals of the Paris Agreement.
(EU) 2019/ 504	European Parliament and of the Council	Introduced changes to the EU's energy efficiency policy and the governance of the Energy Union in the light of the withdrawal of the United Kingdom from the EU. It made technical adjustments to the

Provision/ Strategy	Published by	Topic
		projected energy consumption figures for 2030 to correspond to the Union of 27 Member States

4.1.2.2 The Internal Energy Market

The legislation and provisions around the internal energy market seek to create a fully integrated and well-functioning internal energy market for the purposes of ensuring affordable energy prices, secure investment for green energy, secure energy supplies and open up the least costly path to climate neutrality.

4.1.2.3 Energy Efficiency

Directive 2012/27/EU on energy efficiency established binding measures to help the EU reach its 20% energy efficiency target by 2020. The directive also introduced energy savings targets and many energy efficiency policies. In December 2018, the revised Energy Efficiency Directive (Directive (EU) 2018/2002) increased the overall EU target for 2030 to at least 32.5% (relative to the 2007 modelling projections for 2030). As part of the European Green Deal, the Commission proposed a review of the Energy Efficiency Directive and published its assessment roadmap on 3rd August 2020.

4.1.2.4 Renewable Energy

One of the agreed priorities of the May 2013 European Council was to intensify the diversification of the EU's energy supply and to develop local energy resources in order to ensure security of supply and reduce external energy dependency. With regard to renewable energy sources, including solar power, onshore and offshore wind, ocean and hydropower, biomass and biofuels, Directive 2009/28/EC of 23rd April 2009 introduced a 20% target to be reached by 2020. In December 2018, the new Renewable Energy Directive (Directive (EU) 2018/ 2001) set the EU's binding overall renewable energy target for 2030 at 32% at least.

4.1.2.5 Security of Supply – Natural Gas

In response to the crisis in Ukraine, Regulation (EU) 2017/ 1938 of the European Parliament and of the Council of 25th October 2017 sets out the requirements of Member States concerning measures to safeguard the security of gas supply. Regulation (EU) 2017/ 1938 requires Member States complete security of gas supply risk assessments and that adequate preventive action plans and emergency plans are developed to mitigate risk identified.

4.1.3 Energy Policy (Ireland)

4.1.3.1 The Department of the Environment, Climate and Communications (DECC)

The Department of the Environment, Climate and Communications (DECC) is responsible for a number of sectors, including energy[3]. Creating and implementing policies in order to protect and manage Ireland's energy supply is a key part of its role.

The DECC's energy portfolio comprises:

a. Electricity;

b. Gas;

c. Transport Energy;

d. Residential Energy Efficiency; and

e. Business and Public Sector Energy.

On its homepage, the Department states:

> '*Ireland is an energy importing economy, relying largely on gas and oil imports to meet its energy needs. At the same time, the effects of climate change are causing increasing disruption in our lives. The need to reduce our carbon emissions and our reliance on fossil fuels in all sectors of our society is becoming more urgent. It is the goal of the government to enable Ireland, within EU and*

[3] The other sectors being: communications; environment and climate action; natural resources and waste policy; and corporate affairs and strategic development.

global frameworks, to achieve a transition to a low-carbon, climate-resilient and environmentally sustainable economy.

By 2030, the government aims to meet the following targets:

- *70% renewable electricity;*
- *30% reduction in CO2 emissions; and*
- *32.5% Improvement in energy efficiency.*

This involves striking a balance between developing low carbon and renewable energy sources, ensuring a safe, secure and reliable supply of electricity, and maintaining a competitive and well-regulated energy market.

Electricity

Electricity makes up almost one fifth of our energy use in Ireland. Our main energy source for this is natural gas. The government is responsible for creating policy relating to the regulation of electricity markets. It is also the government's goal to achieve a reduction in Ireland's CO2 emissions. Electricity generation is currently responsible for a quarter of these. The government designs policy and supports schemes to achieve this, which promote renewable energy sources and support Ireland in its goal to reach national and EU renewable energy targets.

Gas

Energy in Ireland is generated from a number of different sources, both domestic and imported. Almost one third of our overall energy needs, and over half of our electricity, comes from natural gas. The government creates policy and legislation allowing for the liberalisation and regulation of the gas market in Ireland. It is also responsible for reviewing the potential and criteria for using more renewable sources of gas to achieve a reduction in Ireland's greenhouse gas emissions.'

4.1.3.2 Energy/ Fuel Use in Ireland

Transport, heat and electricity are the three key energy sectors in Ireland. The Sustainable Energy Authority of Ireland (SEAI) is the official source of energy data for Ireland, and it publishes an annual report Energy in Ireland. The latest report, published December 2020, presents the energy situation in Ireland at the end of 2019, as follows:

'**Main points for 2019**

Overall energy use in Ireland in 2019 was at almost the same level as in 2001, but CO_2 emissions from energy are down by almost one fifth, while the economy is one and a half times as large.

The 2020 report highlights the further reduction in CO_2 emissions intensity of electricity. Back in 2001, wind supplied approximately 1% of Ireland's electricity and coal 20%. The emissions intensity was 807 gCO_2/kWh, but in 2019, with coal generating less than 2% and wind 32%, the intensity is less than half at 324 gCO_2/kWh. The target of 40% of electricity from renewables sources was within sight at the time the annual report was published.

Demand for fossil fuels fell by 3% in 2019, to 12,774 ktoe, which was 17% lower than in 2005. Despite this progress, 87% of all energy used in Ireland in 2019 came from fossil fuels, with almost a half of all energy use from oil, mostly for transport.

Main trends in national fuel use for 2019

Oil continues to be the dominant energy source and maintained a 49% share of total primary energy in 2019. The share of oil in overall energy use peaked in 1999 at 60%. Consumption of oil increased by just 0.1% in 2019, to 7,193 ktoe, but was still 21% lower than in 2005.

Natural gas use increased by 2.0% in 2019, and its share of total primary energy increased to 31%. Natural gas use was 30% higher than in 2005.

Coal use decreased by 53% in 2019, and its share of total primary energy fell to 2.6% down from 10.5% in 2015. Since 2005, coal use has fallen by 80% (10.8% per annum). Most of the reduction has been in electricity generation.

Peat use fell by 8.3% in 2019 and its share of overall energy use was 4.3%.

Total Renewable energy increased by 10.3% during 2019. Hydro and wind increased by 28% and 16% respectively. Biomass use fell by 3.9% in 2019 and other renewables increased by 15%.

The overall share of renewables in primary energy stood at 11.2% in 2019, up from 10% in 2018.

Electricity

Ireland became a net importer of electricity in 2019 for the first time since 2015. Net electricity imports were 55 ktoe, making up 2.1% of electricity generation from just 0.4% of total primary energy.'

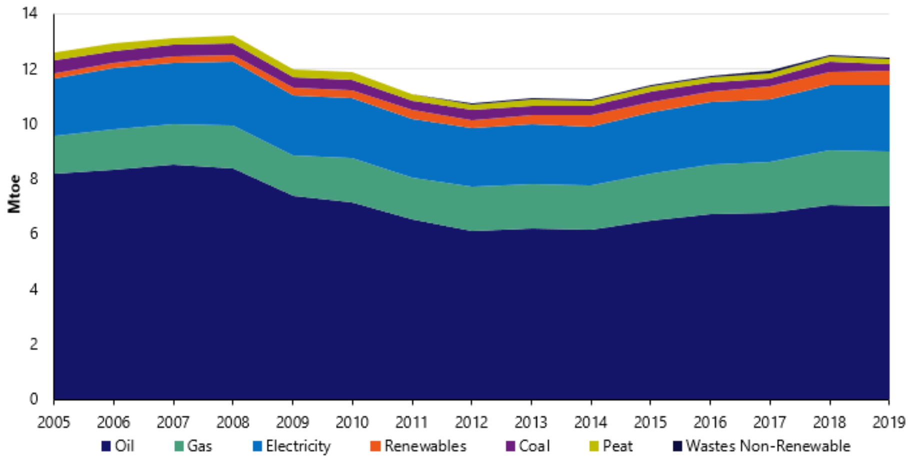


Figure 4-1 Final Consumption by Fuel, Ireland 2019 (SEAI 2020)

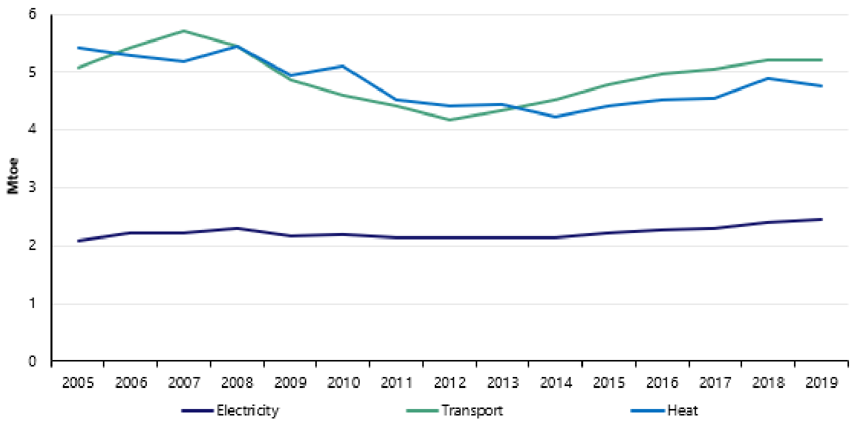


Figure 4-2 Final Energy in Heat, Transport and Electricity

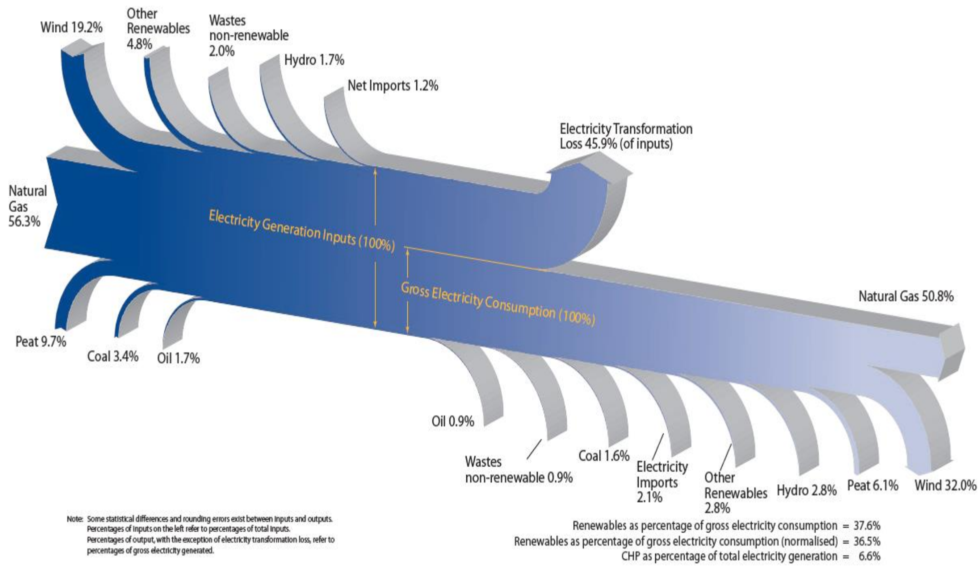


Figure 4-3 Flow of Energy in Electricity Generation, 2019 – Outputs by Fuel, Ireland 2019 (SEAI 2020)

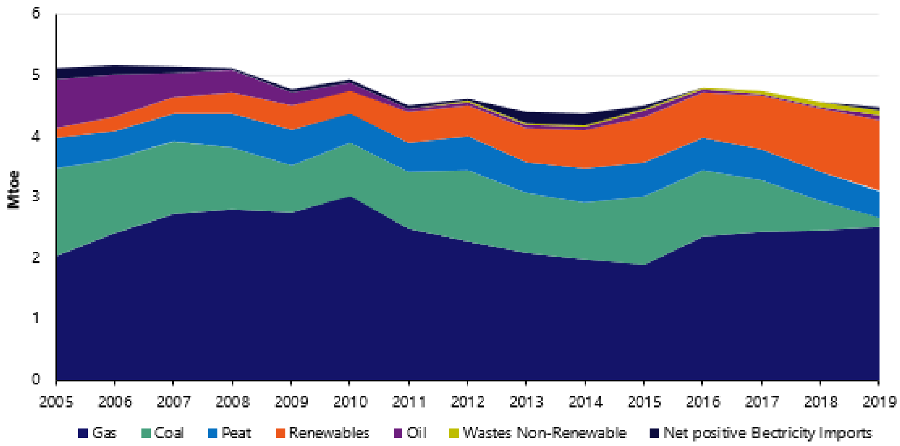


Figure 4-4 Primary Fuel Mix for Electricity Generation, Ireland 2019 (SEAI 2020)

Heat and transport account for approximately 80% of Ireland's energy use while electricity accounts for the remaining 20%. While Ireland continues to increase the availability of renewable electricity, this remains a relatively small part of Ireland's overall required energy mix.

4.1.3.3 Programme for Government 2020

The Programme for Government (Department of the Taoiseach, 2020) states that:

> '*As Ireland moves towards carbon neutrality, we do not believe that it makes sense to develop LNG gas import terminals importing fracked gas. Accordingly, we shall withdraw the Shannon LNG Terminal from the EU Projects of Common Interest list in 2021.*'

In relation to the Programme for Government, and its statements on 'fracked gas', it is noted that most of the LNG in the world is not sourced from fracked gas. Accordingly, the Proposed Development does not depend on fracked gas and the Applicant is confident that it can source gas from non-fracked sources to meet energy demand and ensure security of supply in Ireland.

4.1.3.4 Policy Statement on the Importation of Fracked Gas

On 18th May 2021 the Government issued a Policy Statement on the Importation of Fracked Gas. The Policy Statement stems from the in the Programme for Government noted in Section 4.1.3.3. The Policy Statement includes the following:

> '*The placing of a legal prohibition on the importation of fracked gas in national legislation has been considered and legal advice has been provided by the Attorney General. In the context of European Union Treaties and the laws governing the internal energy market, it is considered that a legal ban on the importation of fracked gas could not be put in place at this time.*
>
> *…*
>
> *Ireland imports much of its natural gas via the two interconnector pipelines from Moffat in Scotland, which provide the majority of natural gas currently used in Ireland. Given the level of fracked gas in the imports from Scotland is considered very low, the highest risk of fracked gas being imported into Ireland on a large-scale would be via liquefied natural gas (LNG) terminals, if any were to be constructed.*
>
> *The Minister for the Environment, Climate and Communications is currently carrying out a review of the security of energy supply of Ireland's electricity and natural gas systems which is focussing on the period to 2030 in the context of ensuring a sustainable pathway to net zero emissions by 2050*'.

The policy statement concludes with the following policy decisions:

> '*In order to implement the Programme for Government commitment that it does not support the importation of fracked gas, the Government has approved that:*
>
> - *Pending the outcome of the review of the security of energy supply of Ireland's electricity and natural gas systems, it would not be appropriate for the development of any LNG terminals in Ireland to be permitted or proceeded with;*
> - *The Government will work with like-minded European States to promote and support changes to European energy laws – in particular the upcoming revision of the European Union's Gas Directive and Gas Regulation – in order to allow the importation of fracked gas to be restricted; and*
> - *The Government will work with international partners to promote the phasing out of fracking at an international level within the wider context of the phasing out of fossil fuel extraction.*'

The Department of Communications, Climate Action and Environment awarded the contract for the security of supply review on 10th May 2021. The Minister has advised that he expects the review to be completed by the first half of 2022 (Houses of the Oireachtas, 2021).

Since October 2018, there have been seven separate security of supply reviews. These are discussed in Section 4.1.3.5. All these reviews have consistently identified the risks associated with Ireland's dependence on a single gas supply point from the UK, these are:

1. 20th July 2021, Government of Ireland, Draft National Risk Assessment Overview of Strategic Risks 2021/ 2022;
2. 26th March 2021, Government of Ireland, *National Risk Assessment for Ireland 2020;*
3. 11th November 2020, Commission for Regulation of Utilities (CRU), *Identification of National Electricity Crisis Scenarios for Ireland* (CRU/20/138);
4. July 2019, Government of Ireland, *National Risk Assessment – Overview of Strategic Risk*;
5. 15th June 2020, Department of Communications, Climate Action and Environment, *the National Energy and Climate Change plan 2021 to 2030;*
6. 2018, CRU, *National Preventative Action Plan Gas 2018 – 2022 Ireland*; and
7. October 2018, Department of Communications, Climate Action and Environment, CRU, GNI and EirGrid, *Long Term Resilience Study 2018*.

Additionally, the following studies confirm the energy security risks for Ireland and broadly support the need for gas import route diversity:

1. SEAI. *Energy Security in Ireland 2020 report*;
2. EirGrid's *Tomorrow's Energy Scenarios 2019 Ireland* (EirGrid, 2019);
3. The European Network of Transmission System Operators for Gas (ENTSOG);
4. EirGrid. *Ten year Network Development Plan (2020);* and
5. The International Energy Association (IEA) *'Ireland 2019 Review of Energy Policies of IEA Countries* (IEA, 2019).

In relation to the Policy Statement on the Importation of Fracked Gas, it is noted that most of the LNG in the world is not sourced from fracked gas. For context, all of the LNG required for the Proposed Development represents only 1% of the globally traded non fracked LNG. LNG is a globally traded commodity and there are 37 operational LNG terminals in Europe at present. Accordingly, the Proposed Development does not depend on fracked gas and the Applicant is confident that it can source gas from non-fracked sources to meet energy demand and ensure security of supply in Ireland.

Finally, on 6th July 2021, CRU Commissioner, Dr Paul McGown, testified to the Oireachtas Joint Committee on Environment and Climate Action that (Houses of the Oireachtas, 2021);

> '*When we talk about this diversity of supply we are being quite open. We have obligations around security of supply and we must consider all options. A relationship has been drawn between LNG and certain types of gas and I am not sure that this helps the overall discussion. LNG can be and could be natural gas. Another point on diversity of supply is the type of gas that is entering the system. We should also be considering what role indigenous biogas will have and what role blue hydrogen might have as we transition through a blended natural gas system to a system that might ultimately be decarbonised.*
>
> *There are many aspects to diversity of supply. I would neither rule in nor rule out that we might be discussing the role of LNG, but I emphasise that we should take the idea of fracked gas and separate it completely from the idea of LNG, to just consider LNG, if we are looking at that as a route for natural gas to ensure diversity and therefore security of supply.*'

4.1.3.5 Energy Policy to 2030, Transition to Low Carbon

The Government's Energy White Paper (DECC, 2015) outlined a transition to a low carbon energy system for Ireland by 2050. The White paper was a complete energy policy update, in which the Government set out a framework to guide policy and the actions that Government intended to take in the energy sector from then (2015) up to 2030. The paper took into account European and International climate change objectives and agreements, as well as Irish social, economic and employment priorities.

4.1.3.6 Climate Action Plan 2019

The Climate Action Plan, published in June 2019 (CAP 2019) (DECC, 2019), sets policies, measures and targets necessary for Ireland to achieve its 2030 emission reduction targets.

The CAP 2019 supports the adoption of a net zero carbon target by 2050 set at EU level:

> '*The Government supports the adoption of a net zero target by 2050 at EU level. The Climate Action*
> *Plan puts in place a decarbonisation pathway to 2030 which would be consistent with the adoption*
> *of a net zero target in Ireland by 2050. The Plan also commits to evaluating in detail the changes which would be necessary in Ireland to achieve this target. In 2014 Ireland adopted a National Policy Position for an 80% reduction in CO2eq. emissions by 2050 compared to 1990 levels for the electricity generation, built environment, and transport sectors. It also outlines an approach to carbon neutrality in the agriculture and land-use sector, including forestry, which does not compromise on national capacity for sustainable food production.*'

According to its Statement of Strategy 2016-2019, the high-level objective in respect of 'Climate Action and Energy' is to:

> 'E*nable the State, within EU and global frameworks, to pursue and achieve transition to a low-carbon, climate-resilient and environmentally sustainable economy, underpinned by a secure and competitive energy supply, in the period to 2050.*'

One of the stated objectives the CAP includes Increasing renewables from 30% to 70% by adding 12GW of renewable energy capacity and the closing of peat, coal and oil plants.

The 70% renewables target combined with the commitment to phase out coal and peat-fired electricity generation leaves natural gas as the primary back up to address intermittency in wind generation for the foreseeable future.

'Interim Climate Actions', published by the Government in 2021, refers to the new Programme for Government, published in June 2020, which outlined Ireland's updated commitment to a green post pandemic recovery, including a more ambitious climate target of an average 7% emissions reduction per year to 2030. The measures proposed in 'Interim Climate Actions' are intended to be used to drive continued delivery of climate action across all Government Departments and bodies, while the Climate Action Plan 2021 is being prepared for publication in summer 2021. A renewed National Development Plan is also due for publication later this year.

'Interim Climate Actions' 2021 formally replaces the Annex of Actions published as part of the Climate Action Plan, 2019, and will be subject to the same process of monitoring and reporting, including the publication of Quarterly Progress Reports. The purpose of 'Interim Climate Actions' 2021 is to maintain a whole-of-government focus on implementation and continue to progress new climate actions while the Plan to reach 7% per annum reductions is developed. Its stated objective is to ensure that planning and implementation go hand in hand.

4.1.3.7 Security of Supply

Ireland currently has two sources of natural gas. The year-on-year production from the country's only remaining producing natural gas field, the Corrib gas field, is currently declining, resulting in a growing reliance on imports via a single supply point from the UK through two gas interconnector pipelines. Ireland currently imports over 50% of its gas needs, and these imports are forecast to grow to over 80% by 2025 and 90% by 2030.

The Department of Communications, Climate Action and Environment has also noted in relation to energy policy (DECC, 2020a):

> '*Energy policy seeks to balance three core priorities – namely sustainability, security of supply and competitiveness. Secure supplies of energy are critical to support society and the economy. Ensuring the security of energy supply of our gas and electricity networks is a therefore a key priority.*'

As outlined in Section 4.1.3.2 in the last three years, from October 2018, there have been seven separate security of supply reviews. All these reviews have consistently identified the risks associated with Ireland's dependence on a single gas supply point from the UK, these are in chronological order:

1. October 2018, Department of Communications, Climate Action and Environment, CRU, GNI and EirGrid, *Long Term Resilience Study 2018*;
2. 2018, CRU, *National Preventative Action Plan Gas 2018 – 2022 Ireland*;
3. July 2019, Government of Ireland, *National Risk Assessment – Overview of Strategic Risk*;
4. 15th June 2020, Department of Communications, Climate Action and Environment, *the National Energy and Climate Change plan 2021 to 2030;*
5. 11th November 2020, Commission for Regulation of Utilities (CRU), *Identification of National Electricity Crisis Scenarios for Ireland* (CRU/20/138);
6. 26th March 2021, Government of Ireland, *National Risk Assessment for Ireland 2020;* and
7. 20th July 2021, Government of Ireland, Draft National Risk Assessment Overview of Strategic Risks 2021/ 2022.

Long Term Resilience Study.

The importance of energy security for Ireland is highlighted in the study commissioned by the Department of Communications, Climate Action and Environment, with support from the Commission for Regulation of Utilities (CRU), Gas Networks Ireland (GNI) and EirGrid, 'Long Term Resilience Study 2018'.

The Long Term Resilience Study 2018 published jointly by EirGrid and Gas Networks Ireland examined the long term security of supply position up to 2040. The report referred to the dependency on gas imports from the Moffat entry point in Scotland via onshore pipelines in Scotland and two subsea interconnectors having been reduced by the Corrib field production, but notes that as Corrib production declines, 'gas imports from Britain will once again represent the dominant source of supply'. Thus, Ireland could potentially have a high level of dependence on a single import route.

The report outlines a number of possible ways for Ireland to improve its security of supply position. These options include integration of bio-methane (renewable natural gas), LNG import terminals (fixed and floating options), further gas interconnection (e.g. to France) and permanent gas storage.

The Long Term Resilience Study 2018 concluded with a Key Recommendation to:

> '*Conduct a detailed cost benefit analysis for a floating LNG terminal. The most economically advantageous option to improve the resilience of Ireland's gas supply is a floating LNG terminal.*'

National Preventative Action Plan (Gas) for 2018 – 2022 Ireland

EU Regulation 2017/ 1938 mandates that EU Member States implement measures to safeguard gas security of supply. Consequently the National Preventative Action Plan (Gas) 2018 – 2022 Ireland was completed by the CRU in 2018. It noted that:

> '*The N-1 calculation removes the technical capacity of the single largest piece of gas infrastructure on a peak day with a view to determining whether the remaining gas infrastructure can meet 100% of peak day gas demand. To pass, the calculation must equate to 100% or more. Ireland failed the Infrastructure Standard meaning that after losing the single largest gas infrastructure the technical capacity of the remaining infrastructure cannot meet demand.*
>
> *It can be seen that the result of the N-1 calculation is 85%36 and that Ireland fails to meet the criteria (i.e. if the supply of gas via Moffat is partially disrupted Ireland will be unable to deliver sufficient gas from other entry points to meet total demand on a 1 in 20 year peak-day).*'

National Risk Assessment – Overview of Strategic Risks

The 2019 National Risk Assessment (NRA) identified, discussed and considered risks facing Ireland over the short, medium and long term. The National Risk Assessment plays an important part in the early identification of potentially significant risks that Ireland may face. While not intended to replicate or displace the detailed risk management that is already conducted within government departments and agencies, the National Risk Assessment does aim to provide a systematic overview of strategic risks that can form an important, and inclusive part of the overall process of risk management. In relation to security of gas supplies, ***Risk 5.2 Ensuring an affordable, sustainable and diverse energy supply*** was identified and noted:

> '*Ireland's situation as an island on the periphery of Europe renders it particularly vulnerable to disruptions to the supply or price of oil, gas or electricity which would have significant economic, social and competitive impacts. Such disruption could arise from natural disaster, economic trends or geopolitical change, such as Brexit, disruption to oil supplies in the Middle East, Russian sanction impacts on gas supplies and OPEC cuts. Brexit poses a particular risk as Ireland imports the vast majority of its energy requirements, oil, gas and transport fuels, from or via the UK. ………*
>
> *Ensuring an energy supply that is not only affordable, sustainable and diverse but also secure will be extremely important as pressure increases on the world's resources due to climate change and increased environmental concerns. There are also geopolitical implications contributing to this risk, with international relations and tensions, including increased pressure on global free trade agreements, creating doubt over the security and price of energy supply. In the last few years, the price of fossil fuels, particularly oil, have been more volatile, with*

international prices beginning to rise after a period of sustained low prices. This has been passed through to the consumer with price increases evident in the gas, electricity and transport fuel sectors.'

National Energy and Climate Change Plan 2021 to 2030

The Government's National Energy and Climate Plan (NECP) 2021-2030 was developed in accordance with Regulation (EU) 2018/ 1999 of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action.

Article 4: (National objectives, targets and contributions for the five dimensions of the Energy Union) of the Regulation states the following:

> '*Each Member State shall set out in its integrated national energy and climate plan the following main objectives, targets and contributions, as specified in point 2 of section A of Annex I: …*
>
> *(c) as regards the dimension 'Energy Security':*
>
> *(1) national objectives with regard to:*
>
> — *increasing the diversification of energy sources and supply from third countries, the purpose of which may be to reduce energy import dependency,*
>
> — *increasing the flexibility of the national energy system, and*
>
> — *addressing constrained or interrupted supply of an energy source, for the purpose of improving the resilience of regional and national energy systems, including a timeframe for when the objectives should be met.*'

The NECP 2021-2030 states that:

> '*Ireland's objectives are to maintain and, where necessary, facilitate the enhancement of resilience of the gas and electricity networks. Ireland is committed to maintaining the security of our energy system in the most cost-effective manner. Ireland is cognisant of the risks posed by the impacts of climate change to our energy security. The policies and measures set out under this plan, both in terms of mitigation and adaptation, serve to offset those risks. The impact of the wide range of policies and measures aimed at increasing energy efficiency will contribute considerably to ensuring security of our energy system. A review of the security of energy supply of Ireland's natural gas and electricity systems is being carried out. The focus of the review is the period to 2030 in the context of ensuring a sustainable pathway to 2050. Given the increasing dependence of electricity production on natural gas and the increasing dependence on imports from the UK, it is important that close co-operation on security of supply continues with EU Member States and the UK.*'

As peat and coal will no longer be part of Ireland's electricity generation mix by 2025, there will be an increased reliance on natural gas, thus reducing the diversification of Ireland's fuel mix and impacting on security of supply. The Plan forecasts that for the year 2025, natural gas will provide 52% of electricity in Ireland, with renewables 46%, hydro 1%, waste and back up oil the remaining 1% (National Energy and Climate Plan – DECC, 2020b). By 2040, the NECP forecasts gas generating 40% of electricity, with renewables supplying 58%. The NECP also forecasts that with increasing intermittent renewable generation, and increasing electrical demand, the amount of electricity produced from gas fired generation increases by 30% from 2025 to 2040.

One of the stated key policies and measures included in the NECP is the following:

> '*Facilitate infrastructure projects, including private sector commercial projects, which enhance Ireland's security of supply and are in keeping with Ireland's overall climate and energy objectives.*'

The NECP notes Ireland's increasing energy import dependency on the UK with the decline of the Corrib gas field. Specifically, the NECP states:

> '*Given Ireland's high and increasing reliance on gas for electricity, our low import route diversity, Ireland's relatively high dependence on imported gas, which is likely to increase as the Corrib gas field progressively depletes, and the potential increasing role of gas in the energy mix for*

heat, transport and power generation including as a back-up for intermittent power generation, our objectives are to:

- *Ensure the resilience of the gas network to a long-duration supply disruption, in the context of EU and national climate objectives. Actively participate in EU and regional initiatives to maintain and enhance security of supply including national, regional and EU co-operation on emergency planning and response for gas and electricity networks, including risk assessments, preventative plans and emergency plans;* and
- *Following the withdrawal of the United Kingdom from the EU, engage with our EU partners to put in place an EU/ UK framework for continued necessary regional co-operation between Ireland and the UK on matters related to gas and electricity security of supply, including emergency preparedness and response and solidarity in an emergency situation.*'

Identification of National Electricity Crisis Scenarios for Ireland

In accordance with Regulation (EU) 2019/ 941 on risk-preparedness in the electricity sector, the CRU, as competent authority, identified 23 national electricity crisis scenarios. (CRU, 2020) The work was completed in close cooperation with the Irish TSO (EirGrid). The report sets out information about each scenario. Based on the analysis completed to date, each scenario was given a score relating to the likelihood, potential impact, overall risk rating and cross-border impact rating.

One of the 23 scenarios was a curtailment of UK gas supply over a prolonged period (up to one month) from Moffat or full loss of supply (e.g. technical failure) for a shorter period. The NRA sets the likelihood as between 10 and 100 years, indicating that either possibility is 'unlikely' but the impact of the scenario is heavily influenced by wind power availability during the crisis. It would likely cause significant lost load for a prolonged period, thus it was rated as having a 'disastrous' impact and given an overall risk rating of 'major'.

National Risk Assessment for Ireland 2020

On the 26th March 2021, Government of Ireland published the National Risk Assessment for Ireland 2020. The Government noted: '*The National Risk Assessment has been developed following extensive consultations with all Departments and key Agencies and the input of subject matter experts. It identifies and assesses the likelihood and impact of key risks facing the State across a broad range of emergencies.'*

The National Risk Assessment provides a basis for establishing priorities for the mitigation of the key risks identified at national level and will inform Government decisions regarding resource allocation. The Minister added '*It is intended that publication of this document will enhance public awareness of the significant risks which the State faces and which are being addressed by colleagues across Government.*'

All Government Departments submitted a list of risks which, in their expert view, had the potential to trigger a national level emergency. A total of 16 key risks were approved as the Consolidated List of National Risks (2020) for assessment. 'Disruption of Energy Supply' was identified as one of the 16 key risks.

'Disruption of Energy Supply' was considered to have the highest possible level of impact at a 'very high impact'. This means it has an economic impact greater the 8% of annual budget and/ or a social impact with the 'community not being able to function without significant support'. It's likelihood of the risk was assessed to occur between 11 to 50 years.

The Risk assessment noted:

'***7.3.4. Disruption to Energy Supply (J)***

A secure, reliable and safe supply of electricity, gas and oil is critical to the economy and society.

……

Fifty percent of electricity generated in Ireland is from gas. Gas supply comes from two main sources, the Corrib gas field and the UK interconnector. The ESRI (2011) estimate that loss of gas fired electricity would cost the state up to €1 billion per working day. The Expert Focus

Group determined that disruption to the gas interconnector with the UK during a period of cold weather represented the reasonable worst-case scenario. The impact on electricity generation was deemed critical. There is a cross-border dependency with the UK as part of a Europe-wide integrated network stretching further east to Russia. This network is governed by EU Directives which will no longer apply to the UK after BREXIT. The governance of this cross-border dependency will therefore require further consideration during the lifetime of this NRA.'

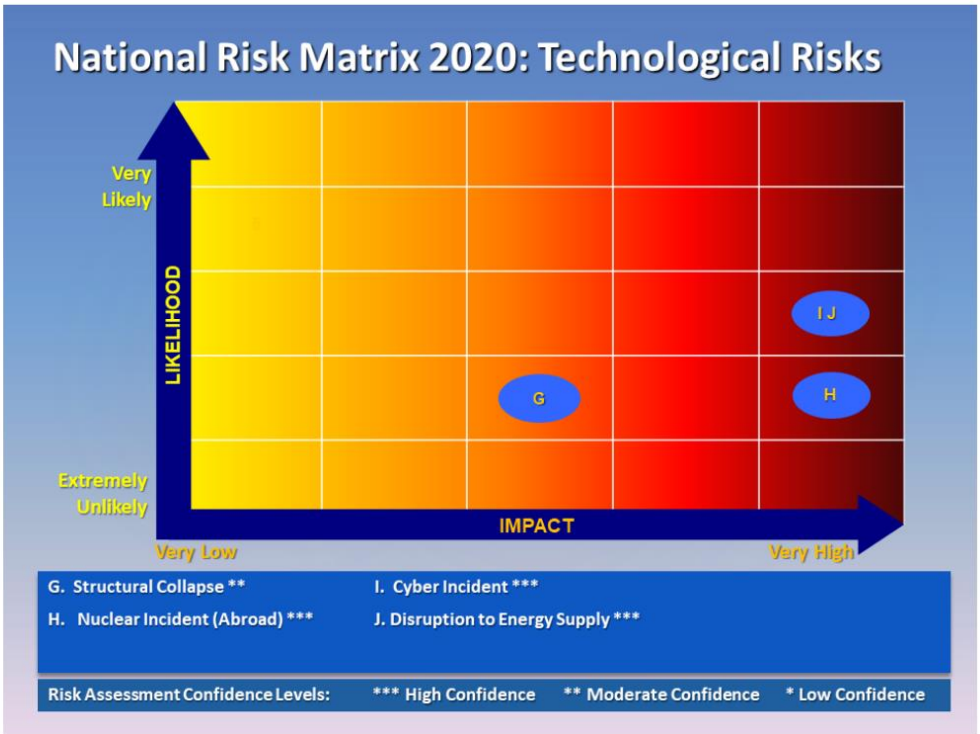


Figure 4-5 National Risk Matrix 2020 – Technological Risks

Draft National Risk Assessment Overview of Strategic Risks 2021/ 2022

On 20th July 2021, the Government of Ireland published the draft National Risk Assessment (NRA) Overview of Strategic Risks 2021/ 2022. Section 1.2 Overview of strategic risks - Economic risks noted:

'*In terms of energy-related risks, disruptions to the supply or price of oil, gas, or electricity could have significant economic, social or competitive impacts, and our geographic position renders us particularly vulnerable to such disruptions. Ireland imports the vast majority of its energy requirements from or via the UK.*'

4.1.3.8 Electricity

Electricity Generation and Grid Capacity

EirGrid as the system operator for the electricity grid together with SONI as the system operator of the Northern Ireland grid, have together published 'Shaping Our Electricity Future' 2030 in support of decarbonisation policies set by the Government of Ireland and the Government of the United Kingdom. This supports the target of no less than 70% electricity from renewable sources by 2030. The report examines the challenges this will pose to the system.

The report states that long term electricity demand in Ireland is increasing and is forecast to increase significantly due to the expected expansion of many large energy users. With this increase in demand, and the expected decommissioning of generation plant due to decarbonisation targets and emissions standards, it is expected that new capacity will be required.

The report further notes that there is sufficient renewable energy capacity in the connection pipeline to meet the Renewable Ambition by 2030. Over the 10-year transition, demand will increase, older high emissions capacity will exit the market (approximately 20% of portfolio), and generator outages will tend to increase as older capacity, that is set to be decommissioned, struggles to justify funding for maintenance. The orderly coordination of the retirement of fossil fuel capacity, synchronised with the development and energising of new renewable and clean dispatchable generation, and matching the increased consumer demand is key to mitigating the risk of potential supply shortfalls.

'*As more weather-dependent renewable energy sources connect to the electricity system the greater the impact weather patterns will have on electricity production. Weather patterns vary over different timeframes, day-night and seasonal being two of the most well-known cycles. Weather also varies over a multi-day horizon due to continental-scale patterns. One of the most onerous of these for renewable energy production in Ireland are blocking anti-cyclones, whereby wind output is consistently low for multiple days to a week. During such times, the wind outputs in our neighbouring electricity systems, Great Britain and France, will also be affected by the same weather regime. To compound this challenge, such instances can be accompanied by a cold snap in winter.*'

'*As more renewable generation penetrates the energy market over time, there will be a growing need to adapt capacity markets to ensure that generation adequacy standards continue to be met.*'

The situation as of the spring of 2021 is that:

'*This winter we experienced a combination of factors such as zero/ low wind, low available interconnector support, poor plant performance and a cold snap resulting in record peak electricity demand. We expect the number of system alerts to increase over the coming winters as capacity exits and demand increases. We will be working with CRU and DECC to address these issues.*

Relative to the Generation Capacity Statement 2020-2029, a number of factors have exacerbated the adequacy position in Ireland over the last 12 months:

- *Forecasted new generation failed to materialise – new generation that was previously successful in the capacity market auctions has been withdrawn by the developer.*
- *Delay in building new capacity – additional new capacity that was forecasted for delivery in 2022/ 3 has been delayed because of planning compliance, emissions audits and the global pandemic.*
- *Emissions Limits – Fossil fuel generation has been excluded from the capacity market from October 2024 because the plant will exceed new EU emission limits. In the absence of having a capacity contract it is assumed that the plant seeks to close earlier than expected.*
- *Increase in generation outages – the availability of a number of existing generators, including those plant expected to decommission in the coming years, has been lower than forecasted.*'

The report further predicts that:

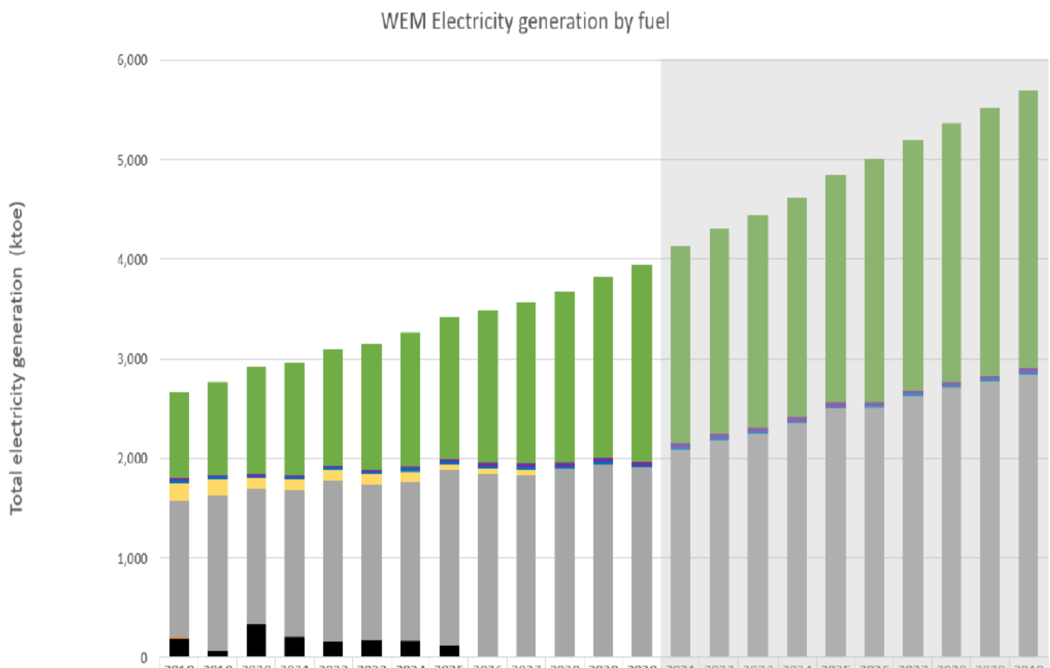
'The recent withdrawal of previously procured capacity and the failure of the recent auction to clear sufficient capacity means there is a significant capacity shortfall against security standards for Ireland. The situation is challenging in the short term (current and next winter). System alerts are expected to continue during this period. The main issues are in October 2023 and 2024.'

EirGrid believes 1 to 2 GW of new clean, dispatchable capacity will be required between now and 2030 in Ireland. Gas-fired generation is expected to play a key role here.

The Climate Action Plan 2019 notes the need for development within electricity generation as follow:

'*Intermittency also creates the need for a range of technology solutions which may include large-scale interconnection, storage, and dispatchable capacity (e.g., natural gas plants that can generate electricity at times where there is no wind).*'

The NECP has set out predicted increases in demand, see Figure 4-6 below.



	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Renewables ktoe	877	936	1,080	1,122	1,164	1,256	1,346	1,430	1,532	1,623	1,722	1,826
Pumped storage ktoe	20.4	15.0	16.9	19.9	21.0	25.0	28.1	24.0	39.2	38.7	39.8	39.3
Waste ktoe	25.9	23.1	23.1	23.0	23.1	23.0	23.1	23.1	23.0	23.0	23.1	23.0
Peat ktoe	178	159	106	106	106	106	106	53	53	53	0	0
Gas ktoe	1,377	1,560	1,359	1,470	1,627	1,561	1,592	1,765	1,836	1,825	1,887	1,938
Oil ktoe	11.7	0.3	0.6	0.7	0.8	0.8	1.2	3.9	6.6	9.2	6.4	6.2
Coal ktoe	185	77	337	215	153	173	170	122	0	0	0	0

	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Renewables ktoe	1,974	1,979	2,058	2,129	2,208	2,284	2,437	2,511	2,600	2,687	2,793
Pumped storage ktoe	41.9	43.4	40.1	40.4	39.9	39.0	35.9	35.9	34.7	34.1	36.0
Waste ktoe	23.1	23.1	23.1	23.0	23.1	23.0	23.1	23.0	23.1	23.0	23.1
Peat ktoe	0	0	0	0	0	0	0	0	0	0	0
Gas ktoe	1,899	2,078	2,175	2,240	2,342	2,498	2,506	2,621	2,702	2,771	2,838
Oil ktoe	7.0	7.9	6.8	7.3	9.5	5.1	4.1	5.1	6.3	7.0	8.0
Coal ktoe	0	0	0	0	0	0	0	0	0	0	0

Figure 4-6 Electricity Generation by Fuel, NECP 2021-2030 (DECC, 2020b)

The NECP further states that as the penetration of electricity generated from wind increases, the electricity network must be able to handle the unpredictability of wind while still operating in a secure manner. The increased penetration of wind energy places an increased reliance on the gas network. Even with the growth in renewables up to the target of 70% of total electrical generation by 2030, the NECP shows gas demand increasing from 4.4 MTOE[4] to between 6.38 to 8.06 MTOE from now until 2040. The NECP goes on to state:

> '*…as the penetration of electricity generated from wind increases the electricity network must be flexible to handle the unpredictability of wind while still operating in a secure manner. The increased penetration of wind energy also places an increased reliance on Ireland's gas network.*'

Thus, the NECP formulates the specific policy goal to:

> '*Facilitate infrastructure projects, including private sector commercial projects, which enhance Ireland's security of supply and are in keeping with Ireland's overall climate and energy objectives.*'

In its statement to the Joint Oireachtas Committee on Climate Action in July 2021, the CRU commented (CRU, 2021):

> '*With regard to energy's contribution to our 2030 carbon reduction targets, the CRU is already working towards the delivery of an electricity sector with world-leading levels of intermittent renewable generation, including significantly increased contributions from solar and on- and offshore wind. This will be facilitated by flexible, efficient gas generation, of a similar scale to that which we have today, but used less frequently, which will provide back-up during those, sometimes extended, periods of very little sunshine or wind…*

[4] Millions of tonnes of oil equivalent

Natural gas, which will be decarbonised over time, will provide an essential underpinning for the security of energy supply, ensuring we can meet this demand as we transition to a net-zero carbon economy…

The Single Electricity Market Committee is also running capacity auctions to secure the additional generation capacity required. The twin challenges of replacing a large part of our existing generation fleet, while meeting rapidly growing demand, means that a minimum of 2GW of new gas-fired plant will be needed in the next few years. This flexible capacity is required to support increased renewables, enable us to retire older carbon intensive plant (coal, peat and oil) and ensure security of supply. This capacity is in addition to the increased storage and interconnection which must also be delivered at pace…

Gas is an essential transition fuel for Ireland as we move to a fully decarbonised energy system. Gas-fired generation will play a pivotal role in underpinning electricity security of supply and the secure electrification of heating and transport. As Corrib gas is in decline and in the absence of new indigenous production, we will be increasingly dependent on imports from the UK via our existing interconnectors. Implementing a strategy to decarbonise gas, and to ensure secure and diverse supplies and supply routes for gas, will be a key priority, noting that an increasing proportion of this could be indigenous biomethane and, in time, green hydrogen…'

4.2 Planning Policy

4.2.1 Introduction

This section focuses on the key planning policies at national, regional and local level that guide the nature and extent of the Proposed Project.

This section is written by Aiden O'Neill, Town Planner and Director of Coakley O'Neill Town Planning Ltd, who holds the qualifications of BSc(Hons), PGDip and is a Corporate Member of the Irish Planning Institute. Aiden has over 25 years' post qualification experience in the full range of planning services in the UK and Ireland, including energy, waste, industrial, water services and airport infrastructure.

4.2.2 National Planning Framework 2018 (NPF)

The NPF (which forms part of Project Ireland 2040) is the national level statutory plan guiding land use and sustainable development in Ireland for the next two decades (Department of Housing, Local Government and Heritage, 2020). Climate action and responding to climate change are core themes that guide the NPF and inform its policies and objectives.

National Strategic Outcome (NSO) 8 – Transition to a Low Carbon and Climate Resilient Society, of the NPF states:

> '*Ireland benefits from interconnection with the UK gas pipeline network and while there are two gas pipelines with two separate entry points into the island of Ireland, both pipelines are connected through a single facility in Moffat, Scotland.*'

Critically, NSO 8 also notes that:

> '*In addition, our gas storage capacity is limited, which poses a security of supply risk and constrains smoothing of seasonal fluctuation in gas prices.*'

Our energy security regarding gas is precarious in terms of the current infrastructure connecting Ireland to the UK gas pipeline network but also geo-politically, as the UK is no longer a member of the EU.

Therefore, ensuring autonomous gas supply and storage separate from being reliant on the UK is of paramount importance.

4.2.3 National Development Plan 2018-2027 (NDP)

Together with the NPF, the NDP (Department of Public Expenditure and Reform, 2018) constitutes Project Ireland 2050. The sum of €21.8 billion (€7.6 billion Exchequer/ €14.2 billion non-Exchequer) has been assigned under the NDP to support the realisation of NSO 8 of the NPF. The NDP states that NSO 8 is central to all other elements of spatial policy.

Within the context of plans for Irish society to transition to a low-carbon future, the NDP is also pragmatic in acknowledging that our national gas supply network nevertheless requires development in the meantime

The NDP states that:

> '*[G]iven the intermittent nature of this technology [i.e. wind energy], a proportion of Ireland's electricity needs will likely continue to be generated from gas over the medium to longer term. It will therefore remain necessary for a certain level of gas fired generation to continue to be available to ensure continuity of supply and the integrity of the electricity grid during the transition towards a low-carbon energy system.*'

The NDP therefore highlights that natural gas will be required into the future for electricity generation within Ireland. In addition to energy policy documents, the NDP also acknowledges that the national gas pipeline network will need investment and development as will the realm of gas supply, especially as the Corrib gas field is projected to decline and become exhausted by early next decade.

The NDP explicitly places the delivery of new gas infrastructure projects in the domain of the commercial/ private sector, as the State is not in a position to facilitate such projects itself.

This implies that a degree of reliance on natural gas will continue for some time into the future, and that to ensure Ireland's society and economy are supported in functioning well and fully throughout the country, gas infrastructure projects are required to support regional and rural development in particular.

This is related to one of the key spatial policy themes of the NPF, which is that the continued growth and current dominance of the Greater Dublin Area must be counter-balanced by even greater regional growth so that regional parity can be achieved across the country.[5]

In relation to NSO 9 'Sustainable Management of Water and other Environmental Resources' of the NPF, the NDP notes that Ireland's future energy security will be partly dependent on new infrastructure investment to potentially supply natural gas from a future gas field to the national gas network.

4.2.4 National Marine Planning Framework 2020 (NMPF)

The NMPF is a long term marine spatial planning framework that forms part of Project Ireland 2040 and parallels the NPF. The NMPF was approved by Cabinet on 23rd March 2021, and subsequently voted on by Seanad Éireann on 19th April 2021, and Dáil Éireann on 12th May 2021, before being launched on 1st July 2021 (Department of Housing, Local Government and Heritage, 2021).

With regard to energy production and natural gas storage[6], the NMPF contains the following objective:

> '*Support the development of natural gas storage where appropriate in the context of the outcome of the review of the security of energy supply of Ireland's electricity and natural gas systems. This review is being carried out by Department of the Environment, Climate and Communications, and is focusing on the period to 2030 in the context of ensuring a sustainable pathway to 2050.*'

Accordingly, Natural Gas Storage Policy 1 of the NMPF is as follows:

> '*Subject to assessments required for the protection of the environment, and only where in keeping with the outcome of the review of the security of energy supply of Ireland's electricity and natural gas systems (which is being carried out by Department of the Environment, Climate and Communications), natural gas storage proposals should be supported.*'

The NMPF states that while security of supply is a key energy policy objective for Ireland and the European Union, the issue cannot be examined in isolation from sustainability, and that natural gas storage installation and activities can have potential adverse environmental impacts.

In addition, Transmission Policy 4 of the NMPF states that:

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[5] Section 2.4 'Growing Our Regions' of the NPF (page 26) states the following:
In accordance with the National Planning Framework vision, 'regional parity' is considered to be a more credible, reasonable and viable alternative scenario [to 'business as usual' and regional dominance scenarios], whereby the targeted growth of the Northern and Western and Southern Regional Assembly areas combined would exceed that projected under a 'business as usual' scenario and would at least equate to that projected for the Eastern and Midland Region.

[6] The NMPF states that natural gas can be stored offshore in depleted natural gas fields, or as LNG, which could be stowed floating or on land.

> '*Where possible, opportunities for land-based, coastal infrastructure that is critical to and supports energy transmission should be prioritised in plans and policies. Designation of land-based zones for the purposes of co-ordination and integration with relevant Marine Plans must be considered, where appropriate.*'

In this context, the site of the Proposed Development is located on lands zoned for marine-related industry which require deep water access, including energy infrastructure, in the Tralee-Ballylongford strategic landbank.

Furthermore, Ports, Harbours and Shipping Policy 1 of the NMPF is as follows:

> '*To provide for shipping activity and freedom of navigation the following factors will be taken into account when reaching decisions regarding development and use:*
>
> - *The extent to which the locational decision interferes with existing or planned routes used by shipping, access to ports and harbours and navigational safety. This includes commercial anchorages and approaches to ports as well as key littoral and offshore routes;*
> - *A mandatory Navigation Risk Assessment;*
> - *Where interference is likely, whether reasonable alternatives can be identified.*
> - *Where there are no reasonable alternatives, whether mitigation through measures adopted in accordance with the principles and procedures established by the International Maritime Organization can be achieved at no significant cost to the shipping or ports sector.*'

The above policy is relevant to the Proposed Development in terms of its proximity to Foynes Port as well as generally, regarding its location in a navigable harbour. The site of the Proposed Development is located approximately 23 km west along the Shannon Estuary from Foynes Port. Foynes Port and the site of the Proposed Development are adjacent to the world's busiest shipping routes. The Shannon Foynes Port company, which manages Foynes port, has capacity to handle over 10 million tonnes per year and has statutory jurisdiction over all marine activities on a 500 km^2 area on the Shannon Estuary, including the site of the Proposed Development.

4.2.5 Strategic Integrated Framework for the Shannon Estuary 2013-2020 (SIFP)

- The SIFP was published in November 2013 (Clare Co. Council, Kerry Co. Council (KCC), Limerick City and Co. Councils, Shannon Development and Shannon Foynes Port Company, 2013). The previously permitted scheme for an LNG regasification terminal at the location of the current Proposed Development is referenced in this strategic inter-jurisdictional plan. While the SIFP is not a statutory plan itself, it has been incorporated into the Kerry County Development Plan 2015-2021; the Clare County Development Plan 2017-2023; the Limerick City and County Development Plan; and the Regional Spatial and Economic Strategy for the Southern Region (Southern RSES).
- As illustrated in Figure 4-7, the Proposed Development site is located in one of nine strategic development locations identified in the SIFP: 'Strategic Development Location H: Tarbert-Ballylongford land bank, Ballylongford'. The SIFP references the previously permitted LNG scheme when it states that this location:
  - '*[I]ncludes a significant portion of lands currently zoned for industrial use within the Kerry County Development Plan, including a portion that has extant planning permission for a major LNG terminal.*'

•

Figure 4-7 Location of the Proposed Development Site in the Tarbert-Ballylongford Land Bank (Generally Identified in Red)

- The SIFP states:

> '*Ballylongford benefits from a significant deepwater asset and extant permission for a major LNG plant, the availability of natural gas, the proximity to the national grid and the potential for refrigeration from the regasification process, combined with the additional physical infrastruture in terms of roads and water. This makes the lands a very attractive location for other industries to locate in the future. There is also potential for gas fuelled electricity generation in the future. The SIFP proposes a Strategic Development Location around the Tarbert-Ballylongford complex to accommodate further development of the energy infrastructure and allow for economic development that will be attracted to such a significant site by virtue of its energy provision and deepwater facilities.*'

The SIFP also states that the Tarbert-Ballylongford land bank is zoned for industrial development in the Kerry County Development Plan and that:

> ' *[T]he proposed LNG plant will be a significant regional project which will act as a catalyst for further industrial development at this location in the future. The extension of the natural gas market and the existing electricity network distribution infrastructure already in place is intended to develop the area in a sustainable manner as a power generation hub within the region.*'

In addition, the SIFP states that:

> '*With the extension of the natural gas network and the existing electricity distribution infrastructure in place the SDL [Strategic Development Location H: Tarbert-Ballylongford land bank, Ballylongford] lends itself to development in a sustainable manner as a power generation centre for the region*.'

The SIFP therefore highlights that the prosperity of the entire region is, to a large degree, contingent on a scheme of the nature of the Proposed Development.

In relation to the Tarbert-Ballylongford land bank Strategic Development Location, the SIFP highlights that the previously permitted (and since expired) LNG regasification terminal scheme and associated permitted Combined Heat and Power Plant scheme are key enablers for the region, as well as being of national importance:

'*The significant storage of oil reserves at this location is a further strategic asset confirming the importance of the SDL in a national context. The level of connectivity with the existing grid network together with synergies with ESB Moneypoint, and the extension of the natural gas network from the Combined Gas Cycle Turbine proposal and the adjacent proposal for the LNG facility presents a real opportunity.*'

The SIFP also highlights that the previously permitted LNG regasification terminal scheme is seen as a key economic driver for the region:

'*The Estuary is also likely to benefit from other significant foreign investment of around €500 million through implementation of planning approval for the first LNG terminal in Ireland at the Tarbert-Ballylongford Landbank near Tarbert. The scheme will contain four insulated storage tanks of 200,000 cubic metres capacity and a re-gasification facility linked to the existing gas transmission system. Such significant investments, particularly in energy infrastructure are likely to be a catalyst for other major foreign investment in the region.*'

Lastly, the SIFP envisages that a scheme such as that of the Proposed Development will play a significant role in establishing the Universities and Shannon Development-led 'Shannon Energy Valley', '*which it is believed could provide a National hub for Energy Research & Development, Industry and Commerce to attract mobile international investment and generate high end employment.*'

The SIFP is explicit that a scheme of the nature of the Proposed Development is of regional and national economic and infrastructural importance.

4.2.6 Southern Assembly Regional Spatial and Economic Strategy (RSES)

The SIFP is highlighted in the RSES as a good practice example in regard to marine spatial planning. The RSES Southern Regional Assembly, 2020) emphasises the key significance of the previously permitted LNG regasification terminal scheme for the development and prosperity of this peripheral region. The RSES states the following:

'*The zoned lands at Tarbert/ Ballylongford in North Kerry with extant planning for strategic energy and marine related industry including the Shannon Gas LNG project are a further example of the regional and national potential of the location.*'

The previously permitted LNG scheme, in combination with the associated permitted Combined Heat and Power Plant scheme, are also referenced as a nationally important project in the RSES with regard to energy hubs under the Gas Networks Ireland section of the 'Water and Energy Utilities' chapter:

'*The Tarbert-Ballylongford lands in Co. Kerry comprise of 390 hectares of lands zoned for marine-related industry and compatible industries. Planning permission exists at the location to build a Liquified Natural Gas (LNG) importation and storage terminal on a portion of the site. The proposal included a 500MW Combined Heat and Power (CHP) plant, a 26 km pipeline and permitted connection to the natural gas grid. It is anticipated that the project would position the area as a major National Centre for CHP and facilities requiring access to deep water with substantial requirements for electricity and natural gas*.'

The RSES contains a number of Regional Planning Objectives (RPOs) of which Objective RPO 225 seeks to:

'*e. Strengthen the gas network sustainably to service settlements and employment areas in the Region, support progress in developing the infrastructures to enable strategic energy projects in the Region. An example is the Tarbert/ Ballylongford landbank in Co Kerry which is a strategic development site under the Strategic Integrated Framework Plan for the Shannon Estuary and support for the extension of the Gas Network from Listowel into the Kerry Hub and Knowledge Tri-Angle settlements of Tralee, Killarney and Killorglin.*'

In relation to the potential for energy and renewable energy production in the South West Strategic Planning Area, the RSES states:

'*Example of an opportunity: Tarbert- Ballylongford Landbank LNG and CHP Project, a key site identified in the Strategic Integrated Framework Plan (SIFP) for the Shannon Estuary.*'

4.2.7 Kerry County Development Plan 2015-2021

The current Kerry County Development Plan (CDP) has been effective since 16th March 2015 (KCC, 2015). The review of the Kerry CDP is currently underway, with the Kerry County Development Plan 2022-2028 due to be published next year (i.e. 2022). The SIFP is integrated into the CDP via 3 objectives: ES-22; ES-23, and; ES-24.

Objective ES-22:

> ‘*Support the implementation of the Shannon Integrated Framework Plan (SIFP) to facilitate the sustainable economic development of the Shannon Estuary*.’

Objective ES-23:

> ‘*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.*’

Objective ES-24:

> ‘*Ensure that development proposals for the Tarbert/ Ballylongford landbank are supported with detailed site level flood risk assessments. As part of this, the probability of flooding within the site together with the vulnerability of proposed land uses shall be taken into consideration and appropriate mitigation measures incorporated, where necessary, so as to adequately manage flood risk.*
>
> *In addition, only water compatible industrial type land uses, including flood control infrastructure and compatible industrial activities requiring a waterside location will be permitted on lands which have an annual exceedance probability of coastal flooding of 0.1% AEP (Extreme Flood Extent).*’

The Tarbert-Ballylongford strategic land bank is mentioned in the Core Strategy of the CDP, with the realisation of the potential of this land bank hinging to a great extent on the previously permitted LNG regasification terminal scheme being developed. A key element of the CDP's Core Strategy is the:

> ‘*Promotion of the Tarbert/ Ballylongford landbank as a strategic location for sustainable industrial/ energy type development in the region*.’

The Core Strategy of the CDP also contains Objective CS-7, where the land bank’s sustainable development is prioritised and linked with the sustainable development of Tralee and Killarney.

Objective CS-7:

> ‘*Prioritise the sustainable development of the Linked Hub Towns of Tralee and Killarney and the Tarbert/ Ballylongford landbank, in line with National and Regional policy.*’

As illustrated in Figure 4-8, the Tarbert/ Ballylongford land bank of 390 hectares (ha) is zoned in the CDP for:

> *‘Marine-related industry, compatible or complimentary industries and enterprises which require deep water access*.’

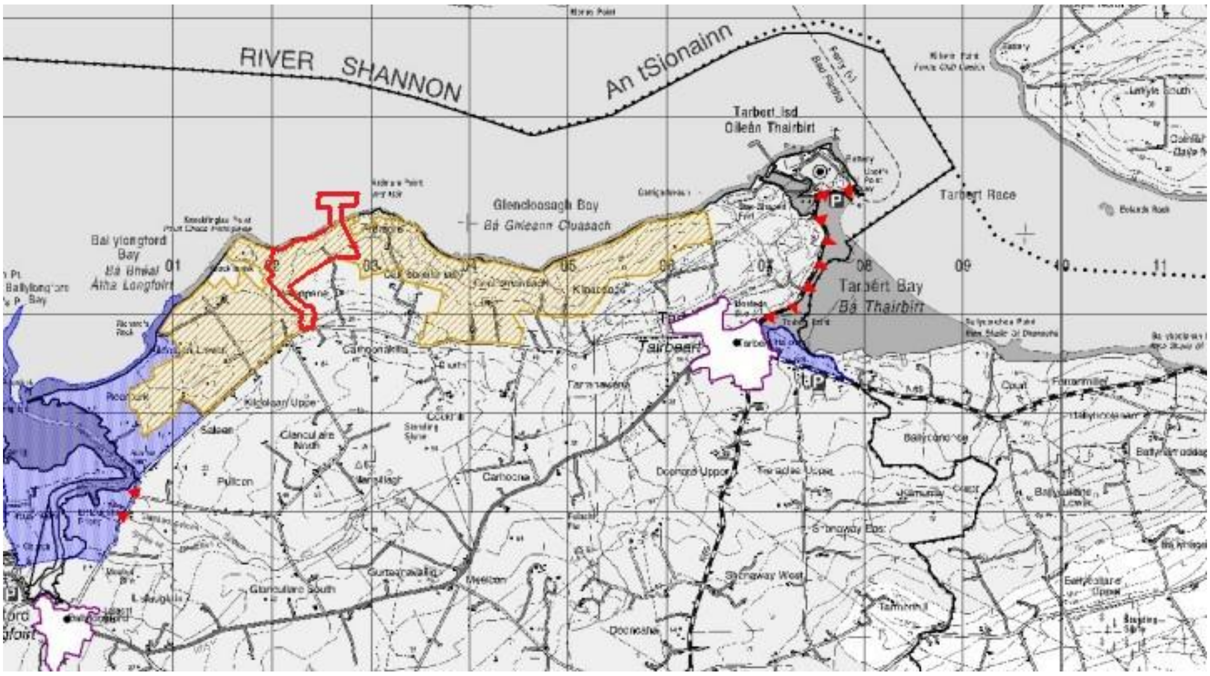

Figure 4-8 Zoning Objective Pertaining to the Proposed Development Site (Generally Identified in Red)

The previously permitted LNG regasification terminal scheme, in combination with the associated permitted Combined Heat and Power Plant scheme, are referenced in the 'Economic Development and Employment' chapter of the CDP. In a similar fashion to other policy documents, the CDP states that the previously permitted scheme has huge potential to support both the region's economic development as well as the region's energy security. The CDP states:

> '*Within the land bank planning permission has been secured for the construction of a Liquefied Natural Gas (LNG) regasification terminal. This site is 104 hectares in size. In addition, planning permission has also been granted within the LNG site for a Combined Heat & Power plant. These two developments were extensively environmentally assessed and have the potential to sustainably create substantial employment both at the construction and operation phases and can act as a catalyst for future industrial development and employment arising from the availability of secure gas and electricity supply in this region.*'

The 'Transport and Infrastructure' chapter of the CDP references the previously permitted LNG regasification terminal (in combination with the associated permitted Combined Heat and Power Plant and the associated permitted pipeline) as being of national importance to the Irish electricity-generation market. In addition, the CDP considers that Co. Kerry's potential for power generation is almost entirely contingent on a scheme such as that of the Proposed Development site:

> '*In relation to power generation Co. Kerry is well placed to encourage and facilitate the sustainable development of power generation facilities in the county, for a variety of reasons, namely: the proximity to Cork and Limerick, the proposed LNG plant in Tarbert/ Ballylongford which is a large industrial landbank and a deep sea estuary.*'

Finally, the CDP also contains an Energy and Power objective that relates to the Proposed Development implicitly as, aside from the previously permitted LNG regasification terminal within the Tarbert/ Ballylongford land bank, no other LNG project has been proposed in Co. Kerry.

Objective EP-6:

> '*Promote sustainable LNG associated enterprises/ industries at appropriate locations and expand the gas distribution network.*'

The draft Kerry County Development Plan 2022-2028 is currently being prepared for publication in Q3 2021.

4.2.8 Clare County Development Plan 2017-2023

Noting the Inspector's report in respect of pre-application consultation on the Proposed Project (case reference ABP-304007-19), wherein it was indicated that there is the potential for visual impact from the Co. Clare side of the Shannon Estuary, the following provisions and objectives of the Clare County Development Plan 2017-2023 are considered (Clare Co. Council, 2017):

'*6.3.6 Shannon Estuary: The Shannon Estuary is a natural asset of international importance and offers significant potential for future economic development in Co. Clare and the Mid-West region. In recognition of the potential to capitalise on this natural advantage and the need to take a sustainable approach to future development in the area, a Strategic Integrated Framework Plan (SIFP) for the Shannon Estuary has been prepared. The SIFP identifies and zones two sites in Co. Clare for marine-related industry and also identifies opportunity sites for other key activities such as renewable energy development and aquaculture. It also promotes the potential of the estuary for tourism and recreation activities. The SIFP is contained as Volume 7 of this Plan.*

CDP6.9 Development Plan Objective: Shannon Estuary It is an objective of Clare Co. Council: To proactively implement the Strategic Integrated Framework Plan for the Shannon Estuary including the mitigation measures identified in Volume 2 Appendices of the Plan.

8.8.3 Energy Security The ability to deliver a secure and uninterrupted sustainable energy supply at a competitive cost is critical to the ability of Co. Clare to continue to attract and retain high levels of foreign direct investment and to provide a supportive environment for industry. Clare Co. Council will promote the implementation of the Clare Co. Renewable Energy Strategy and will facilitate the development of a range of sustainable forms of energy creation within the County in order to ensure a secure and effective supply of energy. The Shannon Estuary is identified as a key asset in contributing to the diversity and security of energy supply in the region. Significant potential exists to harness the sustainable development of renewable energy sources to assist in meeting renewable energy targets, as set out in the Strategic Integrated Framework Plan (SIFP) for the Shannon Estuary. The SIFP identifies four sites within the Shannon Estuary that are of strategic significance in national and regional terms relative to their contribution to the security and diversity of energy supply and further economic potential. The four sites of strategic significance are:

- *Moneypoint;*
- *Tarbert;*
- *Tarbert-Ballylongford land bank; and*
- *Aughinish Alumina.*

CDP8.37 Development Plan Objective: Energy Security It is an objective of Development Plan: To promote and facilitate the achievement of secure and efficient energy supply, storage and distribution for Co. Clare.

11.3.2 Strategic Integrated Framework Plan (SIFP) for the Shannon Estuary: The Shannon Estuary is one of Ireland's most important maritime resources and already contains a number of long-established, large commercial ports, as well as nationally significant industries and economic centres. However, since the enactment of the European Communities (Natural Habitats) Regulations S.I. 94/19974, it has become increasingly apparent that the future development and extension of such activities will need to be closely co-ordinated with the conservation objectives for the European sites concerned. As the entire estuary is designated as a cSAC – and large parts also as an SPA – no developments can be planned for, or permitted, unless the prior assessment regime laid out in Article 6 of the Habitats Directive has been complied with. In addition, public authorities are obliged to avoid pollution and deterioration of natural habitats and the habitats of species, as well as disturbance of the species, for which areas have been designated in so far as such disturbance could be significant in relation to the objectives of the Habitats and Birds Directives. Furthermore, the Cloon River, which flows into the Shannon Estuary, is a designated cSAC for the freshwater pearl mussel which is the subject of further specific protection measures. However, the designation of habitats is not meant to prohibit development. It is meant to ensure that policies, plans and projects are conceived having due regard to maintaining the integrity and dynamics of a habitat, its constituent species and the necessary environmental resources so as to sustain them at favourable conservation status.

The existence of such designations requires a systematic approach to the development of plans, policies and objectives. This is necessary to demonstrate that environmental considerations have been taken into account from the beginning – particularly in the initial consideration of alternatives – so that it can be demonstrated that only the least damaging reasonable alternative is progressed should an assessment under Article 6(4) be required. The design of such alternatives then needs to be developed and assessed in detail to ensure that the assessment regime laid out in Article 6 of the Habitats Directive has been complied with. This, in turn, calls for an evidence-led approach whereby decisions take account of all relevant environmental considerations –including resources such as air and water quality, disturbance, pollution and connectivity. Accordingly, to facilitate the implementation of Development Plan Objective CDP 11.1 Integrated Development of Shannon Estuary – the inter-jurisdictional Strategic Integrated Framework Plan for the Shannon Estuary has been prepared and is contained in Volume 7 of this Plan. The SIFP sets out an overall strategy for the proper sustainable growth, development and environmental management of the Shannon Estuary region for the next 30 years. Within its lifetime the SIFP must be able to respond to changing circumstances at EU, national, regional and local levels within policy and governance, as well as contextual changes within the estuary region, including population, lifestyles and aspirations for the future.

The Strategy aims to:

- *Support the multi-functional nature of the Shannon Estuary and identify opportunities to expand the existing economic base, including port-related industry and other associated activities;*
- *Facilitate the diversification of the economy through the promotion of appropriate commercial/ industrial employment, environmentally friendly aquaculture, maritime energy, transport, recreation and tourism industries in a sustainable manner;*
- *Promote, manage and enhance the natural coastal environment along the estuary, including its cultural, natural and built heritage;*
- *Safeguard the estuary's sensitive environmental resources and natural heritage of national, European and international significance.*

CDP11.2 Development Plan Objective: Strategic Integrated Framework Plan (SIFP) for the Shannon Estuary It is an objective of the Development Plan: a To support and implement the inter-jurisdictional Strategic Integrated Framework Plan (SIFP) for the Shannon Estuary in conjunction with the other relevant local authorities and agencies. All proposed developments shall be in accordance with the Birds and Habitats Directive, Water Framework Directive and all other relevant EU Directives. All proposed developments shall incorporate the Mitigation Measures as contained in the SIFP – Volume 7 of this Plan - for ensuring the integrity of the Natura 2000 Network.

11.3.3 Strategic Development Locations: The Shannon Estuary is one of Ireland's premier maritime resources with a number of long-established and successful marine enterprises including major ports and nationally significant industries and economic centres. The estuary benefits from key attributes that influenced the development of large scale industry and the marine industrial base. These existing industries have the potential to attract further significant investment to the area. There are two definable clusters of industry on the Shannon Estuary, one concentrated broadly around Moneypoint/ Tarbert/ Ballylongford, and another focussed around Foynes/ Aughinish/ Cahiracon.

CDP11.3 Development Plan Objective: Marine-Related Industry/ Large-Scale Industry on the Estuary: It is an objective of the Development Plan: To capitalise on the natural deep water potential and existing port and maritime infrastructure, by facilitating and proactively encouraging the environmentally-sustainable development of maritime industries at appropriate locations within the Shannon Estuary, while seeking to improve and promote the road and rail connectivity of the deepwater ports in the County. All proposed developments shall be in accordance with the Birds and Habitats Directive, Water Framework Directive and all other relevant EU Directives. All development associated with marine-related industry shall incorporate the sector and site specific Mitigation Measures as contained in the SIFP – Volume 7 of this Plan - for ensuring the integrity of the Natura 2000 Network.'

Consistent with the Shannon Integrated Framework Plan, these key provisions and policies of the Clare County Development Plan 2017-2023 endorse the strategic role and function of the Shannon Estuary in supporting marine industry, and specifically reference the cluster of industrial activity in the Tarbert/ Ballylongford Strategic Development Location. The important role of the Shannon Estuary in the diversity and security of energy supply in the region is also acknowledged.

4.2.9 Listowel Municipal District Local Area Plan 2020-2026

The Listowel Municipal District Local Area Plan 2020-2026 (LAP) was adopted by Kerry Co. Council on 21st September 2020 (KCC, 2020). The LAP reiterates what other statutory policy documents state in terms of the importance for the local and regional economy and energy supply of a scheme such as the Proposed Development:

> '*Within the [Tarbert/ Ballylongford] land bank planning permission has been secured for the construction of a Liquefied Natural Gas (LNG) regasification terminal. The LNG site measures 104 hectares in size. In addition, planning permission has also been granted within the LNG site for a Combined Heat & Power plant.* ***These two developments have the potential to enable substantial employment both at the construction and operation phases and can act as a catalyst for future industrial development and employment arising from the availability of secure gas and electricity supply in this region*** *[emphasis added].*'

The overall Strategic Development Objective OS-08 of the LAP is to support the policies and objectives of the SIFP as follows:

> '*Support the sustainable development of the land zoned within the Tarbert/ Ballylongford area in accordance with the policies and objectives of The Strategic Integrated Framework Plan for the Shannon Estuary (SIFP) and the Kerry County Development Plan.*'

In addition, the previously permitted LNG regasification terminal and the permitted Combined Heat and Power Plant scheme are considered to be a solution to the established trend of rural decline in the locality of Ballylongford:

> '*The industrial land known as the Tarbert/ Ballylongford Land Bank is approximately 2 km to the north of [Ballylongford] village and comprises 398 hectares. On part of this site planning permission has been granted for a liquefied natural gas (LNG) import terminal. This development would, over a three year period, provide approximately 650 construction jobs and on completion 50 permanent jobs. Planning permission has also been granted for a Combined Heat & Power Plant which will, if developed result in the creation of additional employment. The Ballylongford Land Bank therefore represents enormous potential to create local employment for the village.*'

The LAP further states that the previously permitted LNG regasification terminal and the permitted Combined Heat and Power Plant within the Tarbert/ Ballylongford land bank, '*if completed together with future supporting developments will have a significant positive impact on employment, demand for services, and residential development in Tarbert.*'

Finally, the LAP also contains infrastructure objective LS-T-01 as follows:

> '*Sustainably harness the economic potential from the provision of a secure natural gas energy supply to the region.*'

The Proposed Development would support the realisation of this local policy objective.

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CHAPTER 05
Land and Soils

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park
Environmental Impact Assessment Report

Table of Contents

Figures

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Tables

5. Land & Soils

5.1 Introduction

This chapter of the EIAR assesses and evaluates the potentially significant effects on the land, soils and geology of the Proposed Development site and surrounding area from the Proposed Development.

Hydrogeology-related impacts are assessed under Chapter 06 – Water.

In order to assess baseline conditions, a desk-based review of publicly available information and previous site investigation data pertaining to the Proposed Development site was carried out. In assessing potential significant impacts associated with construction and operational phases of the Proposed Development on land, soils and geology, AECOM has considered both the importance of the attributes and the predicted scale and duration of likely impacts.

5.2 Competent Expert

This assessment has been undertaken by Kevin Forde, Associate Hydrogeologist in the AECOM Ground, Energy and Transaction Services team and has more than 28 years' post-graduate experience. He graduated with an honour's degree in Geology (1991) and has since earned a post graduate diploma in Computing (UCC, 1992) and a Masters in Hydrogeology (UCL, 1993). He has extensive experience of ground contamination assessment and remediation for both public and private sector clients involving environmental due diligence, pre-construction site investigation, EIAR, contaminated land remediation and construction phase soil waste management.

5.3 Legislation and Policy

This chapter has been prepared with reference to the following:

- European Union Water Framework Directive (WFD) (2000/60/EC). The following legislation in Ireland governs the shape of the WFD characterisation, monitoring and status assessment programmes in terms of monitoring different water categories, determining the quality elements and undertaking characterisation and classification assessments:
  - European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003);
  - European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010).
- European Communities Environmental Objectives (Groundwater) (Amendment) Regulations, 2016 (S.I. No. 366 of 2016);
- 'Guidelines for Preparation of Soils, Geology, Hydrogeology Chapters of Environmental Impact Statements' (Institute of Geologists Ireland (IGI), 2013);
- European Communities, Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report' (EC, 2017); and
- European Communities, Environmental Impact Assessment of Projects – Guidance on Scoping (Directive 2011/92/EU as amended by 2014/52/EU) (EC, 2017).

5.4 Methodology

This assessment meets the requirements for an EIAR as outlined in the relevant National and EU legislation (EU, 2014, Stationery Office, 2018). This chapter has been prepared in accordance with the following documents:

- Environmental Protection Agency (EPA) Draft guidance document 'Guidelines on the Information to be Contained in Environmental Impact Assessment Reports', (EPA, 2017);
- European Commission guidance document 'Environmental Impact Assessment of Projects;
- Guidance on the preparation of the Environmental Impact Assessment Report' (European Commission, 2017);
- EPA 'Guidelines on the information to be contained in Environmental Impact Statements', 2002;

- Advice Notes on Current Practice in the Preparation of Environmental Impact Statements, (EPA, 2003); and
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment, Government of Ireland, 2018;
- The Institute of Geologists of Ireland guidance document 'Guidelines for Preparation of Soils, Geology, Hydrogeology Chapters of Environmental Impact Statements (IGI, 2013).

5.4.1 Study Area

The study area with regard to land and soils encompasses the entire area within the boundary of the Proposed Development site.

5.4.2 Determination of the Baseline Environment

The baseline land and soils environment has been determined from desktop review and a site walkover survey.

The following is a list of sources of information consulted for use in this chapter:

- Geohive website[1] for historical Ordnance Survey of Ireland (OSI) maps of 1:2,500 scale and 1:10,560 scale (1837 to 1913) and aerial photographs (1995, 2000, 2005, 2013 and 2018);
- Geological Survey of Ireland (GSI) website[2] for Public Viewer Geoheritage, Geotechnical, Geochemistry, Geohazards Natural Resources (Minerals/ Aggregates) and Groundwater mapping;
- EPA website[3] for groundwater information;
- Environmental Sensitivity Mapping (ESM) website for soil and water data[4];
- Previous site investigation reports (ARUP, 2007; Halcrow, 2007);
- Local authority web portals; and
- Topography survey map (AECOM, March 2020).

5.4.3 Determination of Sensitive Receptors

The sensitivity of the existing environment identifies the ability of the receptor to respond to potential effects. Receptors have been identified during the baseline study and a qualitative assessment has been used to assign a sensitivity rating from low to extremely high based on the TII's 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' (TII, 2009). Assigning a sensitivity rating (Table 5-1) considers an attribute's likely adaptability, tolerance and recoverability, as well as their designation.

With regards to natural resource use, the materials themselves have been identified as the sensitive receptors. Consuming materials impacts upon their immediate and (in the case of primary materials) long-term availability; this results in the depletion of natural resources and adversely impacts the environment.

Table 5-1 Estimation of Importance of Geological Attributes

Importance	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale	
Very High	Attribute has a high quality or value on a regional or national scale	**Soil and Geology:** Geological feature rare on a regional or national scale (Natural Heritage Area, NHA) or of high value on a local scale (County Geological Site)

[1] http://map.geohive.ie
[2] http://www.gsi.ie
[3] http://gis.epa.ie/EPAMaps/
[4] https://airomaps.geohive.ie/ESM/

Importance	Criteria	Typical Examples
	Degree or extent of soil contamination is significant on a national or regional scale Volume of peat and/ or soft organic soil underlying route is significant on a national or regional scale*	Large existing quarry or pit Proven economically extractable mineral resource
High	Attribute has a high quality or value on a local scale Degree or extent of soil contamination is significant on a local scale Volume of peat and/ or soft organic soil underlying route is significant on a local scale*	**Soil and Geology:** Contaminated soil on site with previous heavy industrial usage Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site) Well drained and/ or highly fertility soils Moderately sized existing quarry or pit Marginally economic extractable mineral resource
Medium	Attribute has a medium quality or value on a local scale Degree or extent of soil contamination is moderate on a local scale Volume of peat and/ or soft organic soil underlying route is moderate on a local scale*	**Soil and Geology:** Contaminated soil on site with previous light industrial usage Small recent landfill site for mixed wastes Moderately drained and/ or moderate fertility soils Small existing quarry or pit Sub-economic extractable mineral resource
Low	Attribute has a low quality or value on a local scale Degree or extent of soil contamination is minor on a local scale Volume of peat and/ or soft organic soil underlying route is small on a local scale*	**Soil and Geology**: Large historical and/ or recent site for construction and demolition wastes Small historical and/ or recent landfill site for construction and demolition wastes Poorly drained and/ or low fertility soils Uneconomically extractable mineral resource

* Relative to the total volume of inert soil disposed of and/ or recovered

Source: Based on criteria outlined within the TII's Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (TII, 2009)

5.4.4 Describing Potential Effects

The methodology used for describing the potential effects considers the 'quality' of the effects (i.e. whether it is adverse or beneficial), the 'probability' of the event occurring and the 'duration' of the effects (i.e. whether it is short or long term) as per Section 3.7.3 and Table 3.3 of the EPA's draft guidelines (EPA, 2017).

Specific assessment criteria and typical examples for soil and geology (based on information within the TII's 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' (TII, 2009)) are outlined in Table 5-2.

Table 5-2 Criteria and Examples for Describing Potential Effects on Land and Soils Environment

Magnitude of Effect	Criteria for Effects	Typical Examples (Positive and Negative)
Large Adverse	Results in loss of attribute	Soil and Geology: Loss of high proportion of future quarry or pit reserves Irreversible loss of high proportion of local high fertility soils Removal of entirety of geological heritage feature Requirement to excavate/ remediate entire waste site Requirement to excavate and replace high proportion of peat, organic soils and/ or soft mineral soils beneath alignment
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Soil and Geology: Loss of moderate proportion of future quarry or pit reserves Removal of part of geological heritage feature Irreversible loss of moderate proportion of local high fertility soils Requirement to excavate/ remediate significant proportion of waste site Requirement to excavate and replace moderate proportion of peat, organic soils and/ or soft mineral soils beneath alignment
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Soil and Geology: Loss of small proportion of future quarry or pit reserves Removal of small part of geological heritage feature Irreversible loss of small proportion of local high fertility soils and/ or high proportion of local low fertility soils Requirement to excavate/ remediate small proportion of waste site Requirement to excavate and replace small proportion of peat, organic soils and/ or soft mineral soils beneath alignment
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Soil and Geology: No measurable changes in attributes
Minor Beneficial	Results in minor improvement of attribute quality	Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality	Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

Source: Based on 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' (TII, 2009)

5.4.5 Significance of Effects

A qualitative approach was used to determine the significance of effects as per the EPA's draft guidance determination figure (Figure 3.5; page 53). Due account was taken of both the sensitivity of the attributes (Table 5-1) and the description of the potential effect (Table 5-2). It shall be noted the control measures such as sealed drainage, as outlined in Chapter 02 – Project Description, have been considered as embedded mitigation in the project design and their application has been assumed in determining the significance of the effect. Mitigation measures have then been devised for each potential complete pollutant linkage (comprising a source, pathway and receptor).

Table 5-3 Significance Ratings

		Magnitude of Effect			
		Negligible	**Small**	**Moderate**	**Large**
Importance of Attribute	**Extremely High**	Imperceptible	Significant	Profound	Profound
	Very High	Imperceptible	Significant/ Moderate	Profound/ Significant	Profound
	High	Imperceptible	Moderate/ Slight	Significant/ Moderate	Severe/ Significant
	Medium	Imperceptible	Slight	Moderate	Significant
	Low	Imperceptible	Imperceptible	Slight	Slight/ Moderate

With regards to use of natural resources, the following significance criteria have been used:

Table 5-4 Significance Criteria for Assessment of Natural Resource Usage

Effect	Criteria for Effects of Material Assets Used	Significance
Major	Large decrease material assets availability greater than 5% of current baseline potentially causing significant burden to the national material asset market.	Significant
Moderate	Moderate decrease in material asset availability between 2% and 5% of current baseline potentially causing moderate burden to the national material asset market.	
Minor	Minor decrease in material asset availability between 0.1% and 1.9% of current baseline causing a minor burden to the national material asset market.	Not Significant
Negligible	Negligible decrease in material asset availability less than 0.1% of current baseline causing insignificant burden to the local and regional material asset market.	

5.4.6 Limitations and Assumptions

AECOM has reviewed and appended a number of previous site investigation reports as part of this assessment. These investigation reports were undertaken by third parties and AECOM takes no responsibility for the conclusions presented in those reports. The reports were undertaken to provide geotechnical recommendations for previous approved scheme designs, although provide useful information with regard to the Proposed Development.

5.5 Baseline Environment

5.5.1 Site Area Description

The Proposed Development site covers an area of approximately 41 ha (or 52 ha including the offshore elements) and is described in Chapter 02 – Project Description.

The Proposed Development site predominantly comprises grassland on the southern shore of the Shannon Estuary with offshore elements of the scheme consisting of the jetty, the site wastewater outfall pipe and seawater intake and discharge at the FRSU.

The Proposed Development site is in a predominantly agricultural area, with the following surrounding land uses noted:

- Immediately to the north is the Shannon Estuary;
- To the east is forestry and agricultural land;
- To the south is agricultural land and the L1010, with infrequent residential properties; and
- To the west is agricultural land, beyond which is coastline.

A number of minor drainage channels are present on the location of the proposed LNG Terminal, with longer features crossing the proposed access road. These are described in further detail in Chapter 06 – Water.

5.5.2 Site History

A review of publicly available mapping suggests the Proposed Development site and the surrounding area have historically been in predominantly agricultural use.

5.5.3 Topography

The north-east of the Proposed Development site slopes relatively uniformly from approximately 35 m above Ordnance Datum (m OD) in the southeast to a clifftop at approximately 5 m OD in the north. On the west of the Proposed Development site, the land generally slopes from southeast to northwest. The parcel of land which will be occupied by the proposed access road is undulating, with topographic highs at approximately 22 m OD.

5.5.4 Quaternary Deposits

GSI mapping indicates that the local quaternary deposits comprise predominantly 'till derived from Namurian sandstones and shales'. Small amounts of alluvium are also depicted at the Proposed Development site, while no quaternary deposits are mapped in pockets on the north of the Proposed Development site, where bedrock is indicated to outcrop. A meltwater channel is mapped crossing the south of the access road and skirting the southwestern site boundary.

Soils mapping indicates the soils beneath the Proposed Development site generally comprise acid brown earths/ brown podzolics of the Kilrush soil series. The soils across the majority of the Proposed Development site are classified as 'well drained', with pockets of 'poorly drained' soils on the north and south. Where present, subsoils are classified as of low permeability and are assessed by GSI as having no aggregate potential, other than areas of alluvium along the Ralappane Stream mapped as having Low or Very Low granular aggregate potential.

Soils and stream sediments in the vicinity of the site have not been mapped under the GSI TELLUS soil geochemical sampling programme.

The shallow geology of the Proposed Development site has been studied during previous investigation works on site, with a more detailed description provided in Section 5.5.9 below.

5.5.5 Bedrock

According to the GSI database, the bedrock underlying the Proposed Development site is described as mudstone, siltstone and sandstone of the Shannon Group, being of Namurian age. The bedrock is seen to outcrop at the coast along the majority of the site's northern boundary.

Risk of erosion along the coastline of the Proposed Development was assessed in the 2007 offshore assessment and concluded that very limited episodic erosion not requiring foreshore protection occurs above high water level along short sections of the coastline, leading to proposed onshore works being set back 10m from the cliff edge.

The Proposed Development site is not located in a Geological Heritage area, according to GSI mapping, and GSI consultation indicates there are no County Geological Sites in the vicinity. There are no GSI geotechnical sites, recorded landslide/ geohazard events, mineral localities or active quarries mapped within the Proposed Development site.

The northeastern part of the Proposed Development site is mapped as having High to Very High crushed rock aggregate potential. Two historic quarries are mapped on the east side of Ardmore Point, 350-400 m east of the Proposed Development site.

Major faulting is not recorded on GSI mapping but local faulting is referenced in a site investigation report for the Proposed Development site, which is reviewed in Section 5.5.9 below, along with a more detailed interpretation of the bedrock geology.

5.5.6 Radon Potential

According to the EPA's online Radon Map, the Proposed Development site is located in an area where <1% of homes are estimated to be above the reference level of 200 becquerels per cubic metre (Bq/m^3). Radon potential risk is therefore considered 'Low'.

5.5.7 Hydrogeology

GSI mapping indicates that groundwater in the bedrock is classified as a 'Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones'. Groundwater vulnerability varies across the site from 'Moderate' to 'Rock at or near Surface or Karst'.

A more detailed assessment of the Proposed Development site's hydrogeology is provided in Chapter 06 – Water.

5.5.8 Designations

There are no recorded Integrated Pollution Prevention and Control (IPPC) Licences, Industrial Emissions (IE) Licences, Discharge Licences, Licensed Waste Facilities or Landfill Sites recorded within 1 km of the Proposed Development site.

The Shannon Estuary to the north is designated as a Special Protection Area (SPA) and a candidate Special Area of Conservation (cSAC). The cSAC extends inland immediately to the west of the Proposed Development site. A Proposed Natural Heritage Area (pNHA) is located approximately 150 m to the west.

On the 21st December 2010, foreshore leases for an jetty and a construction materials jetty were obtained. Foreshore licences were also obtained for a seawater intake and outfall system and storm water outfall pipe in December 2010.

5.5.9 Site Investigation

Onshore (ARUP, 2007) and offshore (Halcrow, 2007) site investigations were undertaken in 2006 and 2007, with key findings detailed below:

5.5.9.1 Onshore Site Investigation

The onshore investigation is included as Appendix A5-1 (Vol. 4) and comprised:

- Twenty six rotary coreholes;
- Thirty one trial pits;
- Six geologging holes, to determine the condition and orientation of bedrock continuities;
- Scan lines along the coastal section;
- One pump test; and

- 2-D Resistivity, Electromagnetic and Seismic Refraction Geophysical Survey.

The geotechnical testing was undertaken in the context of the then-proposed construction of four LNG tanks, but the report provides useful information with regards to the geological properties of the Proposed Development site.

The geology encountered during site investigation can be summarised as follows:

Table 5-5 Geology Encountered during Onshore Investigation

Stratum	Extent	Thickness	Description	Properties
Topsoil	Entire site	0.1 m-0.8 m	Generally brown topsoil with grass roots	No testing of the properties of the topsoil was undertaken as part of the investigation. May be suitable for re-use in landscaped areas.
Upper Till	Encountered in all but two trial pits. Inferred extent was across majority of site, with exception of narrow strips to north, south and west	0.7 m-4.2 m	Orange/ brown/ grey sandy very gravelly clay/ silt and clay with many angular to sub-rounded cobbles and boulders of siltstone and shale rock fragments. The material was noted to be very granular and was considered likely to be a glacial debris flow deposit.	Based on geophysical data, the Upper Till was divided by ARUP into two distinct layers, one which was soft to firm, and the other firm to soft. Groundwater was encountered within the Upper Till in a number of trial pits, with flows described as being from seepage to slow. Permeabilities of 3 to 4 x 10^{-6} m/s were calculated for the Upper Till. Natural moisture contents within the Upper Till were recorded between 8% and 40%. Despite its high granular content (>65%), Atterberg Limits testing indicated it behaves as a clay/ silt and clay. CBR tests undertaken showed the Upper Till loses strength rapidly with increasing moisture content.
Inter-Glacial Deposits	Small pocket on western boundary (recorded in trial pits TP09, TP10 and TP13	0.2 m-2.0 m	Laminated sands and silts and gravels with rounded to subangular cobbles and boulders, considered to be fluvioglacial in origin.	The laminated silts were recorded by ARUP to be firm in consistency, with the sands and gravels described as coarse and medium dense. Groundwater was encountered in trial pits TP09 and TP10, but not in TP13. ARUP noted the material was unstable, with trial pit walls collapsing in TP10 and TP13 and running silt in TP09 undermining the overlying clay stratum.
Lower Till	West of site	0.3 m-9.8 m	Stiff to very stiff dark grey/ black, gravely clay/ silt with many subrounded cobbles. ARUP concluded from observations of cliffs on the northern site boundary that the deposit was a lodgement till, deposited at the base of a moving ice sheet, as it was sheared into the upper weathered layers of the mudstone bedrock.	The till was recorded as still to very stiff in trial pits, with geophysical results indicating it to be firm to stiff. No water seepages or strikes were recorded within this material and was indicated to be of low permeability. Similar to the Upper Till, despite its high granular content, the material was described as cohesive based on Atterberg limits testing. Similar to the Upper Till, lower Till was considered very susceptible to deterioration in wet conditions.
Bedrock (Shannon Group)	Entire site. Mudstone-siltstone and sandstone were noted to underlie the west of the site,	Depth not proven.	Sandstone, siltstone and mudstone. Rotary corehole logs recorded argillaceous (clay) bands in the mudstone and interbedded in the siltstone-sandstone	The interpretative report referenced the presence of a number of inactive suspected faults, oriented in a northwest-southeast direction. It was reported these had been identified in a previous report by Weston Geophysical Engineers (2007) 'Probabilistic

Stratum	Extent	Thickness	Description	Properties
	while sandstone and siltstone were dominant on the eastern site section.		beds, with some clay-filled fractures noted. Shallowest in east of site (0.75 m bgl), with depth to top of bedrock generally increasing to the west (9.8 m of overburden recorded in borehole RC25)	Seismic Hazard Analysis for the Tarbert/ Ballylongford LNG Project'. ARUP's Interpretation of geologging revealed that planar failure in cut slopes will be controlled by joint sets J1-J3, wedge failure by J2-J5 and toppling failure in J6-J8. A distinct weathered zone was noted to be difficult to delineate in the rock mass, possibly due to its interbedded and locally faulted nature. The material was described as relatively resistant to crushing and reasonably durable. The bedrock was classified as moderately strong uniaxially, with a weak to moderately weak tensile strength. Groundwater was encountered in the upper fractures/ weathered zone of the bedrock and artesian conditions were noted in a number of isolated locations across the site. Permeability testing was undertaken in a number of locations, with permeabilities of 2 x 10^{-6} m/s calculated in the sandstone, 1 to 5 x 10^{-6} m/s in the siltstone and 1 to 8 x 10^{-5} m/s in the mudstone.

On the basis of permeability testing, ARUP concluded that shallow soils are of relatively low permeability, except in areas with lenses that have higher sand or gravel content. The overburden was considered to act as a confining layer, confining groundwater to the upper fractured bedrock zone.

The report concluded that the soils and geology encountered were favourable for the construction of the then-proposed LNG plant, indicating the then proposed tanks could be founded on the bedrock and that all excavated material will be suitable for re-use as general or structural fill.

It was recommended that earthworks be undertaken in drier summer months, in view of the sensitivity of the overburden to moisture content. For the same reason, it was recommended even, inclined surfaces be maintained on cut and fill surfaces to prevent rutting and water pooling.

The report highlighted it will be prudent to undertake additional investigation at the detailed design stage in order to address any potential data gaps.

5.5.9.2 Offshore Site Investigation

The offshore investigation is included as Appendix A5-2 (Vol. 4) and comprised:

- Fourteen rotary cored boreholes from a jack-up platform in the near offshore area ;
- In-situ sampling and testing; and
- Geophysical investigation.

The investigation was undertaken to inform the geotechnical design of the offshore infrastructure in two targeted areas (jetty and a previous materials jetty). Planned offshore boreholes for a previous 650m jetty design could not be completed in 2007, due to the presence of thick, soft sediments further offshore, and the jetty design was subsequently shortened.

The offshore site investigation encountered four distinct layers, which are summarised below in order of increasing depth:

- Alluvial Deposits: very soft to soft, brown sandy silt, with minor amounts of shells and shell fragments. This stratum was encountered in a number of locations in close proximity to the proposed jetty, and a geophysical survey found it thickened in an offshore direction from the shoreline, potentially to a thickness of 26 m;
- Upper Glacial Till: generally medium dense to very dense brown to grey gravelly sand and sandy gravel, with some clays and silts and frequent cobbles and boulders. Occasionally comprised stiff

to very stiff brown gravelly clays with minor amounts of sand. Encountered in the majority of locations from seabed to depths of between 2 m and 6 m;

- Lower Glacial Till: Similar to the Upper Glacial Till, but darker and denser/ stiffer; and
- Bedrock: Mainly interlayered sandstone, siltstone and mudstone and shale. Encountered in all fully completed boreholes. Logs revealed great variability in terms of types of bedrock encountered.

Geotechnical testing was undertaken in order to inform foundation recommendations for the offshore jetty structure. Deep foundations in the form of end-bearing steel pipe piles, most likely driven, were proposed for the support of marine structures. It was noted the abundance of cobbles and boulders in the overburden materials may necessitate the use of downhole hammers or drilling techniques in locations. Piles required for breasting and mooring dolphins are expected to be drilled and socketed into bedrock.

Jetty approaches were indicated to be supportable on conventional shallow footing type foundations. Such foundations can be founded on glacial till soils or controlled, compacted structural fill.

5.5.9.3 Environmental Sensitivity Mapping

The ESM Strategic Environmental Assessment (SEA) mapping tool indicates the Proposed Development site to have a low to very low sensitivity with respect to soils and geology.

5.5.9.4 Summary of Baseline Conditions

A summary of baseline conditions at the Proposed Development site is presented in below.

Table 5-6 Summary of Baseline Conditions

Item	Description
Context	The onshore portion of the Proposed Development site is currently largely undeveloped grassland, which covers an area of approximately 41 hectares (or 52 hectares including the offshore area). The land does not appear to have been intensively managed and is currently in use predominantly as grazing land, with tillage for barley reported in areas to the south and west of the Proposed Development site. The Proposed Development site is generally underlain by Till deposits over bedrock of the Shannon Group. The bedrock outcrops on the northern boundary. The offshore portion of the Proposed Development is situated in the Shannon Estuary coastal marine environment.
Character	The land is agricultural and no significant contamination of soils is anticipated based on previous uses. Shallow soils were generally found to act as cohesive materials, with strength reducing rapidly with increasing moisture content. The offshore area is currently undeveloped. The Proposed Development site is surrounded by a mixture of agricultural land, forestry, rural housing, public road, with the Shannon Estuary to the north. No EPA IPPC or IE licenced facilities were identified within 1 km of the Proposed Development site.
Significance	The Proposed Development site consists of agricultural land in agricultural setting. Land use of this nature is abundant within the local area, with agricultural land of a similar nature to the south, east and west. The Proposed Development site is not in a Geological Heritage Area and no active quarries or mineral locations are mapped within 2 km. The onshore Proposed Development site has not been designated as a pNHA. The offshore Proposed Development (jetty and outfall pipe) extends into the Shannon Estuary to the north, which is a cSAC and SPA. The cSAC extends inland immediately to the west of the site.
Sensitivity	Ground conditions beneath the onshore and offshore portions of the Proposed Development site generally consist of topsoil overlaying Till deposits over bedrock. Upper Till is present across the majority of the site to depths of up to 4.2 m. Inter-glacial deposits and Lower Till were also recorded on the west of the Proposed Development site. The Lower Till becomes significantly thicker offshore (up to 20 m thick) and the depth to top of bedrock rock 300-400 m offshore is deeper than -35 m OD. The bedrock consists of mudstone, siltstone and sandstone of the Shannon Group and is classified as a 'locally important aquifer, which is moderately productive in local zones'. Groundwater vulnerability varies across the onshore Proposed Development site from 'Moderate' to 'Rock at or near Surface or Karst'. Overall, the soils and geology are considered to be of low environmental sensitivity.

5.6 Characteristics of the Proposed Development

5.6.1 Project Description

The Proposed Development is outlined in Chapter 02 – Project Description, and comprises the following 5no. key elements:

- Offshore Floating Storage Regasification Unit (FSRU) including LNG Vaporisation Process Equipment;
- Offshore jetty and access trestle;
- Wastewater outfall pipe, extending offshore to below low tide level
- Onshore support facilities, including a nitrogen generation facility, a control room, a guard house, workshop and maintenance buildings, instrument air generator, fire water system;
- Onshore Above Ground Installation (AGI) including odorisation equipment; and
- Onshore Power Plant and Battery energy storage system (BESS) facility.

The onshore elements of the Proposed Development are to be constructed mainly at a platform level of 18 m OD in the north of the site.

The offshore portion of the Proposed Development is situated in the Shannon Estuary coastal marine environment and the jetty and access trestle extend northward to a deep water channel, with the jetty platform aligned with the tidal current direction.

5.6.2 Construction Activities

Construction of the LNG terminal and Power Plant is expected to take approximately 32 months. The civil works of relevance to soil and geology will mainly be carried out during the 10 month enabling phase and include the following activities:

5.6.2.1 Excavation and Infilling to Prepare Development Platform

The overburden will be, in places, quite thin and to create the level platforms for the entire LNG and Power Plant facility, approximately 480,000 m³ of overburden soils and rock will be excavated and placed as fill for both the LNG facility and the Power Plant facility. The LNG facility will be constructed to a finish grade elevation of 18 m OD.

All excavated material will be used onsite and no import of soil is expected. Excess material is anticipated to be used in the laydown area.

It is expected that blasting will be required to excavate some of the rock, which cannot be removed by rock breaking equipment mounted on tracked excavators. The blasting will be carried out in a controlled manner in accordance with a pre-approved plan. The blasting will be carried out in a controlled manner to minimize the noise and ground vibrations. This is done by designing a blast pattern with a small charge in many holes drilled in to the rock at close spacing; the individual charges are then set off in a sequence using an electronic relay so that the maximum charge going off at any instant (this is referred to as the 'maximum instantaneous charge') is only the small amount of charge in any one of the holes. This causes cracks in the rock which allows the rock to be broken up further using mechanical rock breakers; the rock is then excavated using tracked excavators.

Excess excavated material will be stockpiled for use as engineering fill, landscaping and other uses throughout the Proposed Development site.

It is anticipated the approaches to the jetty will be supported on abutment structures on shallow foundations. The approach areas will require to be stripped of surficial materials ahead of works. Where unsuitable materials are encountered at subgrade or abutment foundation level, these shall be replaced with structural Fill.

Offshore development will include significant work over water and the jetty will consist of steel pipe piles and rock socket installation, construction of pile caps and installation of precast concrete decking, with in-situ concrete toping.

Approximately 26,000 tonnes of imported aggregate will be delivered from local quarries along the L1010 from the Tarbert direction, to facilitate the formation of access roads during construction.

5.6.2.2 Piling of Foundations

Based on previous geotechnical investigations and the current design, it is anticipated the jetty and outlet structure will be constructed with steel piles, likely in a combination of driven and bored piles, although the exact methodology will be confirmed at detailed design stage.

Typically, the construction of the jetty would be staged from the water using floating barges and self-elevating platforms (jack-ups), assisted by tugboats. Other smaller equipment such as compressors, generators, and land-based machines will also be used. A temporary loading/ mooring facility has been included in the proposed jetty design to allow a mooring point for the construction floating plant.

The construction materials would consist of steel tubular piles, structural steel fabrications, precast concrete elements, reinforcing steel and in-situ concrete. Other elements of the marine structures (pile caps, beams, and deck planks) will largely be precast concrete.

A proportion of the piles supporting the jetty would be drilled and socketed into the rock to ensure stability of the jetty. Spoils from the drilling operation would be conveyed to the surface via reverse-circulation through the drill stem and contained within designated scows or other vessels. Pile installation and construction of the roadways and platform deck would most likely advance outward from shore.

The use of precast concrete would be maximised, while the use of *in situ* concrete would be minimised to reduce any potential environmental impacts on the Shannon Estuary. Any in-situ concrete work would be staged in a manner to prevent concrete from entering the water. Piles would be pre-fabricated as much as possible to minimize in-water construction.

The onshore buildings are generally proposed to comprise pre-engineered/ manufactured structural steel structures which may be founded directly on rock; through rock-socketed piles; or directly on shallow soils/ fill, dependent on the findings of geotechnical testing.

Pile arisings will be reused onshore as landscaping material on the north-eastern boundary of the site forming a screening berm approximately 2 m high, subject to chemical suitability assessment.

5.6.2.3 Proposed outfall pipe

A drainage outfall pipe from the site into the Shannon Estuary is proposed and will discharge surface water, groundwater, treated foul water and used firewater from the proposed development. It will consist of a 900mm diameter concrete drainage pipe laid in a trench across the foreshore and extending below low water mark. A foreshore licence for an outfall pipe at the proposed location was secured in December 2010 and any marine notices will be applied for to the Shannon Foynes Port Company as required.

Areas of disturbance of the cliff and foreshore will be minimised and disturbance of the seabed below the low water mark will be small, arising primarily from the excavation of the trench and clearing and levelling of the ground to install the outfall pipe. The works will not result in any impact on the amenity use of the foreshore or adjacent marine area.

Surplus material excavated from the trench will be removed and incorporated as in earthworks on the adjacent terminal development works and it is proposed to backfill the excavated trench with concrete suitable for underwater use. Care will be taken not to spill or dispose of concrete on the foreshore..

The disturbance to the foreshore as a result of the discharge of drainage water through the outfall pipe is also considered to be small. The volume being discharged through the outfall pipe is negligible by comparison to the volume of water flowing through the estuary. Given the nature of the ground conditions at the discharge point, no negative impact due to erosion or deposition of material is expected.

5.6.2.4 Installation of Process and Utility Equipment, Piping and Instrumentation

The installation of process equipment and utilities is likely to require the excavation of trenches. This may necessitate the breaking out of rock, using excavator-mounted rock breaking equipment. It is anticipated the excavated rock may be used as fill in other site areas.

5.6.2.5 Construction of Buildings and Site Landscaping

Once foundations have been installed, construction of buildings will commence from the development platform level.

Any areas of site landscaping will be formed using site-won topsoil, where possible.

5.6.3 Operational Activities

During operation of the Proposed Development, ships carrying LNG will berth alongside the FSRU at the jetty and unload directly to the FSRU. The LNG vaporisation process equipment to regasify the LNG to natural gas will be onboard the FSRU. The heat for LNG vaporisation will be via seawater, supplemented by heat from gas fired heaters when the water temperature is inadequate.

The storage or use of hazardous materials during the operational phase of the Proposed Development will be limited to:

- Diesel – Firewater pumps, black start generator and emergency generators will be powered by diesel; and
- Chemical odorant – Odorant NB, a liquid odorant consisting of a tertiary butyl mercaptan (78-82%) and dimethyl sulphide (18-22%) which is classified as Toxic to the aquatic environment (Category 2) (Hazard Code H411) will be stored onshore under a nitrogen gas blanket in two bunded bulk tanks (each 22.3 m^3 capacity) at the Ralappane AGI Gas Metering/ Odorization Area and will be injected into the gas stream under controlled conditions.
- Minor quantities of maintenance oils, greases, lubricants, cleaning chemicals, etc. A designated chemical cage is included within the design of the proposed warehouse/ workshop building;

LNG itself is not considered to be a potential source of contamination to soils, because in view of its extremely low vaporisation temperature (approximately -160°C) it will never be present as a liquid or solid under ambient conditions.

Ancillary construction will include access roads, internal roads, car parking, workshop, entrance security guardhouse, and landscaping. The internal road network will service access and egress for all site buildings.

The Proposed Development site access will be from the L1010 to the south of the site.

5.7 Embedded Mitigation Measures

The assessment of impacts assumes the implementation of embedded control measures, as set out in Chapter 02 – Project Description. These will include use of precast concrete components where possible in the offshore area, routing of road runoff from the approach road north to the Power Plant and LNG Terminal rather than to natural drainage leading to the Ralappane Stream, separation of sealed road drainage from other stormwater drainage, the provision of an attenuation system, including a Class 1 interceptor fitted with control valves and a firewater impoundment basin, and provision of designated bunded storage facilities for potentially-contaminating chemicals and fuels.

5.8 Assessment of Impact and Effect

An analysis of the potential impacts of the Proposed Development on the land, soils, geology and hydrogeological environment during the construction and operational phases is outlined below. Due to the inter-relationship between land, soils and water (hydrology), the following impacts will also be considered applicable to Chapter 06 – Water and Chapter 16 – Waste.

5.8.1 Construction Phase

5.8.1.1 Changes to Topography – Excavation and Infilling

Beneath the Proposed Development footprint a process of 'cut and fill' will be employed in order to level the footprint of the proposed buildings and infrastructure and achieve the desired 18 m OD platform level from which to commence construction works.

To reach the desired level on the south of the Proposed Development site, it will be necessary to cut into the bedrock, through mechanisms such as blasting. Filling, where possible using site-won materials, will be required on the north of the Proposed Development site to raise the land to the platform level. A retaining wall will be constructed along a portion of the northern boundary of the platform above foreshore level.

The estimated cut and fill volumes are presented in Table 5-7 below.

Table 5-7 Earthworks Volumes

	Cut (m^3)	Fill (m^3)
Topsoil	35,000*	35,000
Soil	356,054	437,115
Rock	81,062	-
Total	472,115	472,115

*Excess topsoil will be placed on the laydown area or spread onsite

The 'cut and fill' operation at the Proposed Development will produce an estimated 472,115 m^3 of material consisting of overburden soil and rock spoil. This material is likely to be largely reusable as Class 2 Cohesive general fill. All surplus material will be processed (screened/ crushed) and reused on-site and there is no intention to import soil material to the Proposed Development site.

The visual impact of the Proposed Development is considered in Chapter 10 – Landscape & Visual Impact.

Excavation and infilling impacts will result in a **permanent direct** effect of **neutral** quality which will have an **imperceptible** effect on the character of the environment but is certain to occur and **irreversible**. This is considered to be a **moderate** effect on a soil environment of **low** sensitivity and the significance of the effect is considered **slight.**

5.8.1.2 Use of Natural Resources

All excavated material will be reused onsite and no import of soil is expected. However, 26,000 tonnes of aggregate will be sourced from local quarries to facilitate construction of access roads. These will be delivered along the L1010 from the Tarbert direction. The sourcing of these aggregates from reputable, authorised quarries is mandated by applicant requirements and for ensuring regulatory compliance. Sources of material may include the following:

- Ardfert Quarries, Ardfert, Co. Kerry;
- O'Mahoney Quarries, Tralee, Co. Kerry;
- Roadstone, Foynes, Co. Limerick; and
- Liam Lynch, Adare, Co. Limerick.

Aggregates are natural non-renewable resources and their use results in depletion of the national stock of these resources. According to the Irish Concrete Federation (ICF), Ireland produces approximately 36 million tonnes of aggregates annually (ICF, 2019), of which the Proposed Development's required 26,000 tonnes represent just 0.07%.

Onshore and offshore pile arisings will be reused on the site as landscaping materials on the north-eastern boundary of the site forming a screening berm approximately 2 m high, subject to chemical suitability.

Use of natural resources will result in a **permanent direct** effect of **neutral** quality, as it will be **imperceptible** within the wider environment but is certain to occur and **irreversible**. Therefore, use of natural resources is considered to be a **small** effect on an environment of **low** importance and the significance of the effect is considered **imperceptible.**

5.8.1.3 Accidental Spills and Leaks

During construction of the Proposed Development, there is a risk of accidental pollution incidents from the following sources:

- Spillage or leakage of stored oils and fuels;
- Spillage or leakage of oils and fuels from construction machinery or site vehicles; and
- Spillage of oil or fuel from refuelling machinery on site.

Accidental spillage can potentially result in the impact of soils underlying the Proposed Development site. This is considered a **direct negative** effect and, if it occurs, will be confined to one-off releases. The impact can alter the character of soil and/ or groundwater at the local site but will be **temporary** in nature, as minor spills would likely be attenuated by natural processes (sorption/dilution/dispersion). The impact will therefore result in a **small adverse** effect on a **low** importance soil environment and the significance of the effect will be **imperceptible** with regard to soils.

The potential for accidental spills and leaks to impact on the hydrological and hydrogeological environment is considered in Chapter 06 – Water and also in the Major Accidents to the Environment (MATTE) section of the Quantitative Risk Assessment submitted to the Health and Safety Authority as part of this application.

5.8.1.4 Use of Concrete and Lime

Lime and concrete (specifically, the cement component) is highly alkaline and any spillage can impact soil quality. The activities most likely to result in contamination include concreting during piling and building construction. This impact is also considered in Chapter 06 – Water, in the context of its impact on the groundwater and surface water environment.

The impact can result in a **direct** effect of **negative** nature and **temporary** duration given it is only associated with the construction programme, which is temporary in nature. Impacts on soils associated with the use of concrete and lime are considered unlikely to occur and, shall they occur, are likely to be rare events. Therefore, it is considered to be a **small** effect to a **low** importance soil environment and the significance of the effect is **imperceptible.**

5.8.1.5 Impacts of Soils and Geology on the Proposed Development

In addition to assessing the potential impacts the Proposed Development may have on the soil and geology environment, it is also necessary to consider the potential impacts of the soils and geology on the Proposed Development.

Shallow Soils

The main onshore infrastructure will be constructed on a part of the Proposed Development site where the superficial soils comprise predominantly glacial till. Two types of glacial till have been identified on the Proposed Development site although composition-wise they are very similar. Based on geotechnical performance testing, both were expected by ARUP to provide a reasonable substrate for fill construction and for foundations for light-weight structures. Heavy settlement-sensitive structures may be founded on rock, either directly or by means of rock-socketed piles.

It has been concluded in previous site investigation reporting that the glacial till loses its shear strength and bearing capacity to a high degree with even a slight increase in water content. The upper several metres of till sediments at the seabed were reported to be Soft to Very Soft at 2 of 14 boreholes in the 2007 offshore site investigation, with other soft sediments, interpreted as alluvium rather than till, reported at the further offshore attempted drilling locations and inferred from offshore geophysical surveys.

Glacial till and greywacke sandstone have been shown to be a relatively non-aggressive material in terms of sulphate and chloride, so that no particular precautions are likely to be required for protecting concrete and other construction materials in contact with it.

It is noted that the Proposed Development provides the opportunity to study and document regional glacial geology through cutting and foundation pit exposures in the glacial deposits and bedrock, which will add to the national records.

Shallow soils are therefore considered to have a neutral to favourable impact on the Proposed Development and to be a **minor beneficial** effect on a **low** importance soil environment, and the significance of the effect is **imperceptible**.

Bedrock

The bedrock beneath the Proposed Development site has not been identified as of particular importance. The Proposed Development site is not located in an area of Geological Heritage and there are no active quarries or mineral localities recorded within 2 km.

As the Proposed Development retaining wall and platform level will be above the main coastal bedrock outcrop area, with the exception of the main site outfall, the Proposed Development will not impact the main coastal bedrock outcrop areas.

Geotechnical site investigation has previously been undertaken onsite, in the context of a previously proposed scheme. It was concluded that the unweathered siltstone and sandstone bedrock was expected to provide a competent foundation medium.

Bedrock quality is therefore considered to have a **moderate favourable** effect on the Proposed Development on a **low** importance bedrock environment, and the significance of the effect is **slight**..

5.8.2 Operational Phase

5.8.2.1 Accidental Spills and Leaks

Diesel fuel tanks for the fire water pumps and generators will be stored within bunded areas

Spills during fuelling can in theory discharge to ground; however, this will be prevented from entering the soil around the generators, as drainage will be directed to an oil/ water interceptor prior to discharge to the storm water drainage system. In addition, there will be a shut off valve from the generator yard to the external surface water drainage network. These measures will significantly reduce the likelihood of soil or groundwater contamination from spills and the impact of accidental spills

Accidental emissions of diesel or other hazardous substances can cause contamination should they enter the soil environment. They will be considered to be **direct negative** effects of temporary duration given that they will be confined to one off releases. This is considered to be a **small adverse** effect to a **low** sensitivity environment and the significance of the effect is **imperceptible**.

5.8.2.2 Removal of Land from Agricultural Use

The removal of land from agricultural or other potential beneficial uses can result in a **permanent direct** effect on existing land use in the area. The total hardstanding area is estimated to cover 14 ha, with the remainder left unsurfaced, landscaped or developed into attenuation ponds.

The removal of agricultural land can be considered to be **permanent** and the effect is considered **negative**; however, it is likely to be of **low** magnitude given the Proposed Development site is located within an agricultural setting where land use is predominantly of agricultural nature. This is considered to be a **small** effect to an environment of **low** significance and the significance of the effect is **slight**. Additional information on impacts on land use and properties can be found in Chapter 15 – Material Assets.

5.8.2.3 Seismic Hazard

A study of the seismic hazard potential carried out in 2007 indicated the Proposed Development is located in a structurally stable bedrock terrain, which earth record indicates is largely aseismic and that the tsunami risk for this site located within an estuary protected from the ocean is negligible.

5.8.2.4 Radon Hazard

The Proposed Development site is located in an area where <1% of homes are estimated to be above the reference level of 200 becquerels per cubic metre (Bq/m^3). Radon potential risk is therefore considered ‘Low’.

5.9 Cumulative Impacts and Effects

The cumulative impacts of the Proposed Development and nearby consented projects in the vicinity of the Proposed Development are discussed below. A planning search of granted and pending planning applications made within the vicinity of the Proposed Development site is presented in Chapter 04 – Planning and Development.

5.9.1 Summary of Schemes Considered in Cumulative Impact Assessment

5.9.1.1 LNG Pipeline

Permission was granted in 2009 for a pipeline to connect the Proposed Development site to the existing national gas network near Foynes, Co. Limerick. The application was accompanied by an EIAR.

No significant residual effects were identified to geology and soils in the EIAR for the LNG pipeline. A revised assessment of the permitted pipeline will be included within the required future application for consent under section 39A of the Gas Act 1976 (as amended).

5.9.1.2 Data Centre Campus

As part of the Masterplan, a Data Centre Campus is to be constructed to the west of the Proposed Development. This will be subject to its own EIAR and planning application.

5.9.1.3 220 kV and Medium Voltage (10/ 20 kV) Power Transmission Networks

An application to connect to the national electrical transmission network via a 220 kV high voltage connection was submitted to EirGrid in September 2020. An offer has yet to be received. It is expected that the high voltage connection will run 5 km east under the L1010 road to the EirGrid Kilpaddoge 220 kV substation.

The LNG Terminal may need to be operational before the Power Plant and/ or 220 kV high voltage grid connection are completed or operational. Therefore, the LNG Terminal design will also require an onsite substation and a separate 20 kV medium voltage connection, from the existing Electricity Supply Board Networks (ESBN)/ EirGrid Kilpaddoge substation. This will be used as a back-up electricity system when the Power Plant is undergoing maintenance.

The medium voltage (10/ 20 kV) and 220 kV power connections will be constructed in parallel with the Proposed Development but will be subject to separate planning design and planning applications.

5.9.2 Construction Impacts

Individual impacts from the Proposed Development and other schemes considered can result in **small** effects on a **low** sensitivity environment; therefore, the significance of the effect has been assessed as **imperceptible** or **slight**. As outlined in Section 5.8 above, mitigation measures proposed to manage and control potential impacts during the Proposed Development will reduce the potential magnitude and significance of effects.

Taking account of mitigation measures proposed, the cumulative impacts of all schemes proceeding can result in **small** effects on a **low** sensitivity environment geological environment and the effect has been assessed as imperceptible or **slight**.

5.9.3 Operational Impacts

The individual impacts from the Proposed Development and cumulative schemes to land and soil can result in effects ranging from **negligible to small** and mitigation measures proposed to manage and control potential impacts during operation will further reduce the magnitude of effects and significance of effects.

The cumulative operational effect of the Proposed Development and cumulative schemes are considered to be **slight**.

5.10 Mitigation and Monitoring Measures

Mitigation measures associated with both the construction and operational phases of the Proposed Development are outlined below. Due to the inter-relationship between land, soils and water (hydrology) the following mitigation measures discussed will be considered applicable to Chapters 05 and 06. Waste Management (Chapter 16) is also deemed an interaction in some of these considerations.

5.10.1 Construction Phase

In order to prevent/ minimise potential significant effects, a number of mitigation measures will be adopted as part of the construction works onsite. The main areas of potential impact and mitigation measures are set out below:

- Geotechnical design;
- Soil excavation and filling - Control of soil/ rock excavation and fill placement works;
- Pile installation – Minimisation of sediment disturbance
- Accidental spills and leaks – Fuel and chemical handling, transport and storage;
- Use of concrete and lime – The use of lime, concrete and cement during pad foundation, jetty, outfall, road and culvert construction; and
- Use of natural resources – Sources of fill and aggregates for the project.

5.10.1.1 Construction Environmental Management Plan

An OCEMP has been prepared for the Proposed Development which incorporates relevant environmental avoidance or mitigation measures to reduce potential environmental impact. The OCEMP will be modified and extended by any relevant construction related requirements imposed as conditions of any planning permission granted as a result of this application. The OCEMP will include a Waste Management Plan and Surface Water Management Plan, to be prepared in accordance with Department of Environment, Community & Local Government guidelines (DoECLG, 2006) and any construction-related requirements imposed as conditions of any planning permission granted. It will also include details of proposed environmental monitoring for the duration of the construction works, be this good practice or as a planning condition requirement, be this good practice or as a planning condition requirement.

5.10.1.2 Geotechnical Design

Prior to commencement of the Proposed Development, site investigation results will be used to inform the geotechnical design. Foundation solutions will be designed based on the properties of the underlying soils and bedrock, appropriate methodologies will be selected for the excavation of bedrock and foundation design will be finalised. Where necessary, further detailed site investigation will be undertaken to provide design parameters for the Proposed Development.

5.10.1.3 Soil Removal and Compaction

Temporary storage of soil will be carefully managed in such a way as to prevent potential negative impact on the receiving environment. Spoil and temporary stockpiles including stone stockpile areas will be positioned in locations which are distant from the shoreline, drainage systems and retained drainage channels and away from areas subject to flooding, so as not to cause potential runoff to soils. The OCEMP outlines proposals for the excavation and management of excavated material. Movement of material will be minimised in order to reduce degradation of soil structure and generation of dust. In order to minimise the potential environmental impact of stockpiles, the OCEMP will contain the following mitigation measures that will be implemented during the construction phase:

- Store excavated topsoil and rock for reuse in graded stockpiles less than 2 m high to prevent damage to the soil structure. Other excavated materials of lower engineering quality can be stored in higher piles. The depth of topsoil removal across the site is expected to be 0.15 m and, in total, 35,000 m^3 of topsoil is expected to be removed, stockpiled and reused on site during the proposed development works;
- Of this 35,000 m^3 of topsoil, 13,745 m^3 is expected to be used as backfill and the remaining 21,255 m^3 will be used to cover the lay down area on completion of constructions and also used in landscaping or to form berms.
- To help shed rainwater and prevent ponding and infiltration, the sides and top of the stockpiles will be regraded to form a smooth gradient with compacted sides reducing infiltration and silt runoff;
- Manage potential silty runoff from stockpiles and excavated area using silt fences and silt traps placed at crossing points to avoid siltation of watercourses on and close to the Proposed Development site. These will be maintained and cleaned regularly throughout the construction phase. Attention will also be paid to preventing the build-up of dirt on road surfaces, caused by lorries and other plant entering and exiting the Proposed Development site.
- Segregate different grades of soil where they arise and topsoil will first be stripped from any land to be used for storing subsoil; and
- Minimise movements of materials within the stockpiles in order to reduce the degradation of the soil structure.

Although there was no visual or olfactory evidence of contamination reported in soils during the geotechnical site investigation works, all excavated materials will be visually assessed for signs of possible contamination such as staining or strong odours. Should any unusual staining or odour be noticed, this soil will be segregated and samples of this soil analysed for the presence of possible contaminants in order to determine an appropriate disposal outlet.

Soils, pile arisings and crushed rock will be tested for their chemical and geotechnical suitability prior to use as fill. Fill placement and compaction will be undertaken in line with defined procedures and will be inspected by a geotechnical engineer.

As the glacial till loses its strength with increasing moisture content, the OCEMP will also include the following mitigation measures for earthworks:

- Maintain an even inclined surface on cut and fill surfaces to prevent the formation of ruts and hollows (which may promote ponding);
- Defer final shaping and trimming of formation levels until immediately prior to placement of surface dressing;
- Undertake earthworks in glacial till in times of dry weather, where possible; and
- Manage groundwater and surface water flows through drainage channels.

5.10.1.4 Pile installation

The piles supporting the offshore structures are expected to be end bearing and will be driven piles into till sediment, where possible, to minimise sediment mobilisation. Cobbles and boulders in the till may require the use of drilled piles in places and drilled, rock-socketed piles will be used for the first section of the approach trestle (where overburden sediments are thin) and for the breasting and mooring dolphins. Drilled piles will be installed using reverse circulation techniques to minimise temporary impacts from drill cuttings or grout on the estuary. Piles will be prefabricated as much as possible to minimise in-water construction and pile installation will likely advance outward from the shoreline.

In situ grouting of precast jetty members and construction of in-situ reinforced concrete trestle roadways and jetty platform deck will be managed to prevent wet concrete from entering the estuary.

5.10.1.5 Bedrock Excavation

Where bedrock is to be removed as part of the cut/ fill exercise on the Proposed Development site, it is anticipated that rock breaking and blasting may be required to achieve the 18 m OD formation level. Mitigation measures relating to the associated noise impacts are set out in Chapter 10 – Noise and Vibration. Groundwater seepages from bedrock cut faces will be managed by surface water drainage swales installed close to the toe of the cut faces.

5.10.1.6 Fuel and Chemical Handling

In order to prevent spillages to ground of fuels, and to prevent any consequent soil or groundwater quality impacts, it will be necessary to adopt mitigation measures during the construction phase, which include:

- Designating a bunded storage area at the contractor’s compound for all oils, solvents and paints used during construction. Oil and fuel storage tanks will be bunded to a volume of 110% of the capacity of the largest tank/ container within the bunded area. Drainage from the bunded area will be diverted for collection and safe disposal. All containers within the storage area will be clearly labelled, so that appropriate remedial action can be taken in the event of a spillage. When moving drums from the bunded storage area to locations within the Proposed Development, a suitably-sized spill pallet will be used for containing any potential spillages during transit;
- Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles, will take place in a designated area, which will be away from surface water gullies or drains. Spill kit facilities will be provided at the fuelling area in order to provide for accidental releases or spillages in and around the area. Any used spill kit materials will be appropriately disposed of using a hazardous waste contractor; and
- Where mobile fuel bowsers are used on the Proposed Development, i.e. in the event of a machine requiring refuelling outside of the designated area, fuel will be transported in a mobile, double-skinned tank. Any flexible pipe, tap or valve in this tank will be fitted with a lock where it leaves the

tank and locked shut when not in use. The pump or valve will also have a lock and be locked shut when not in use. Each bowser will carry a spill kit and each bowser operator will have spill response training.

5.10.1.7 Control of Concrete and Lime

Ready-mixed concrete will be either produced onsite in a batching plant or brought to the Proposed Development by truck. A suitable risk assessment for wet concreting will be completed prior to works being carried out which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil, to surface water courses or to the marine environment.

The pouring of concrete will take place within designated areas as required, using a geosynthetic material to prevent concrete runoff into the soil. Washout of concrete-transporting vehicles will take place at an appropriate facility offsite where possible. Alternatively, where washout takes place onsite, it will be carried out in carefully-managed onsite wash out areas.

5.10.1.8 Sources of Aggregates and Clean Fill for the Project

While it is anticipated all excavated materials will be re-used on site for the Proposed Development, 26,000 tonnes of aggregate will be brought to site for construction of the access road. In addition, there is potential for small quantities of clean fill materials to be required to facilitate other construction works, for example, where site-won soils or crushed rock are not of sufficient geotechnical or chemical quality for re-use. The source of this fill material will be vetted in order to ensure that it is of a reputable origin and that it is 'clean' (i.e. will not introduce contamination to the environment).

All potential suppliers will be vetted for the following criteria:

- Environmental management status; and
- Regulatory and legal compliance status of the company.

Clean fill material will be sourced from suppliers which comply with the above requirements. If recycled aggregate is used as imported fill, rigorous chemical testing will be undertaken to confirm that it is 'clean' (i.e. will not introduce contamination to the environment).

5.10.1.9 Earthworks

It is recommended that earthworks be undertaken in dry weather, where possible, in view of the sensitivity of the overburden to moisture content. For the same reason, it is recommended even, inclined surfaces be maintained on cut and fill surfaces to prevent rutting and water pooling.

5.10.2 Operational Phase

5.10.2.1 Fuel and Chemical Handling

All hazardous or water-polluting materials will be handled or stored in a manner to prevent/ minimise potential impact on soil.

With regard to the emergency back-up generators associated with the Proposed Development, the diesel will be stored in fuel tanks in bunded areas. Bunding will also be provided for each transformer bay.

If a leak from one of the fuel storage tanks were to occur this will be identified by the leak detection system that will be present on each tank. The generator will be disabled in this event and the fuel will be allowed to collect within the bund

All bunds will provide 110% capacity, automatic emptying of rainwater and have valved discharge points.

Secondary containment will also be provided for other hazardous materials to be stored onsite, such as maintenance oils, odorants and cleaning chemicals.

Spill kits will be located at strategic points around the Proposed Development in order to ensure a quick response to any spillages shall they occur. Any used spill kits will be disposed of using a hazardous waste disposal contractor and in accordance with relevant EU and Irish waste management legislation. The EPA Guidance Note 'Storage and Transfer of Materials for Scheduled Activities' (EPA, 2004) shall be taken into account when designing material storage and containment onsite.

5.10.2.2 Environmental Management Plan

An environmental management plan will be prepared for the Proposed Development during the operational phase incorporating all mitigation measures and emergency response measures, as described in this assessment.

5.11 Do Nothing Scenario

Should the Proposed Development not take place, the soils and geology will remain in their current state and there will be no change.

5.12 Residual Impacts and Effects

5.12.1 Construction Phase

The implementation of mitigation measures highlighted above will significantly reduce the likelihood and magnitude of the potential effects on land and soils occurring during the construction phase. The magnitude of the potential residual effects during construction phase is therefore considered to be **negligible** on an environment of **low** sensitivity, therefore the significance of the potential effect of the Proposed Development is considered to be **imperceptible** on the surrounding land and geological environment.

5.12.2 Operational Phase

The implementation of measures inherent to the building design and mitigation measures highlighted above will significantly reduce the likelihood and magnitude of the potential effects on land and soils occurring during the operational phase. The magnitude of the potential residual effects during construction phase is therefore considered to be **negligible** on an environment of **low** sensitivity, therefore the significance of the potential effect of the Proposed Development is considered to be **imperceptible** on the surrounding land and geological environment.

5.13 Decommissioning Phase

As outlined in Chapter 02 – Project Description, in the event of decommissioning, measures will be undertaken by the Applicant to ensure that there will be no significant, negative environmental effects from the closed LNG Terminal and Power Plant. Examples of the measures that will be implemented are outlined in Section 2.9.12, Chapter 02 – Project Description. As a result, additional potential impacts and associated effects arising during the decommissioning phase are not anticipated above and beyond those already assessed during the construction phase.

5.14 Summary

The Proposed Development site covers an area of approximately 41 ha (or 52 ha including the offshore elements) and comprises grassland on the southern shore of the Shannon Estuary, with a jetty and outfall pipe extending into the marine environment. Onshore and offshore geological/ geotechnical site investigations were undertaken at relevant locations on the Proposed Development site in 2006 and 2007.

Soil deposits comprise predominantly ‘till derived from Namurian sandstones and shales’ with small amounts of alluvium in localised areas, up to 4.2 m thick in total. Groundwater was encountered in place within the till, with low rates of inflow. Permeabilities of 3 to 4 x 10^{-6} m/s were calculated for the upper till. Geotechnical testing showed the upper till loses strength rapidly with increasing moisture content and behaves like a clay/ silt and clay, despite its high granular content. The lower till layer overlying bedrock is stiff and is of low permeability and no water strikes were recorded in this material.

The bedrock underlying the Proposed Development site is described as mudstone, siltstone and sandstone of the Shannon Group, of Namurian age, with siltstone and sandstone predominating in the area of the proposed jetty, LNG Terminal and Power Plant construction. The bedrock outcrops along the majority of the site’s northern boundary. Groundwater in the bedrock is classified as a ‘Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones’. Groundwater was encountered in the upper fractures/ weathered zone of the bedrock and topographically-driven artesian conditions were noted in a number of isolated locations across the Proposed Development site.

Groundwater vulnerability varies across the Proposed Development site from 'Moderate' to 'Rock at or near Surface or Karst' and depth to rock onshore varies from 0.75 m in the east of the Proposed Development site to up to 9.8 m, with the top of bedrock becoming deeper with increasing distance offshore.. A number of inactive faults orientated from northwest to southeast were inferred in the area. Bedrock permeabilities were moderate and ranged from 1 x 10^{-5} to 5 x 10^{-6} m/s depending on rock type. The bedrock is described a moderately strong, crushable and suitable for use as aggregate and engineered fill onsite.

Radon, seismic and tsunami potential risks are considered 'Low'.

Soils and geology encountered at the Proposed Development site are considered favourable for the construction of the proposed LNG plant, with most plant founded on bedrock at the cut platform level of 18 m OD and all excavated soil and rock material (of the order of 480,000 m^3) will be suitable for re-use onsite as general or structural fill or for landscaping. The ESM SEA mapping tool indicates the Proposed Development site to have a low to very low sensitivity with respect to existing soils and geology.

Construction stage spill and leaks, including the use of concrete and lime products and fuels, are expected to give rise a low impact on a low sensitivity environment, if managed in accordance with the OCEMP. The significance of any effect arising from this is slight.

The impact will therefore result in a **small adverse** effect on a **low** importance soil environment and the significance of the effect will be **imperceptible** with regard to soils.

Other construction phase risks arise from excavation, pile construction, rock breaking and material stockpiles on the site in terms of rock slope stability and silt runoff. Driven piles will be used offshore where possible to minimise sediment mobilisation and bored piles will be installed using reverse circulation techniques to minimise temporary impacts from drill cuttings or grout on the estuary. Pile arisings will be used onshore as to form a landscaping berm on the north-eastern edge of the site, subject to chemical suitability. The removal of land from agricultural or other potential beneficial uses is considered a permanent direct effect. Temporary storage of soil and crushed rock will be stored in low sensitivity areas distant from the shoreline, drainage systems, retained drainage channels or areas subject to flooding and will be carefully managed in accordance with the OCEMP to prevent potential negative effect on the receiving environment.

Operational Phase risks to soils and geology will arise principally from diesel fuel tanks for the fire water pumps and generators which will be managed by siting this equipment within bunded areas resulting in a low risk of impact to a low sensitivity environment and the significance of any effect is **slight**.

Mitigation measures associated with both the construction and operational phases of the Proposed Development have been proposed, which may also interact with waste management and water aspects of the development.

An OCEMP has been prepared for the Proposed Development which incorporates relevant environmental avoidance or mitigation measures to reduce potential environmental impact.

Construction Phase mitigations include:

- Foundation solutions will be designed based on the properties of the underlying soils and bedrock;
- Temporary storage of soil/ crushed rock will be managed to prevent potential negative impact on the receiving environment;
- Soils will be tested for their chemical and geotechnical suitability prior to re-use as fill;
- Fill placement and compaction will be undertaken in line with defined procedures and will be inspected by a geotechnical engineer;
- Concrete use and wash-out areas will be in designated area with measures to prevent alkaline wastewaters or contaminated storm water to the underlying subsoil, surface watercourses or to the marine environment; and
- Any fill material brought on to Proposed Development site will be vetted in order to ensure that it is of a reputable origin and that it is 'clean' (i.e. will not introduce contamination to the environment).

Operational Phase mitigations include:

- Handling all hazardous or water-polluting materials in a manner to prevent/ minimise potential impact on soil;
- Secondary containment and spill kits will be provided for other hazardous materials to be stored onsite, such as diesel fuel, chemical odorant, maintenance oils and cleaning chemicals; and
- An Environmental Management Plan will be prepared for the operational phase.

Cumulative impacts arising from the related LNG Pipeline, Data Centre Campus and medium voltage (10/ 20kV)/ 220kV power supply developments envisaged under the Master Plan were considered and no significant cumulative effects were identified to geology and soils. These developments will be subject to separate EIARs. The cumulative operational effect of the Proposed Development and cumulative schemes are considered to be slight.

Should the Proposed Development not take place, the soils and geology will remain in their current state and there will be no change.

The residual effect of the Proposed Development on the surrounding land and geological environment is considered to be imperceptible at both the construction and operational phases.

Table 5-8 Summary

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Effect Significance
Construction	Changes to Topography – Excavation and Infilling	Low	Excavation and reuse of 480,000 m^3 of soil and rock. Permanent, direct, irreversible moderate effect	Neutral	All surplus material will be processed (screened/ crushed) and reused onsite and there is no intention to import soil material to the Proposed Development site. Temporary storage of soil will be carefully managed in such a way as to prevent potential negative impact on the receiving environment. Spoil and temporary stockpiles including stone stockpile areas will be positioned in locations which are distant from the shoreline, drainage systems and retained drainage channels and away from areas subject to flooding, so as not to cause potential runoff to soils. Movement of material will be minimised in order to reduce degradation of soil structure and generation of dust. The OCEMP will outline proposals for the excavation and management of excavated material.	Slight
Construction	Use of Natural Resources	Low	Excavation and reuse of 480,000m^3 of soil and rock. Permanent direct Irreversible effect, of neutral quality	Negligible	All excavated material will be reused onsite. Offshore pile arisings will be reused onshore as landscaping material to form a berm on the north-eastern edge of the site, subject to chemical suitability. 26,000 tonnes of aggregate will require to be brought to site from local quarries for the formation of access roads during construction. The source of this fill material will be vetted in relation to the environmental management status and regulatory and legal compliance status of the originating facility and include appropriate chemical testing if derived from recycled fill material. Certain to occur and irreversible, but will be imperceptible within wider environment.	Not significant
Construction	Accidental Spills and Leaks Spillage or leakage of stored oils and fuels; Spillage or leakage of oils and fuels from construction machinery or site vehicles; and Spillage of oil or fuel from refuelling machinery on site.	High	Adverse impact on soils underlying the Proposed Development site. Direct negative small effect of temporary duration	Medium	Spillages are unlikely to occur and, if they occur, will be confined to one-off releases. Hazardous materials will be controlled via the OCEMP and stored in bunded areas. Low impact on a low sensitivity environment and the significance of the impact is slight. In order to prevent spillages to ground of fuels, and to prevent any consequent soil or groundwater quality impacts, it will be necessary to adopt mitigation measures during the construction phase, which include: • Designating a bunded storage areas and handling procedures for all oils, solvents and paints used during construction; • Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles, will take place in a designated area with appropriate facilities; and • Refuelling outside of the designated area will be via a mobile double skinned tank with lockable fittings and an onboard spill kit.	Imperceptible
Construction	Use of Concrete and Lime	Low	Lime and concrete (specifically, the cement component) is highly alkaline and can impact soil quality during piling and building construction. Direct small effect of negative nature and temporary duration	Medium	Hazardous materials will be controlled via the OCEMP and stored in bunded areas. A suitable risk assessment for wet concreting will be completed prior to works being carried out, which will include measures to prevent discharge of wet concrete, grout, alkaline wastewaters or contaminated storm water to the underlying subsoil or to the marine environment. Washout of concrete-transporting vehicles will take place at an appropriate facility off site where possible, alternatively, where washout takes place onsite, it will be carried out in carefully-managed onsite wash out areas. Potential for low impact on a low sensitivity environment and the significance of the impact is slight.	Imperceptible
Construction	Impact on Soil/ Geology	Low	Slight to moderate beneficial effect	Neutral	The opportunity to study and document regional glacial geology through cutting and foundation pit exposures in the glacial deposits and bedrock, which will add to the national records. Shallow soils are therefore considered to have a neutral to favourable effect on the Proposed Development and to be a minor beneficial effect on a low importance soil environment, and the significance of the effect is imperceptible. Unweathered bedrock is expected to provide a competent foundation medium, therefore bedrock quality is therefore considered to have a moderate favourable impact effect on the Proposed Development in a low importance bedrock environment, and the significance of the effect is slight.	Imperceptible to slight
Operational	Accidental Spills and Leaks	Medium	Spills during fuelling at diesel fuel tanks for the fire water pumps and generators can in theory discharge to ground. Direct negative small effect of temporary duration (given that they will be confined to one off releases).	Medium	All hazardous or water-polluting materials will be handled or stored in a manner to prevent/ minimise potential impact on soil. Secondary containment and spill kits will be provided for other hazardous materials to be stored on site, such as maintenance oils and cleaning chemicals. Diesel fuel tanks for the fire water pumps and generators will be stored within bunded areas. Fuel will be prevented from entering the soil around the generators, as drainage will be directed to an oil/ water interceptor prior to discharge to the storm water drainage system. In addition, there will be a shut off valve from the generator yard to the external surface water drainage network.	Imperceptible

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Effect Significance
Operational	Removal of Land from Agricultural Use	Low	The Proposed Development is located in a 603 acre landbank that is zoned for industrial development and will cover a development area of 41 ha of the overall site (excluding offshore elements). The total hardstanding area is estimated to cover 14 ha, with the remainder unsurfaced, landscaped or attenuation ponds. The removal of land from agricultural or other potential beneficial uses is considered a permanent, direct, small negative effect.	Medium	The removal of agricultural land can be considered to be permanent and the impact is considered negative; however, it is likely to be of low magnitude given the site is located within an agricultural setting where land use is predominantly of agricultural nature.	Slight

5.15 References

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CHAPTER 06
Water

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park
Environmental Impact Assessment Report

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6. Water

6.1 Introduction

This chapter of the EIAR has been prepared by AECOM with input from the project team to assess potentially significant impacts upon the water environment and hydrogeology as a result of constructing and operating the Proposed Development.

Essentially, the assessment aims to satisfy the requirements of the EIA Directive and considers the potential for non-conformance with the EU Water Framework Directive (EU, 2000) (WFD) objectives. The assessment aims to ensure that:

- The need for the avoidance and reduction of impacts on the water environment is taken fully into account in the environmental evaluation; and
- The selection of appropriate means of preventing any significant predicted impact is made through modification of the drainage design, choice of discharge location(s) and/ or adoption of runoff treatment methods, with the objective of designing-out potential adverse environmental impacts.

This chapter describes water, hydrology and flooding risk issues associated with the Proposed Development and shall be read in conjunction with Chapter 07 – Biodiversity and Chapter 05 – Land and Soils, which pay particular attention to the potential for impacts upon the aquatic/ riparian and geological environments, respectively.

In order to describe the baseline conditions, AECOM utilised the geotechnical and environmental investigations data acquired during 2006/ 2007 for a previous planning application on the site, and supplemented this with additional groundwater and surface water measurement and samples collected on the Proposed Development site in February 2020.

In assessing potential significant effects associated with construction and operational phases of the Proposed Development on surface waters and hydrogeology, AECOM has considered both the importance of the attributes and the predicted scale and duration of likely impacts.

6.2 Competent Expert

This assessment has been undertaken by Kevin Forde, Associate Hydrogeologist in the AECOM Ground, Energy and Transaction Services team, who has more than 28 years' post-graduate experience. He graduated with an honour's degree in Geology (1991) and has since earned a post graduate diploma in Computing (UCC, 1992) and a Masters in Hydrogeology (UCL, 1993). He has extensive experience of ground contamination assessment and remediation for both public and private sector clients involving environmental due diligence, pre-construction site investigation, EIAR, contaminated land remediation and construction phase soil waste management

6.3 Methodology

This assessment presented in this chapter has been undertaken to satisfy the requirements for an EIAR as outlined in the relevant National (Government of Ireland, 2018) and EU legislation (EU, 2014). This chapter has been prepared in accordance with:

- 'Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports', 2017 (EPA, 2017),
- 'Environmental Impact Assessment of Projects, Guidance on the preparation of the Environmental Impact Assessment Report', 2017 (European Commission 2017),
- 'Guidelines on the Information to be Contained in Environmental Impact Statements, 2002 (EPA 2002),
- 'Advice Notes on Current Practice in the Preparation of Environmental Impact Statements, 2003 (EPA 2003), and
- 'Guidelines for Preparation of Soils, Geology, Hydrogeology Chapters of Environmental Impact Statements (Institute of Geologists of Ireland (IGI), 2013).

6.3.1 Sources of Information

The assessment presented in this chapter has been based on both a desktop review of existing information and as well as site specific investigation data acquired from the site of the Proposed Development, as follows:.

- Ordnance Survey of Ireland (OSI) website[1] for historical maps of 1:2,500 scale and 1:10,560 scale (1829 to 1913) and aerial photographs (1995, 2000 and 2005);
- OSI Discovery Series, 2010 of 1:50,000 scale;
- Geological Survey of Ireland (GSI) website[2] for Public Viewer and Groundwater Maps;
- EPA Maps website[3] for Groundwater and Surface Water information;
- AECOM 2020 Groundwater and Surface Water Monitoring Report, Shannon LNG site, Tarbert, Co. Kerry, Ireland, report Ref PR-452891_xxx Draft issue dated xx April 2021;
- Shannon LNG Terminal On shore Ground Investigation Interpretive report C1676.30 Issue 2 Arup dated January 2010 (reports 2006 ground investigation data);
- Office of Public Works' (OPW) national flood hazard mapping and management information (www.floodinfo.ie);
- 2007 Shannon LNG Environmental Impact Statement plus appendices, Arup Consulting Engineers for Shannon LNG Limited, dated September 2007 (particularly Appendix 15.1 'Hydrological and Hydrogeological Impact Assessment of the Proposed Shannon LNG (Liquid Natural Gas) Terminal Development at Ballylongford, Co. Kerry', Minerex Environmental Limited (MEL), 2007); and
- 2012 Shannon LNG CHP Plant Environmental Impact Statement plus appendices, Arup Consulting Engineers for Shannon LNG Limited, dated December 2012.

The hydrological and hydrogeological impact assessment study (Minerex Environmental Limited (MEL), 2007) included a detailed hydrological and hydrogeological study of the then-proposed Shannon LNG development site, encompassing the site of the current Proposed Development, the subsequently-permitted CHP plant site and an area west of the Ralappane Stream (EPA nomenclature, was termed the D1 Stream in previous EIA studies).

There has been no significant development of or disturbance on the Proposed Development site since 2007, therefore the findings of the 2007 MEL study are relevant to the current Proposed Development. The findings have been supplemented by additional groundwater and surface water data collected by AECOM Ireland Limited in February 2020 from monitoring locations within the Proposed Development site, see further details below.

Significant soil and bedrock investigations were undertaken by Arup and MEL across the wider site in 2006 and 2007, respectively (see Chapter 05 and Vol. 4, Appendices A5-1 and A5.2 and Appendix A6-1), including:

6.3.1.1 Arup 2006 – Onshore Ground Investigation study

- 33 trial pits for soil description purposes (TP## series locations – where ## represents the sequential location number);
- 26 rotary core boreholes installed into bedrock and subsoils (the RC## series locations), 10 of which were installed as monitoring wells, also utilised but referred to as BH## series wells in the 2007 MEL study); and
- 1 trial pumping well (location PW01)

6.3.1.2 MEL 2007 Hydrological and Hydrogeological Study

- 4 shallow 'gouge core' soil sampling bores (the GC## series monitoring locations);
- 1 percussive window sampling (the PWS3-series monitoring location);
- 36 piezometers installed in clusters at varying depths into bedrock and subsoils (the BR-## series installations);

[1] http://www.osi.ie
[2] http://www.gsi.ie
[3] https://gis.epa.ie/EPAMaps//

- 24 'phreatic' installations with screened sections at the water table (the BR-## series installations);
- 13 staff gauges to monitor drainage, standing water and lagoon water levels across the wider site (the xx-SG# monitoring locations – where xx represents drainage feature numbers (D1-D5);
- 35 surface water physical chemistry monitoring locations (the xx-SW## monitoring locations);
- 9 flow gauge locations (the xx-FG## monitoring locations); and
- 1 weather station to measure climatic conditions.

AECOM acquired measurements and/ or samples at the pre-existing groundwater wells and surface water monitoring locations within the Proposed Development site in February 2020 to confirm and supplement the earlier datasets, map piezometric contours and hydraulic gradients and assess hydrochemistry.

Not all monitoring locations were found in February 2020 - no trace remains of well RC/ BH10, no staff gauges remain at MEL surface water locations D3-FG-SW2 or D1-SW-FG-SG1 and several wells show damage to the well headworks and/ or standpipes, likely due to livestock presence (notably BH14, BH19, BR-01 and BR-11 – see Vol. 4, Appendix A6-2), however the new data acquired in 2020 support the findings of the previous MEL study.

Hydrodynamic modelling of temperature, salinity, suspended sediment and wastewater dispersion in the estuary referred to in this chapter was completed by Hydro Environmental and AquaFact and is described in Appendix A6-4, Vol. 4.

6.3.2 Determination of Sensitive Receptors

The sensitivity of the receiving environment identifies the ability of the receptor to respond to potential effects. Receptors have been identified during the baseline study and a qualitative assessment has been used to assign a sensitivity rating from low to extremely high based on the TII's 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' (TII, 2009). Assigning a sensitivity rating (Table 6-1) considers an attribute's likely adaptability, tolerance and recoverability, as well as their designation.

With regards to natural resource use, the materials themselves have been identified as the sensitive receptors. Consuming materials impacts upon their immediate and (in the case of primary materials) long-term availability; this results in the depletion of natural resources and adversely impacts the environment.

Table 6-1 Estimation of Importance of Hydrological and Hydrogeological Attributes

Importance	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale	**Hydrogeology:** Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. Special Area of Conservation (SAC) or Special Protected Area (SPA) status **Hydrology:** River, wetland or surface water body ecosystem protected by EU legislation e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.

Importance	Criteria	Typical Examples
Very High	Attribute has a high quality or value on a regional or national scale	**Hydrogeology:** Regionally Important Aquifer with multiple wellfields Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2,500 homes Inner source protection area for regionally important water source **Hydrology:** River, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Quality Class A (Biotic Index Q4, Q5) Flood plain protecting more than 50 residential or commercial properties from flooding Nationally important amenity site for wide range of leisure activities
High	Attribute has a high quality or value on a local scale	**Hydrogeology:** Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers Locally important potable water source supplying >1,000 homes Outer source protection area for regionally important water source Inner source protection area for locally important water source **Hydrology:** Salmon fishery Locally important potable water source supplying >1000 homes Quality Class B (Biotic Index Q3-4) Flood plain protecting between 5 and 50 residential or commercial properties from flooding Locally important amenity site for wide range of leisure activities
Medium	Attribute has a medium quality or value on a local scale	**Hydrogeology:** Locally Important Aquifer Potable water source supplying >50 homes Outer source protection area for locally important water source **Hydrology:** Coarse fishery Local potable water source supplying >50 homes

Importance	Criteria	Typical Examples
		Quality Class C (Biotic Index Q3, Q2-3) Flood plain protecting between 1 and 5 residential or commercial properties from flooding
Low	Attribute has a low quality or value on a local scale	**Hydrogeology:** Poor Bedrock Aquifer Potable water source supplying <50 homes **Hydrology:** Locally important amenity site for small range of leisure activities Local potable water source supplying <50 homes Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding Amenity site used by small numbers of local people

Source: Based on criteria outlined within the TII's Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (TII, 2009)

6.3.3 Describing Potential Effects

The methodology used for describing the potential effects considers the 'quality' of the effects (i.e. whether it is adverse or beneficial), the 'probability' of the event occurring and the 'duration' of the effects (i.e. whether it is short or long term) as per Section 3.7.3 and Table 3.3 of the EPA's draft Guidelines on the information to be contained in environmental impact assessment reports (EPA, 2017).

Specific assessment criteria and typical examples (based on information within the TII's 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' (TII, 2009)) are outlined in Table 6-2.

Table 6-2 Criteria and Examples for Describing Potential Effects on Waters Environment

Magnitude of Effect	Criteria for Effects	Typical Examples (Positive and Negative)
Large Adverse	Results in loss of attribute	**Hydrogeology:** Removal of large proportion of aquifer Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems Potential high risk of pollution to groundwater from routine runoff Calculated risk of serious pollution incident >2% annually

Magnitude of Effect	Criteria for Effects	Typical Examples (Positive and Negative)
		Hydrology: Loss or extensive change to a waterbody or water dependent habitat Increase in predicted peak flood level >100mm Extensive loss of fishery Calculated risk of serious pollution incident >2% annually Extensive reduction in amenity value
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	**Hydrogeology:** Removal of moderate proportion of aquifer Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems Potential medium risk of pollution to groundwater from routine runoff Calculated risk of serious pollution incident >1% annually **Hydrology:** Increase in predicted peak flood level >50 mm Partial loss of fishery Calculated risk of serious pollution incident >1% annually Partial reduction in amenity value
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	**Hydrogeology:** Removal of small proportion of aquifer Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems Potential low risk of pollution to groundwater from routine runoff Calculated risk of serious pollution incident >0.5% annually **Hydrology:** Increase in predicted peak flood level >10 mm Minor loss of fishery

Magnitude of Effect	Criteria for Effects	Typical Examples (Positive and Negative)
		Calculated risk of serious pollution incident >0.5% annually Slight reduction in amenity value
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	**Hydrogeology:** Calculated risk of serious pollution incident <0.5% annually **Hydrology:** Negligible change in predicted peak flood level Calculated risk of serious pollution incident <0.5% annually
Minor Beneficial	Results in minor improvement of attribute quality	**Hydrology:** Reduction in predicted peak flood level >10 mm Calculated reduction in pollution risk of 50% or more where existing risk is <1% annually
Moderate Beneficial	Results in moderate improvement of attribute quality	**Hydrology:** Reduction in predicted peak flood level >50 mm Calculated reduction in pollution risk of 50% or more where existing risk is >1% annually
Major Beneficial	Results in major improvement of attribute quality	**Hydrology:** Reduction in predicted peak flood level >100 mm

Source: Based on 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' (TII, 2009)

6.3.4 Appraisal and Significance of Effects

The appraisal methodology considered the 'quality' of the effect (i.e. whether it is adverse or beneficial), the 'significance' of the effects (i.e. the magnitude of the effect in terms of the environment), the 'probability' of the event occurring, and the 'duration' of the effect (i.e. whether it is short or long term). Terminology for describing the quality, significance, extent, probability and duration of effects is set out in Section 3.7.3 of the EPA guidance (EPA, 2017).

A qualitative approach was used to determine the significance of effects as per the EPA's draft guidance determination figure (Figure 3.5; page 53). Due account was taken of both the sensitivity of the attributes (Table 6-1) and the description of the potential effect (Table 6-2).

It shall be noted the control measures such as sealed drainage systems, hydrocarbon interceptors, packaged sanitary wastewater treatment system and process effluent treatment as outlined in Chapter 2 Project Description, have been considered as embedded mitigation in the project design and their application has been assumed in determining the significance of the effect. Mitigation measures have then been devised for each potential complete pollutant linkage (comprising a source, pathway and receptor).

Table 6-3 Significance Ratings

		Magnitude of Effect			
		Negligible	**Small**	**Moderate**	**Large**
Importance of Attribute	**Extremely High**	Imperceptible	Significant	Profound	Profound
	Very High	Imperceptible	Significant/ Moderate	Profound/ Significant	Profound
	High	Imperceptible	Moderate/ Slight	Significant/ Moderate	Severe/ Significant
	Medium	Imperceptible	Slight	Moderate	Significant
	Low	Imperceptible	Imperceptible	Slight	Slight/ Moderate

6.4 Limitations and Assumptions

AECOM has as part of this assessment reviewed and appended a number of relevant site investigation reports to this EIAR (Appendices A5-1 and A5-2). These investigation reports were undertaken by third parties and AECOM takes no responsibility for the conclusions presented in those reports which were used to provide hydrological, hydrogeological and geotechnical recommendations for a previously proposed development on the site.

6.5 Baseline Environment

6.5.1 Site Area Description

The Proposed Development site covers an area of approximately 41 ha; however, development (i.e. buildings and associated process infrastructure) will principally take place in the north-eastern portion of the Proposed Development site, covering an area of approximately 14 ha. There will be an access road leading south from this area to join the L1010 road.

The entire Proposed Development site is currently in agricultural use, predominantly as pastureland though there is tillage (barley) reported to the south and west of the Proposed Development. There are no currently occupied buildings onsite (see Figure F2-1, Vol. 3 for site location and Figure 6-1 for site layout).

The Proposed Development site is surrounded by a mixture of open water, agricultural land, rural housing, public highway and forestry:

- There is an adjacent area of forestry to the east, beyond which is agricultural land. Tarbert town and Tarbert Generating Station are situated approximately 3.8 to 4.0 km east of the Proposed Development site.
- To the north, the Proposed Development site is bounded by the Shannon Estuary.
- To the south, there is agricultural land used for grazing and the Coast Road (L1010) with dispersed residential properties and agricultural lands beyond.
- To the west, the Proposed Development site is bound by coastal marshes, agricultural land and a derelict residential property in the area of the Masterplan Data Centre Campus, with coastline and agricultural land with individual residential dwellings located beyond. The village of Ballylongford is 3.5 km west of the Proposed Development site.

6.5.2 Topography

The Proposed Development site (excluding the access road) will consist of a constructed platform between Knockfinglas Point and Ardmore Point at elevation of 18 m above Ordnance Datum (m OD) (mean sea level at Malin Head, Co. Donegal).

The topography on the north-eastern side of Knockfinglas Point consists of a number of fields sloping towards the northeast from 14 m to <5 m towards the coast, where there is a low cliff, typically 2 to 5 m in height composed of glacial till subsoils and exposed bedrock, above a tidal rock or shingle coastline. No construction on the foreshore is envisaged in this area other than the outfall and jetty structures.

The preconstruction topography in the north-eastern area, where it is proposed that the LNG Terminal and Power Plant will be constructed, consists of a undulating hillside, sloping downward to the north towards the coastline and varying in elevation from 30 to 35 m OD along its southern boundary to 5 to 11 m OD at the northern edge, where there is a low cliff, typically 2 to 5 m in height and composed of glacial till subsoils and exposed bedrock, above a tidal rock or shingle coastline. This is in line with the topography of the surrounding area, which slopes gently towards the coast.

Ground level contours indicate localised surface gradients at a maximum of approximately 1 in 20, towards the north, in the northeast area of the Proposed Development site.

The access road in the southern part of the Proposed Development will join the L1010 road.

6.5.3 Marine Environment

The Proposed Development is located on the southern side of the Shannon Estuary and comprises both onshore (LNG Terminal and Power Plant) and offshore (FSRU, jetty and outfall pipe) elements.

The River Shannon is the longest river in Ireland at 360.5 km and it drains an area of 16,865 km^2 or one fifth of the island’s landmass. This large catchment area includes upland areas and flatter, low land areas used primarily for agriculture, silviculture and turf cutting. These activities give rise to high levels of suspended solids (SS) (80 mg/l) in the estuarine section of the river below Limerick City (McMahon, 1988; McMahon and Quirke, 1992). Light attenuation levels in the estuary are therefore high (McMahon et al., 1992).

Apart from being Ireland's longest river, the Shannon is also, by far, Ireland's largest river by flow having a long term average flow rate of 208.1 m^3/s at Limerick. This is double the flow rate of Ireland's second largest river, the River Corrib. If the flows from all of the rivers and streams into the Shannon Estuary are added to this, the total discharge of the River Shannon at Loop Head increases to 300 m^3/s.

West of the confluence of the River Shannon with the River Fergus, water depths are in excess of 20 m and increase in depth in a westerly direction (British Admiralty Charts nos. 1547 – 1549). Tidal flow velocities are high reaching speeds of approximately 2 m/s and these give rise to high levels of turbulence throughout the estuary; overspills are marked for some areas of the estuary (British Admiralty Charts nos. 1547 – 1549). The maximum tidal range in the Shannon is approximately 5.5 m.

Salinity values range from 0.10 – 26.80 psu (CRFB, 2008) and increase in a westerly direction (McMahon and Quirke, 1992). Because fresh water is lighter than salt water, surface salinities will be lower than deeper values.

Monthly average water temperatures in the Shannon Estuary at Shannon reportedly range from 9.4 to 15.7 ^{o}C (source https://www.seatemperature.org/europe/ireland/shannon).

There are a number of designated marine conservation areas located in the vicinity of the Proposed Development. These include:

- Lower Shannon candidate Special Area of Conservation (cSAC), Site Code 002165.
- Ballylongford Bay proposed Natural Heritage Area (pNHA), Site Code 1332.
- Shannon-Fergus Estuary Special Protection Area (SPA), Site Code 004077.

The Lower Shannon cSAC site includes the Shannon Estuary and river from a line drawn across the mouth between Loop Head and Kerry Head to Killaloe in Co. Clare. The cSAC covers the entire area of estuary and river enclosed by these two boundaries. The site is noted for the presence of a number of habitats listed in Annex I of the EU Habitats Directive (Council Directive 92/43/EEC), including lagoons that are listed as a priority habitat.

The FSRU operations, the jetty and the outfall pipe will be located within the Lower River Shannon cSAC and the River Shannon and River Fergus Estuaries SPA. These designated areas are also discussed in Chapter 07A – Marine Biodiversity.

6.5.4 Drainage

The Proposed Development site is currently drained by a number of shallow drainage channels.

In the north-eastern area, these drainage features are short (100-200 m or less) and drain directly northward towards the coast (see drainage nomenclature on Figure 6-1).

Several longer drainage features cross the southern portion of the Proposed Development site, generally flowing in a west or northwest direction. The drainage features along the access road all ultimately drain to a single surface water course, the Ralappane Stream (River Waterbody Code IE_SH_24R300270 EPA code 24R30, WFD status reported by EPA as 'Unassigned' (EPA, 2021, see also Section 6.5.9), which was termed the D1 Stream in the 2007 MEL study.

The Ralappane (D1) Stream flows in a northwest direction towards the coast close to, but beyond, the western boundary of the Proposed Development site and through a key coastal wetland area, which is part of both the Lower River Shannon cSAC and the Ballylongford pNHA, before discharging to the Shannon Estuary on the southwest side of Knockfinglas Point via a modified channel (see Photograph 1 in Vol. 4, Appendix A6-1).

Figure 6-1 Local Surface Water Network showing Site Boundary and Proposed Development Layout

The north-eastern and north-western areas of the Proposed Development site are composed of poorly-drained soils and showed development of waterlogged areas and reed growth at several locations under winter 2020 conditions, (see Figure 6-1 and Photographs 2 and 18 in Vol. 4, Appendix A6-2).

Along the access road in the south of the Proposed Development, soils appear better drained (Photograph 1 in Vol. 4, Appendix A6-2), except where the proposed road crosses existing drainage features (near sampling locations D1-SW, D3-SW1 and D2-SW1, see Figure 6-2 and Photograph 2 in Vol. 4, Appendix A6-2).

6.5.5 Quaternary Deposits

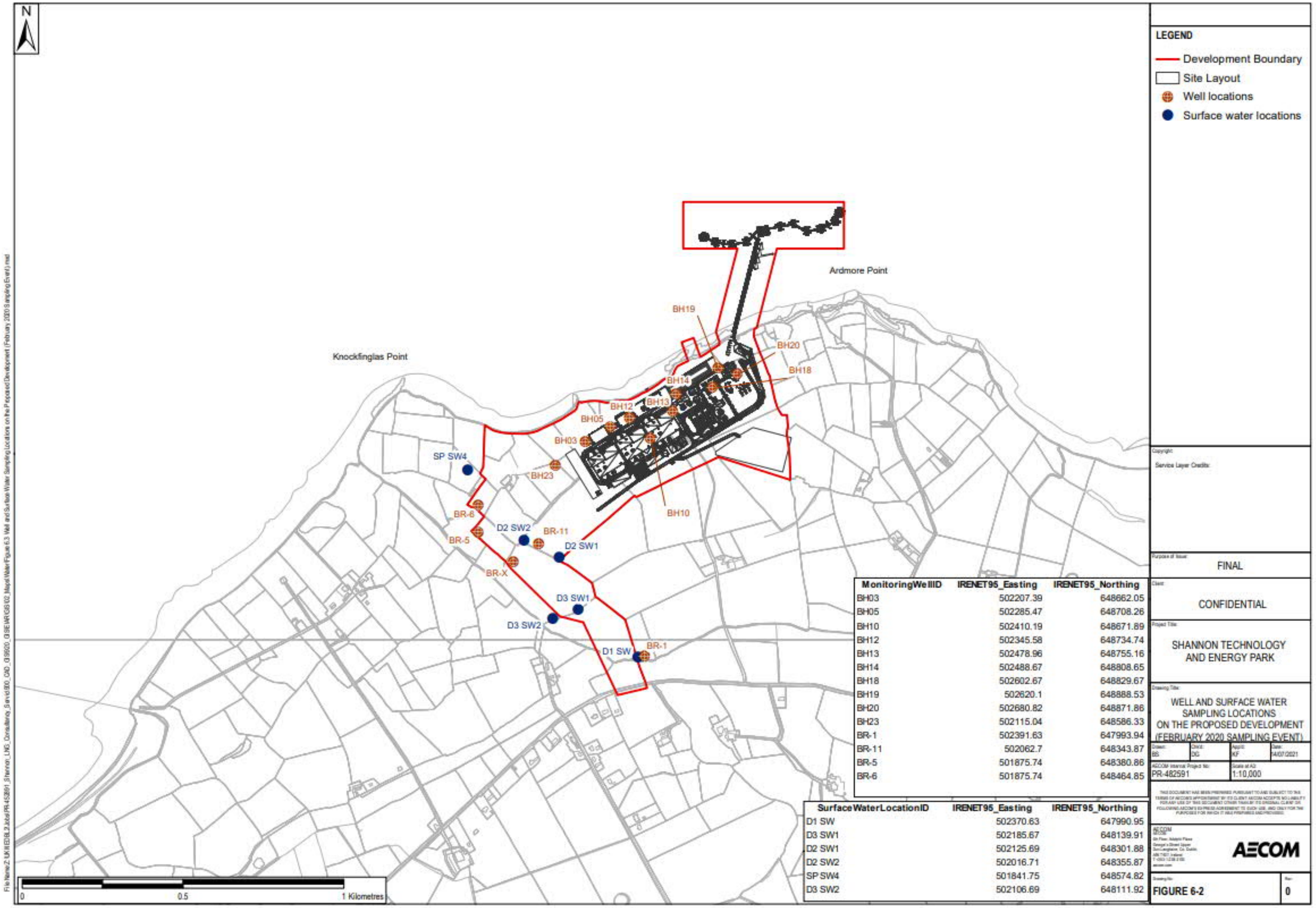
The Teagasc Soil map (provided on GSI mapping website) indicates that the local quaternary deposits are largely glacially-derived and generally comprise predominantly ‘TNSSs - tills derived from Namurian sandstones and shales’.

Small amounts of subsoils classified as ‘A – alluvium’ are also depicted at the Proposed Development site predominantly associated with the principal surface water feature, the Ralappane Stream (stream ref: D1), and associated with inferred periglacial water features (see Chapter 05 - Soils and Geology). No evidence of excavation, filling or waste disposal at the Proposed Development site was observed by AECOM during the December 2020 site walkover or the site assessment works completed during the groundwater and surface water sampling in February 2020.

The previous site investigations identified two distinct Quaternary age glacial till subsoils across the majority of the Proposed Development site, comprising:

- Lower Till - a medium to dark grey coloured stiff stony till encountered directly above bedrock and interpreted as a lodgement till deposited beneath and consolidated by glacial ice; and
- Upper Till – a morainic till deposit over lying the Lower Till, and which is generally lighter brown in colour and less consolidated than the Lower Till. The Upper Till was not encountered at all drilling locations by MEL (2007), due to either lack of deposition or subsequent erosion but, where present, it directly overlies the Lower Till and is from 2 to 3.5 m thick.

In the north-eastern area subsoil thickness in the RC/ BH series bores (Arup, 2007) varied from 0.5 m at RC/ BH20 to 6.7 m at RC/ BH23 (see February 2020 well and surface water sampling locations on Figure 6-2).



MonitoringWellID	IRENET95_Easting	IRENET95_Northing
BH03	502207.39	648662.05
BH05	502285.47	648708.26
BH10	502410.19	648671.89
BH12	502345.58	648734.74
BH13	502478.96	648755.16
BH14	502488.67	648808.65
BH18	502602.67	648829.67
BH19	502620.1	648888.53
BH20	502680.82	648871.86
BH23	502115.04	648586.33
BR-1	502391.63	647993.94
BR-11	502062.7	648343.87
BR-5	501875.74	648380.86
BR-6	501875.74	648464.85

SurfaceWaterLocationID	IRENET95_Easting	IRENET95_Northing
D1 SW	502370.63	647990.95
D3 SW1	502185.67	648139.91
D2 SW1	502125.69	648301.88
D2 SW2	502016.71	648355.87
SP SW4	501841.75	648574.82
D3 SW2	502106.69	648111.92

Figure 6-2 Well and Surface Water Sampling Locations on the Proposed Development Site

The majority of the MEL (2007) site investigation locations were in the west of, or to the west of, the Proposed Development site and found subsoil thickness close to the valley of the Ralappane Stream (the D1 valley) varied from <1 m to 10 m (MEL, 2007), with the thickest subsoils being in the more elevated areas of the Proposed Development site and the thinnest subsoils being in the eroded, fault-controlled valley features or along the coastline.

The glacial till subsoils are discussed in more detail in the Chapter 05 - Land and Soils however MEL (2007) interpreted both till horizons to be clay-dominated (40-70% clay) and concluded that this subsoil type is characterised by poor drainage, low infiltration properties and low permeability, consistent with AECOM field observations of poorly drained areas in February 2020. The glacial till as a whole therefore acts as a hydraulically-confining horizon above the more-permeable weathered bedrock horizon.

Water strikes during drilling in 2006 and 2007 were generally encountered at the base of the tills/ top of rock and standing water levels in the boreholes frequently rose above the level of the water strikes, indicating locally confined (occasionally artesian) conditions in the weathered bedrock.

6.5.6 Bedrock

According to the GSI database, the bedrock underlying the entire Proposed Development site is described as undifferentiated mudstone, siltstone & sandstone of the Lower Carboniferous (Namurian) age Shannon Group (GSI stratigraphic code SHG).

The Shannon Group is reported by the GSI to consist of grey to dark grey bedded sandstones and siltstones, with subordinate blackish grey mudstone or shale. The sandstones frequently show fining upward cycles and are interpreted as forming via turbidite deposition in a marine environment.

The Shannon Group bedrock at the Proposed Development site, and in North Kerry generally, is poorly exposed at the surface inland but there is a good bedrock exposure along the northern coastal boundary of the Proposed Development, showing the bedrock strata typically dipping towards the north-north-west at an angle of 15 to 20^{o}, but with some gentle folding of the strata evident in shoreline exposures on the west side of Ardmore Point.

The cored bores drilled in 2006 (Arup, 2010) in the north-eastern area logged the Shannon Group bedrock as fine grained sandstones interbedded with argillaceous (siltstone and mudstone) bands, with unweathered bedrock showing variable fracture spacing depending on borehole location and with the rock being interpreted as strong and as medium to occasionally thickly bedded (0.1 to 0.3 m thick sandstone/ siltstone beds).

Depth to bedrock at the Proposed Development site varies from 0.5 m below ground level (bgl) (BH20) to 8.0 m bgl (BR-6). Bedrock underlying the main construction area in the northwest of the Proposed Development is generally between 1 and 5 m bgl.

Bedrock at the Proposed Development site is generally unweathered below approximately 10-14 m bgl (MEL, 2007). Below this depth, the bedrock is generally dark grey, very dense and with few, tight fractures. Borehole BR-1 is an exception to this and is reported to show deeper weathering and more extensive fracturing. The drilling logs for boreholes RC/ BR03, RC04, RC/ BR05, RC07, RC08, RC/ BR12, RC/ BR13, RC/ BR14, RC16, RC/ BR19 and RC/ BR20 show iron-staining on bedrock fracture surfaces, suggesting some groundwater movement within this unit.

The upper few metres of bedrock are noted to be more weathered, typically 2-3 m thick, where present (Arup, 2007), having a brownish grey colour and being more extensively fractured along bedding planes and joints. Groundwater strikes were generally encountered within this more open and permeable weathered rock horizon and were artesian in places, particularly in the lower-lying, poorly-drained area between the proposed LNG Terminal and CCGT facilities and Knockfinglas Point, due to the overlying low permeability tills acting as a confining layer.

Borehole BR-1, adjacent to Ralappane Stream and a low lying waterlogged area in the very south of the Proposed Development, showed a high degree of weathered bedrock and both this weathering and the high water table may indicate faulting and groundwater discharge along the east-west alignment of the Ralappane Stream (D1 stream) in this area, which is not in the same orientation as both the main northwest to southeast Ralappane Stream (D1 stream) alignment downstream and the coincident mapped F1 bedrock Fault (MEL, 2007).

The 2006-2007 studies showed that the areas of higher topographic relief between Knockfinglas Point to the west and Ardmore Point in the east are composed of a greater proportion of sandstone and siltstone, which are more resistant to erosion and underly the higher ground in this area, whereas further to the west, outside the area of the Proposed Development site, the relative lack of shoreline and inland bedrock exposures and more subdued topography suggest a greater proportion of softer, less resistant mudstone bands in the near-surface bedrock succession.

The bedrock is discussed in more detail in Chapter 5 - Land and Soils.

6.5.7 Hydrogeology

According to the GSI database, the Shannon Group underlying the Proposed Development site is classified as a 'LI - locally important aquifer, which is moderately productive in local zones'.

The National Draft Gravel Aquifer Map does not indicate a gravel aquifer under the Proposed Development site or in the study area. No extensive clean sands or gravels with resource potential were encountered during the 2006-2007 intrusive site investigation.

The GSI database classifies groundwater vulnerability beneath the Proposed Development site as High to Extreme, due to the relatively thin soil cover across much of the site.

The inferred groundwater flow direction within both the overburden/ subsoil and the bedrock unit beneath the Proposed LNG Development site is to the north or north west in line with the regional gradient, while that beneath the access road is towards the west or southwest towards the wetland areas and the Ralappane Stream (D1 stream).

The Shannon Group bedrock aquifer is not expected to have any significant permeability or transmit large volumes of groundwater other than in the 2-3 m thick weathered bedrock zone.

A search of the GSI well database found no springs or recorded groundwater abstraction wells potentially within a 1 km radius of the Proposed Development site.

The following four private wells are recorded between 1 and 2 km outside of the redline boundary of the Proposed Development site in the GSI well database. All have 'Poor' reported well yields (<100 m^3/day) and are used for agricultural or domestic supply purposes (where use is reported).

- 0813NEW010 - townland Carhoonakilla, depth 33.5 m, depth to rock 9.8 m, yield 26 m^3/day.
- 0813NEW019 - townland Kilcolgan, depth 33.5 m, depth to rock 1.5 m, yield 26 m^3/day, use Agri & domestic.
- 0813NEW029 - townland Kilcolgan, depth 8.2 m, depth to rock 8.2 m, yield 8.7 m^3/day, use Agri & domestic.
- 0813NEW031 - townland Kilcolgan, depth 31.7 m, depth to rock 6.1 m, yield 15 m^3/day, use Agri & domestic.

It shall be noted that there is no requirement to register abstraction wells with the GSI and there may be other, unregistered wells in the vicinity of the Proposed Development site.

The MEL (2007) study identified two groundwater springs within the redline boundary of the Proposed Development. Springs SP-SW4 and SP-SW5 are both located just west of the proposed construction phase car parking/ laydown area and both flow westward towards the D2 Stream, a minor stream/ field drain on the Proposed Development site which flows northwest and then turns southwest and joins the larger Ralappane Stream (D1 stream) outside the site boundary (see Figure 6-1). These minor springs are not recorded on the GSI Wells and Springs database[2].

A larger 150 mm diameter 10 m deep bedrock well, PW01, installed in 2006, was located in an inferred bedrock fracture zone as a potential groundwater supply well for the then-proposed development, however a 28.6 hour pumping test from the 5.4 m bedrock section of the bore indicated a low bedrock permeability (reported as $1.05x10^{-5}$ m/s) and the well was estimated to have a long term yield of <1 L/s (litre per second), which was insufficient for the requirements of the proposed 2007 development (Arup, 2007). A 3 m drawdown was noted in well RC/ BH23, approximately 75 m to the northeast of PW01, during the PW01 pumping test, indicating good connectivity but poor storativity within the bedrock fracture network at the Proposed Development site.

Packer testing of site investigation boreholes at a site just west of the Proposed Development also reported low bedrock permeabilities (1 to 2.1 x10^{-6} m/s) (Arup, 2012).

6.5.8 Hydrology

6.5.8.1 Regional Hydrology

Regionally, the Proposed Development site lies at the western end of the Shannon Estuary South hydrometric area and Water Framework Directive catchment (hydrometric area 24 and WFD catchment 24). The major rivers in this catchment are the Deel (IE_SH_24D021400) and the Maigue (IE_SH_24M010980), 30 to 45 km east of the site. The overall Shannon Estuary South catchment encompasses an area of approximately 2,033 km^2.

The Proposed Development site lies within the Astee_West sub catchment of the Shannon Estuary South (WFD sub catchment name Astee_West_SC_010).

Approximately 1km west of the Proposed Development site, the short (<1km) Reenturk stream rises at a spring and flows generally west to enter the Shannon Estuary. The Ballyline River (IE_SH_24B030700, EPA name Ballylongford_020) is the principal surface water body to the west of the site; its closest tributary, the Glancullure North (IE_SH_24B030860), is approximately 2 km southwest of the Proposed Development site. The Ballyline River rises on higher ground approximately 6 km south of Ballylongford and flows in a northerly direction, joined by tributaries from east and west, and enters the Shannon Estuary north of Ballylongford, where it is termed Ballylongford Creek (IE_SH_24B030860).

To the east of the Proposed Development site, the Doonard Lower watercourse (IE_SH_24T010100) flows towards the northeast and enters the sea at Tarbert. At its closest point it is approximately 1.8 km from the south of the site and 380 m south of the source of the Ralappane River to the south east of the Proposed Development site.

Between Ardmore Point and Tarbert the short (<1km) Farranwana stream (IE_SH_24R300270) flows north to the Shannon Estuary

6.5.8.2 Local Hydrology

There is one minor watercourse on the Proposed Development site, the Ralappane Stream (IE_SH_24R300270) or D1 stream (MEL 2007 nomenclature), classified by EPA as a 3,498 m long Order 1 watercourse. The Ralappane Stream is not assigned a River Waterbody Status by EPA under the 2013-2018 River Basin Management Plan.

MEL carried out detailed mapping of site drainage during the 2007 survey (MEL, 2007 Section 4.5). Catchments, drainage patterns, drain dimensions, flow rates and surface water hydrochemistry were examined in detail in the field (see Figure 6-1).

The Proposed Development site is within two surface water catchments:

- **Catchment D1 -** The western part of the Proposed Development site where the access road and the western part of the parking/ lay down area are proposed to be located is within Catchment D1, which is drained by the Ralappane Stream (D1 Stream).
- **Shannon Estuary Sub-Catchment** - The north eastern portion of the Proposed Development site where the jetty and CCGT Power Plant is to be built are within the Shannon Estuary Sub-Catchment, which drains directly north to the Shannon Estuary coastline.

Catchment D1

Three significant drains were identified by MEL (2007) in the D1 Catchment in the immediate vicinity of the Proposed Development site. These are shown on Figure 6-1 and are named as follows:

- **D1** (named the Ralappane Stream on EPA maps) the main stream in the area – it passes through the southern end of the Proposed Development site, but is largely outside the Proposed Development site and flows parallel to the western edge of the site in a northwest direction via a tidal creek bordered by dense reed beds (forming part of the Lower River Shannon cSAC) to discharge to the Shannon Estuary;

- **D2** (secondary stream/ field drain north of D1) - enters the Proposed Development site from the east and flows towards the northwest through the Proposed Development site before turning southwest and flowing offsite to join the D1 stream to the west of the site; and
- **D3** (tertiary stream/ field drain north of D1) - enters the Proposed Development from the east and flows across the access road area and then offsite to the southwest to join the D1 stream to the west of the site.

Inflows in April/ May 2007 from the D2 stream (0.16 L/s) and D3 stream (0.04 L/s) to the D1 (Ralappane) Stream (average flow 14.87 L/s along stream) suggests that the D2 and D3 inflows are minor inputs to the D1 flow; however the April/ May 2007 monitoring is noted in MEL (2007) as having followed a period of sustained dry weather conditions in early April 2007.

Short streams D4 and D5 flow towards the southwest from springs SP-SW4 and SP-SW5 before joining the D2 stream in the west of the site.

Shannon Estuary Sub-Catchment

The Shannon Estuary Sub-Basin drains directly northward to the coast via overland and groundwater flow, with a number of short unnamed drainage channels crossing the Proposed Development in a generally northerly direction.

6.5.8.3 Flood Risk

According to the Office of Public Works (OPW) flood risk website[4], there is no history of flooding in the immediate vicinity of the Proposed Development site, although there are a number of records relating to recurring flooding associated with both coastal/ estuarine and runoff sources at Ballylongford, approximately 3.8 km west of the Proposed Development site, and recurring coastal/ estuarine flooding on the Ferry Road at Tarbert Island, approximately 4 km east of the Proposed Development site.

A Flood Risk Assessment (FRA) of the Proposed Development site, which is included in Vol. 4, Appendix 6-4, was carried out using a three-step approach:

- Stage 1 – Flood Risk Identification;
- Stage 2 – Initial Flood Risk Assessment; and
- Stage 3 – Detailed Flood Risk Assessment.

The information collated during Stage 1 – Flood Risk Identification and the subsequent Stage 2 – Initial Flood Risk Assessment was insufficient to assess the potential flood risk to the Proposed Development site. The proposals have been classified as 'Highly Vulnerable Development' and therefore their construction within either Flood Zone 'A' or Flood Zone 'B' requires the justification test to be passed.

The Stage 3 – Detailed Flood Risk Assessment involved the construction of a linked 1D-2D hydraulic model using 'Infoworks ICM' modelling software based on hydrographic and topographic survey information. Fluvial flow estimation was undertaken for the 50%, 1% and 0.1% Annual Exceedance Probability (AEP) events along with tidal level estimation for the 50%, 0.5% and 0.1% AEP events. Climate Change flows and levels were also derived for the Mid-Range Future Scenario (MRFS) and High-End Future Scenario (HEFS) in line with current OPW guidance. These flows and levels were subsequently applied to the model to obtain flood extents and levels. Both a baseline and proposed model were developed.

The model results showed that approximately 400 m at the downstream end of the model (Ralappane (D1) stream discharge to the Shannon Estuary) is tidally influenced with a sizeable area liable to tidal flooding, but this area is outside the Proposed Development area. A limited degree of fluvial flooding is present and limited to an area near and beyond the upstream site boundary. The extents of Flood Zone 'A' and Flood Zone 'B' have been determined based on the baseline model outputs.

With the exception of crossings of the watercourses for the access road, there is no development proposed within either Flood Zone 'A' or Flood Zone 'B' and therefore the Proposed Development has a negligible impact on the existing flood regime in the area. Given no development within either flood zone, the proposals are therefore seen to pass the justification test.

The proposed crossings of the watercourses within the Proposed Development have been adequately sized to have a minimal impact on the current hydraulic regime in the area (600 mm culvert (D3 stream

[4] www.floodinfo.ie

crossing), 1200 mm diameter culvert (D2 stream crossing) and 2.4 m x 3.0 m box culvert for the Ralappane (D1) stream crossing)). They also provide an adequate freeboard in accordance with current OPW guidelines for the 1% MRFS AEP fluvial event, which will be seen as an acceptable design flow event for culverts.

The access road levels will be profiled to drain road runoff to an engineered swale adjacent to the road, which will in turn drain northward to the engineered storm drainage system at the LNG Terminal and Power Plant site. There will be no discharge of road runoff to the Ralappane Stream or associated minor watercourses from the access road of from the developed area in the northeast of the Proposed development.

6.5.9 Regional Surface Water Quality

The EPA Quality Rating (Q-value) System has been used to indicate the ecological quality of streams and rivers based on biotic index in Ireland since 1971. River water quality has been provided by the EPA for the Ballyline River west of the Proposed Development site and unnamed river (IE_SH_24T010100) to the east.

The EPA[5] has classified the overall river water quality for the Ballyline River as Q4 – Good. Q-value results of monitoring at two hydrometric stations on the river located at Gortanacooka Br (Station Code RS24B030700, Q-value 3-4) and at Br SW of Shrone (Station Code RS24B030400, Q-value 3-4) both indicate Moderate WFD status, based on data for 2020. Both monitoring stations are located over 3 km west of the Proposed Development site.

River quality for an unnamed river (IE_SH_24T010100) has also been classified as Q4 -Good status based on data for 2017 at a hydrometric station upstream of Tarbert (Station Code RS24T010100), located over 3 km west of the Proposed Development site.

There is no EPA surface water quality data available for the Ralappane Stream (D1 stream) (IE_SH_24R300270) adjacent to the Proposed Development site. A monitoring location named RS24R300270 is shown on EPA mapping on the Ralappane Stream approximately 1.2km upstream of the Proposed Development, however both the EPA and Kerry County Council have indicated that they have no data on record for this location. The EPA has indicated (email dated 27th April 2021) that the Ralappane Stream, like many small streams, is likely to remain unmonitored and unclassified, as long as there is no discharge to it licensed by the Local Authority or EPA.

Transitional Water Quality data for the Lower Shannon Estuary (IE_SH_060_0300) for the period 2010-2012 indicated the estuary to be classified as Unpolluted.

6.5.10 Environmental Site Assessment 2020

6.5.10.1 Groundwater Flow Direction

Groundwater was sampled from 8 of the pre-existing wells on the Proposed Development site by AECOM on 5th and 7th February 2020.

Groundwater levels were measured in 25 wells or piezometer installed by previous site investigations. Groundwater was present in all overburden and bedrock monitoring wells, with depth to groundwater varying between 0.062 m below casing top (m bct) (BH23) and 5.608 m bct (BR-X), with depth to groundwater typically being less than 1 m bct.

Groundwater elevations ranged from 6.098 m OD (BR-6 P2) to 18.143 m OD (BH18).

An assessment of groundwater flow in 2007 by MEL (see Vol. 4, Appendix 6-1) indicated that groundwater flow within the bedrock unit in the north-eastern part of the Proposed Development site was to the north/ northwest towards the Shannon Estuary, in line with the local topographic gradient. Groundwater flow in the western and southern part of the Proposed Development site was generally westward towards the Ralappane Stream (D1 stream).

5 https://gis.epa.ie/EPAMaps/

The groundwater elevation data calculated from depth to water measurements collected in February 2020 and inferred groundwater contours for the bedrock wells are presented in Figure 6-3 below and supports this groundwater flow interpretation.

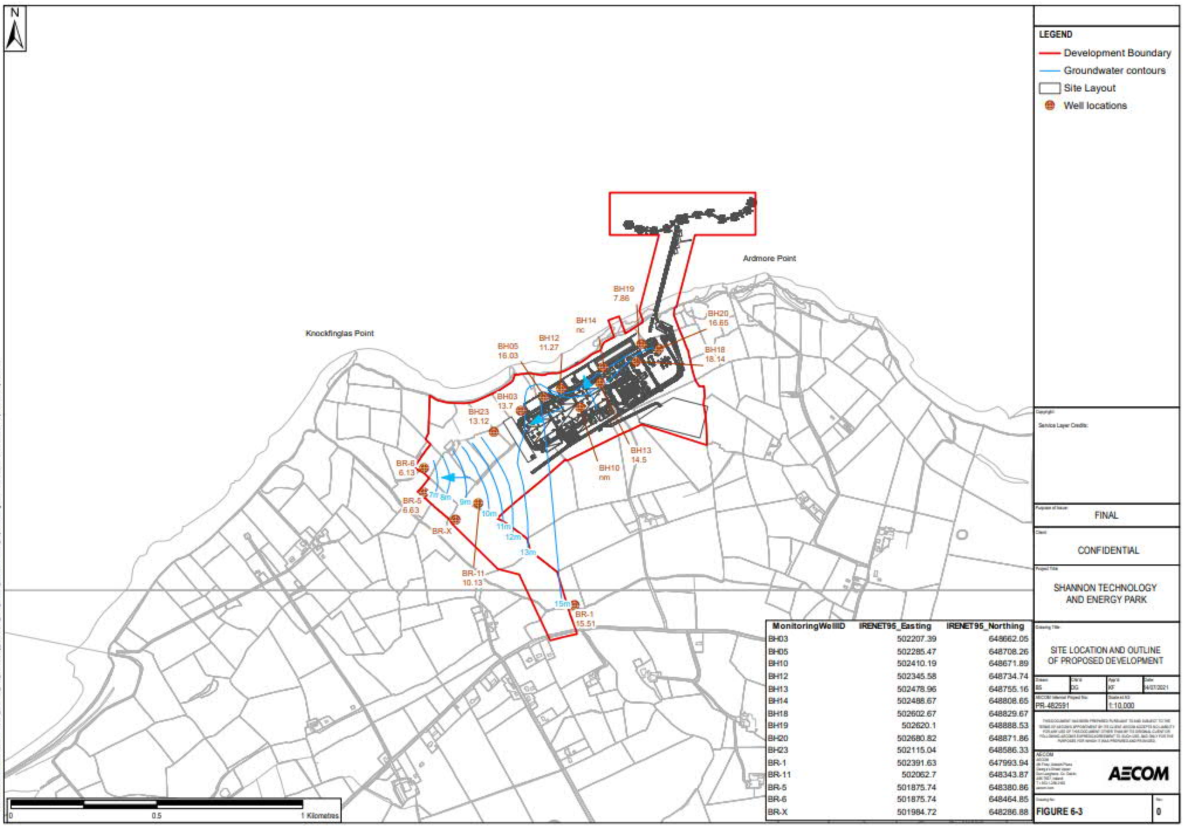


Figure 6-3 Groundwater Elevations and Contours – February 2020 Sampling Event

Bedrock well groundwater elevations in the northern areas of the Proposed Development site indicate generally northward groundwater flows inferred to discharge at the coast to the Shannon Estuary.

In the southern and western areas of the Proposed Development site, groundwater flows towards the main surface water features and generally westward or south-westward towards the Ralappane Stream (D1 stream).

In locations where there are nested piezometer installations in a single borehole, with monitoring zones in both the subsoils and the bedrock (locations BR-1, BR-5, BR-6, BR-11 and BR-X), the water levels in the different monitoring zones show varying vertical head gradients, with vertical upward groundwater head gradients from the deepest to shallowest zones at BR-5 and BR-11 (0.12 and 0.013, respectively) and vertically downward groundwater head gradients at BR-1, BR-6 and BR-X (ranging 0.03 to 0.044) under February 2020 (winter) groundwater conditions.

6.5.10.2 Groundwater Analytical Results

AECOM completed a supplementary Environmental Site Assessment (ESA) in February 2020, which involved the collection and laboratory analysis of groundwater samples and surface water samples within the Proposed Development site to supplement data for the wider area (MEL, 2007).

The supplementary ESA was completed in order to identify potential groundwater or surface water contamination issues which may have been associated with the Proposed Development site resulting from current or past uses of the site and surrounding land.

Sample locations are presented in Figure 6-1 and Volume 4, Appendix 6-2. Samples were delivered to an independent laboratory (EuroFins ELS in Cork) for analysis.

Groundwater Criteria

Appropriate generic assessment criteria were selected based on the Proposed Development site's environmental setting, which is summarised below:

- The bedrock aquifer beneath the Proposed Development site is classified by the GSI as a 'locally important aquifer which is moderately productive in local zones'.

Accordingly, groundwater analytical data were assessed using criteria from the following Irish legislative hierarchy:

- European Union Environmental Objectives (Groundwater) (Amendment) Regulations, 2016. S.I. No. 366 of 2016;
- European Communities Environmental Objectives (Groundwater) Regulations, 2010. S.I. No. 9 of 2010 (Groundwater Threshold Values, GTVs);
- European Union (Drinking Water) Regulations 2014. Statutory Instrument (S.I.) No. 122 of 2014 (Drinking Water Standards (DWS);
- European Communities Environmental Objectives (Drinking Water) Regulations, 2010. S.I. No. 106 of 2007 (Drinking Water Standards (DWS); and
- Environmental Protection Agency's Draft Interim Guidelines Values (IGVs) for the Protection of Groundwater, 2003.

It is assumed that groundwater beneath the Proposed Development site will not be abstracted for potable or production uses.

Tables comparing analytical results with relevant standards and guidance including Environmental Quality Standards (EQSs), IGV, GTV or DWS are provided in Volume 4, Appendix 6-2.

Groundwater Results Summary

Groundwater field readings of the unstable parameters pH, electrical conductivity (EC), temperature and redox potential were taken during the February 2020 sampling event. These parameters were all within the applicable statutory GTV ranges for groundwaters and are consistent with groundwater in a non-carbonate, non-saline aquifer (pH ranged from 6.27 to 8.75 pH units, EC ranged 201 to 553 microSiemens per centimetre, temperature 10.2 to 11.31 ^{o}C and redox ranged 142 to 369 milliVolts).

Groundwater analytical data was screened against generic assessment criteria (GAC) for a future commercial end use of the Proposed Development site and within the context of the site environmental setting. Constituent concentrations were deemed 'potentially significant' if they exceeded the 'generic' values, which is an approach consistent with the principles of human health protection in Irish EPA, UK DEFRA and UK Environment Agency guidance.

None of the groundwater parameters analysed exceeded surface water EQSs (European Union Environmental Objectives Regulations 2015, S.I. No. 386 of 2015), however there were exceedances of the other applicable environmental standards or guidance for certain parameters.

The analytical results indicated that background groundwater conditions at the Proposed Development site are locally impacted by some minor water quality issues:

- Petroleum-range hydrocarbons are detected in excess of IGV and/ or GTV guidance in wells BH05, BH19 and BH20 in the north of the Proposed Development site and in well BR-11 in the west of the Proposed Development site. No evidence of fuel hydrocarbon use or storage was observed on the Proposed Development site, therefore hydrocarbons in groundwater may either originate offsite (potentially related to fuel storage, road runoff or machinery maintenance) and migrate onto site via groundwater flow or be derived from breakdown and decay of organic material in vegetated, waterlogged areas of the Proposed Development site and surroundings.
- Dissolved iron and manganese exceed the DWS and IGV at numerous locations in groundwater; however, water at these locations is not used for potable purposes and the IGV is non-statutory guidance in relation to groundwaters. The most elevated dissolved iron and manganese results are associated with wells BH20 and BR-11, which also show the most elevated hydrocarbon results, suggesting that these most elevated dissolved iron and manganese results in groundwater are related to dissolution of iron and manganese from aquifer materials under anaerobic groundwater conditions resulting from biodegradation of the hydrocarbons in the environment.

- Sodium concentrations in groundwater and surface water are all less than 60 mg/l and generally less than 30 mg/l, so do not indicate that salinity is a significant impact on groundwater quality at the Proposed Development site, despite the site's proximity to the estuary.
- Other inorganic parameters (nitrate, phosphate, chloride, sulphate, alkalinity and total organic carbon) in groundwater were generally typical of surface waters in rural, coastal settings. Groundwater samples generally showed elevated phosphate concentrations (which exceeded the GTV by a factor of up to 4) and chloride concentrations (which exceeded either the GTV or IGV by a factor of up to 7 and reflect the site's marine coastal setting), but none of these inorganic parameters analysed in groundwater exceeded the DWS.

6.5.10.3 Surface Water Analytical Result

Surface Water Criteria

Appropriate generic assessment criteria were selected based on the Proposed Development site's environmental setting, which is summarised below:

- Three key watercourses, the Ralappane Stream (D1 stream), D2 Stream and D3 Stream, are identified on the Proposed Development site and numerous smaller field drains are present within the site boundary. The D2 and D3 streams join the D1 Stream and discharge to the Shannon Estuary 50 m west of the north-western site boundary.

As surface water streams are present at the Proposed Development site, analytical data from these was also assessed using criteria from the following Irish hierarchy:

- European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2015. S.I. No. 386 of 2015. Ireland - AA-EQS Inland/ MAC-EQS Inland;
- Ireland Freshwater EQS (AA/MAC) - European Communities Environmental Objectives (Surface Waters) Regs, 2009. S. I. No. 272 of 2009; European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations, 2010. S. I. No. 327 of 2012; and
- Environmental Protection Agency's Draft Interim Guidelines Values (IGVs) for the Protection of Groundwater, 2003 (EQS only).

Surface Water Analytical Results

Surface water data was screened against GAC for a future commercial end use of the Proposed Development site and within the context of the site environmental setting. Constituent concentrations were deemed 'potentially significant' if they exceeded the 'generic' values, which is an approach consistent with the principles of human health protection in Irish EPA, UK DEFRA and UK Environment Agency guidance.

None of the parameters analysed exceeded surface water EQSs (European Union Environmental Objectives Regulations 2015, S.I. No. 386 of 2015), however there were exceedances of the other applicable environmental standards or guidance for certain parameters.

The analytical results indicated that surface waters at the Proposed Development site are locally impacted by some minor water quality issues:

- Petroleum hydrocarbons were detected at surface water sample D1 SW in the south of the Proposed Development site, where the D1 stream enters the site, suggesting that the hydrocarbons at this location originate upstream of the site.
- Dissolved iron and manganese exceed the DWS at numerous locations in surface water, being highest at spring SP-SW4, which is located in a water-logged, heavily vegetated area, and the significantly elevated iron concentration here is likely related to anaerobic conditions caused by the pooled water and decaying vegetation, however water at these surface water locations is not used for potable purposes.
- Sodium concentrations in surface water are all less than 60 mg/l and generally less than 30 mg/l, so do not indicate that salinity is a significant impact on surface water quality at the Proposed Development site, despite the site's proximity to the estuary.
- Surface water samples show elevated dissolved organic carbon concentrations, generally less than 10 mg/l but are higher at spring SP-SW4 (60.28 mg/l), where it is likely related to slow moving water and decaying vegetation in the hollow where the spring is located.

- Other inorganic parameters (nitrate, phosphate, chloride, sulphate, alkalinity and total organic carbon) were generally typical of surface waters in rural, coastal settings. Surface water samples generally showed elevated phosphate concentrations (which exceeded the EQS by a factor of up to 2) and chloride concentrations (which do not exceed any surface water quality guidance, but reflect the site's proximity to the coast), but none of these inorganic parameters analysed exceeded the DWS.

6.5.11 Groundwater Conceptual Site Model

Rainfall onto the area of the Proposed Development site and the surrounding agricultural land infiltrates into the predominantly clayey soils on the site, providing recharge to the groundwater, or runoff into the streams crossing the site.

The clay till subsoils are frequently poorly drained and the Proposed Development site shows numerous poorly-drained or marshy areas, indicated by extensive growth of reeds, particularly in the western parts of the site. These low permeability tills restrict rainfall infiltration and act as a confining layer to the water-bearing bedrock unit beneath.

The sandstone/ siltstone bedrock is generally encountered at depths between 1 and 5 m bgl at the Proposed Development site. The upper few metres of bedrock of the bedrock are noted to be more weathered (typically the upper 2-3 m), showed groundwater strikes during drilling and the weathered bedrock horizon is considered to be principal lateral groundwater flow pathway, with short groundwater pathways either to the surface watercourses on and near the Proposed Development site or directly to the Shannon Estuary.

Bedrock at the Proposed Development site is generally unweathered below approximately 10-14 m bgl, with few, tight fractures and little groundwater movement reported, other than the deeper fracturing noted at location BR-1 in the south of the Proposed Development site.

Groundwater monitoring in February 2020 indicated that vertical groundwater head gradients at the Proposed Development site are variable and water level measurements in the bedrock wells indicate that groundwater flow in the north of the site is generally northward, discharging to the Shannon Estuary, and is generally westerly in the south and west of the site, discharging towards the surface water courses which ultimately enter the Ralappane Stream (D1 stream) adjacent to the western boundary of the Proposed Development site, which discharges to the Shannon Estuary via the protected wetland area.

Flood risk assessment indicates that the Proposed Development will have negligible impact on the existing flood regime in the area.

The only background water quality issues identified by the 2020 sampling event relate to:

- Localised detections of low concentrations of hydrocarbons in several monitoring wells in the north of the Proposed Development site and in a surface water sample from the south of the Proposed Development site. These hydrocarbon detections are potentially related to degradation of naturally-occurring organic material (decaying vegetation), to upgradient activity involving the use of fuel hydrocarbons (transport, domestic, agricultural or commercial fuel use) or to road runoff to the Ralappane Stream from the L1010 road);
- Elevated dissolved iron and manganese (likely due to anaerobic conditions in the subsoil and bedrock aquifers related to degradation of organic material);
- Elevated chloride (related to the site's coastal setting) and elevated phosphate; and
- Elevated total organic carbon at spring SP-SW4, which is likely to reflect the presence of slow-moving water and decaying vegetation in the hollow where the spring is located.

6.5.12 Summary of Baseline Conditions

A summary of the existing environment baseline conditions at the Proposed Development site is presented in Table 6-4 below.

Table 6-4 Summary of Baseline Conditions

Item	Description
Context	The Proposed Development site is agricultural land, which covers an area of approximately 41 hectares (excluding offshore elements). Historically efforts have been made to improve the agricultural standing of the land with a number of drainage channels constructed and deepened to improve drainage of the land. The land does not appear to have been intensively managed and is currently in use as pastureland. The adjacent marine environment is a designated marine conservation area and is an important marine mammal habitat and is classified as Unpolluted.
Character	The land is unpolluted agricultural land in an agricultural setting. Soil, groundwater and surface water was found to be unpolluted and the environment in the vicinity of the Proposed Development site is generally unpolluted other than pressures associated with its agricultural setting, i.e. some eutrophication (anaerobic conditions) in groundwater and surface water. The adjacent marine environment is classified as Unpolluted The Proposed Development site is surrounded by a mixture of agricultural land, rural housing, public highway and the Shannon Estuary. The Proposed Development site has shown no change in use or significant development since a previous extensive surface water assessment in 2007. There are no EPA Integrated Pollution Control or Industrial Emission licensed facilities within 1 km of the Proposed Development site.
Significance	The Proposed Development site consists of managed agricultural land in an agricultural setting which has shown no increased development since at least 2007. Land use of this nature is abundant within the local area, with agricultural land of a similar nature bounding the Proposed Development site to the south, east and west. The closest designated sites to the Proposed Development site are: • Special Areas of Conservation (cSAC) - Lower River Shannon cSAC - Site code 002165 – borders the entire site to the north and includes the wetland area along the Ralappane Stream (D1 stream) to the west of the site, the salt marsh further west of the site and fields immediately east of the site at Ardmore Point. • Proposed Natural Heritage Area (pNHA) – Ballylongford Bay pNHA – Site Code 001332 – west of Knockfinglas Point and includes the wetland area along the Ralappane Stream to the west of the site, the adjacent heathland and the salt marsh further west of the site. • Special Protection Area (SPA) – River Shannon and River Fergus Estuaries SPA – Site Code 004077 – borders the entire site to the north and includes a portion of the wetland area along the Ralappane Stream to the west of the site and the salt marsh further west of the site. According to the National Parks and Wildlife Service website, the onshore Proposed Development site has not been designated as either a pNHA or SAC. The offshore elements of the Proposed Development are within the Lower Shannon cSAC and the River Shannon and River Fergus Estuaries SPA.
Sensitivity	Ground conditions beneath the Proposed Development site generally consist of topsoil overlaying glacial till over mudstone, siltstone & sandstone bedrock of the Shannon Group, which is classified as a 'LI - locally important aquifer, which is moderately productive in local zones'. Glacial till was encountered beneath the Proposed Development site to depths of between 0.5 m bgl and 8.0 m bgl and the groundwater vulnerability beneath the Proposed Development site is classified as 'High to Extreme' due to the limited subsoil thickness in areas of the site. The Proposed Development site is not located within a groundwater drinking water protection area. A search of the GSI well database found no springs and a relatively small number of low-yielding groundwater abstraction wells between 1 and 2 km from the proposed Development site, though historical site investigation and AECOM's

Item	Description
	2020 sampling identified two springs on the site and there are numerous monitoring wells installed on the Proposed Development site. The monitoring wells on the Proposed Development site were assessed as generally having a poor yield during purging and sampling and a pumping test on bedrock trial abstraction well PW1 in 2006 had insufficient yield (<1 L/s) to meet the needs of the development. The Proposed Development site is drained by a number of short drainage channels which discharge either to the Ralappane Stream (D1 stream) or directly to the Shannon Estuary. The Ralappane Stream drains directly to the Shannon Estuary via a tidal wetland area and river water quality for the Ralappane Stream is not assessed by the EPA.

6.6 Characteristics of the Proposed Development Relating to Hydrology and Hydrogeology

6.6.1 Project Description

The Proposed Development is outlined in Chapter 02 – Project Description and comprises the following 5no. key elements:

- Floating Storage Regasification Unit (FSRU) including LNG Vaporisation Process Equipment, with visiting LNG Carrier moored on seaward side of FSRU;
- Jetty, access trestle with capacity to accommodate up to four tugs;
- Onshore support facilities, including a nitrogen generation facility, control room, guard house, workshop and maintenance buildings, instrument air generator, backup power generators and fire water system;
- Above Ground Installation (AGI) including odorization, metering and pressure control equipment; connecting to the already consented 26 km Shannon Pipeline; and
- Power Plant and Battery Energy Storage System (BESS) facility.

The onshore elements of the Proposed Development are to be constructed mainly at a platform level of 18 m OD in the north of the Proposed Development site.

6.6.2 Construction Activities

The overall construction duration of the Proposed Development will be approximately 32 months. The civil works of relevance to surface water and hydrogeology include the following activities:

- Preliminary enabling works, including clearance, levelling, site roads/ pedestrian access, establishment of lay-down and fabrication area and storm water attenuation ponds;
- Laying of foundations for plant and buildings; and
- Landscaping and reinstatement.

Based on the geotechnical site investigation, excavation to 18 m OD will be required to create the level platform for the LNG Terminal shore facilities and the Power Plant facility. A lower jetty access platform will be constructed at 9m OD and will be accessed via a roadway from the main platform level.

Approximately 480,000 m^3 of overburden soils and rock will be excavated and placed as fill across both the LNG facility and the Power Plant facility in the following construction scenario (each step of which will have an overall net zero cut/ fill balance) (note - the BESS may be built in conjunction with any of the CCGT units):

1. Initial Build (LNG Terminal) 280,000 m^3

2. CCGT Units 1 + 2 130,000 m^3

3. CCGT Unit 3 (+ BESS) 70,000 m^3

All excavated material will be used onsite and no import of soil is expected. Excess material is anticipated to be used in the laydown area, as engineering fill, as landscaping and for other uses throughout the Proposed Development site. It is expected that blasting will be required to excavate some of the rock, which cannot be removed by rock breaking equipment mounted on tracked excavators.

Based on previous geotechnical investigations, the jetties, mooring/ breasting dolphins and outlet structure will be constructed with approximately 203 steel piles inserted into the estuary bed.

The onshore buildings are generally proposed to comprise pre-engineered/ manufactured structural steel structures which may be founded directly on rock; through rock-socketed piles; or directly on shallow soils/ fill, dependent on the findings of geotechnical testing.

All drainage from the construction phase of the Proposed Development will be controlled and monitored as part of the discharge licence for construction surface water drainage for the Proposed Development from Kerry County Council (KCC) and associated planning conditions. Surface water runoff from the access road and construction areas and all storage of materials potentially hazardous to the aquatic environment will be managed to prevent discharges to the Ralappane Stream (D1 stream) or any uncontrolled discharges to the Shannon Estuary.

6.6.3 Operational Activities

During operation of the Proposed Development, ships carrying LNG will berth alongside the FSRU and unload directly to the FSRU. The LNG vaporisation process equipment to re-gasify the LNG to natural gas will be onboard the FSRU. LNG stored onboard the FSRU will be vapourised or regasified onboard the FSRU at the jetty, via a heat exchanger using seawater from the estuary as the heat source at a rate of up to 22,000 m^3/hr (at seawater temperatures <12 ^oC supplementary heating via gas-fired boilers on the FSRU will be used). Seawater used for regasification will be returned from the FSRU to the estuary via horizontal water jets below the water surface.

Some of the seawater intake will pass through an onboard electro-chlorination unit which produces sodium hypochlorite to be injected back into the sea water circulation system. This acts as a biocide to reduce and control biofouling on the internal pipework and heat exchangers.

Approximately 100 m^3/hr of seawater will also be required for the operation of the onboard freshwater generation plant.

The storage or use of hazardous materials onshore during the operational phase of the Proposed Development will be limited to:

- Diesel – Firewater pumps, black start generator and emergency generators will be powered by diesel which will be stored in bunded facilities;
- Chemical odorant – Odorant NB, a liquid odorant consisting of a tertiary butyl mercaptan (78-82%) and dimethyl sulphide (18-22%) which is classified as Toxic to the aquatic environment (Category 2) (Hazard Code H411) will be stored onshore in two bunded bulk tanks (each 22.7 m^3 capacity) at the AGI Gas Metering/ Odorization Area and will be injected into the gas stream under controlled conditions; and
- Minor quantities of maintenance oils, greases, lubricants, cleaning chemicals, etc. A designated chemical cage is included within the design of the proposed warehouse/ workshop building;

LNG itself is not considered to be a potential source of contamination to groundwater or surface waters, because in view of its extremely low vaporisation temperature (approximately -160°C) it will never be present as a liquid or solid under ambient conditions.

Fuel used for fired heaters and general domestic heating will be met by either withdrawing a small natural gas stream from the high pressure send-out or by using the compressed boil-off gas.

Ancillary construction will include access roads, internal roads, car parking, drainage, workshop, entrance security guardhouse, and landscaping. The internal road network will service access and egress for all site buildings.

6.6.4 Effluent

The Power Plant will generate several different process water effluent streams. Some of the Power Plant effluent streams (see Chapter 02 – Project Description) will either be collected and removed Offsite or be pumped or fall by gravity to the effluent sump, as follows:

- Water treatment process effluent – discharged via effluent sump;
- Steam cycle blowdown/ drains and condenser filter backwash– quenched, pH dosed and discharged via effluent sump;
- Auxiliary boiler blowdown/ drains and drain down of feed water, HRSG or auxiliary boiler systems - discharged via effluent sump;
- Turbine building drains – collected and removed offsite for disposal to an appropriate waste licensed facility; and
- Other process liquid wastes - gas turbine wash water effluent, closed cycle cooling water drain down, sludges from petroleum interceptors - collected and removed offsite for disposal to an appropriate waste licensed facility.

The effluent sump will be equipped with a continuous pH monitor and pH dosing equipment prior to discharge to the estuary. Process effluent discharge volumes are anticipated to be up to 47 m^3/hour.

6.6.5 Foul Sewage

Sanitary wastewater will be generated at three locations on the LNG Terminal site (the workshop/ warehouse building, the nitrogen package control room and the main control room) and at four locations in the Power Plant (the administration building, the central control/ operations building, the stores/ workshop/ canteen building and each turbine building).

The LNG Terminal and Power Plant areas will be served by a common waste water treatment plant (WWTP) and all sanitary effluent will be pumped or fall by gravity to the WWTP.

The WWTP will be a pre-engineered/ package biological treatment system that will treat effluent to required discharge standards required by the site's IE licence and will be designed to cater for 67 people. An average flow of 0.4 L/s (34.5 m^3/day) is expected to be discharged from the WWTP.

All treated effluent from the WWTP will be discharged to the Shannon Estuary via the same discharge point as the stormwater.

All sanitary effluent from the FSRU and tugs will be retained onboard and discharged ashore via vacuum lorry and taken offsite for treatment at a licensed facility. LNG carrier ships will not be permitted to unload sanitary effluent at the Proposed Development.

6.6.6 Storm Water Drainage

The proposed Shannon Technology and Energy Park development will have a total impermeable area of approximately 14 hectares including:

- Heater Building, electrical substations, heat exchangers, administration and security guardhouse buildings;
- Laydown and car parking area;
- Access road, Jetty road and footpaths;
- Lined outfall; and
- A percentage of the side slope and landscaping areas.

As part of the Proposed Development, a surface water drainage network consisting of piped drainage and swales/ catch basins will be constructed to collect, convey, and attenuate the surface water runoff generated.

It is proposed that all stormwater from paved and impermeable areas will be collected and discharged, directly to the Shannon Estuary via a discharge pipe that will extend across the foreshore to below the low water mark. All stormwater from paved and impermeable areas will pass through seven Class 1 hydrocarbon interceptors on the site, each serving particular drainage areas of potential concern on the site before joining the combined drainage system leading to the final discharge monitoring station and the surface water outfall to the estuary.

Stormwater collected from roof drains and permeable areas will discharge directly to the estuary via the final discharge monitoring station. All bunded areas within the Proposed Development site will have valved discharge points as part of their connection to the drainage network.

During the operations phase, all drainage from the Proposed Development site will be controlled and monitored in compliance with the terms of the IE licence.

The Proposed Development has an area of 41 ha (excluding the offshore elements), with the balance of the lands being retained as open grassland to the south and west other than the access road.

The area of the existing site that currently discharges to the Ralappane Stream is approximately 34 ha, while the area of the existing site currently discharging northward directly to the estuary is approximately 14 ha.

The stormwater discharge rate calculated is 162 L/s/ha, which equates to a total discharge rate of approximately 3,125 L/s peak flow from the Proposed Development site for a 100 year, 24 hour rainfall event using an SCS curve number approach. Greenfield runoff rates are not applicable to the Proposed Development, as the stormwater discharge is directly to the estuary and not to a watercourse that may cause flooding of the downstream catchment[6].

Groundwater seepages from springs or at the toe of cut slopes will be collected via a groundwater drainage network which will then discharge directly to the Shannon Estuary via the same discharge outfall pipe as the surface water.

Silt traps will also be incorporated into all groundwater drainage system prior to discharge.

6.6.7 Water Supply

The construction phase for the Proposed Development will require a water supply typically in the range 40 to 55 m^3/day (see Chapter 02 – Project Description) however hydrotesting of tanks and pipework will require a short term (up to 5 days) water supply in excess of 110 m^3/day.

A fresh water/ potable water supply will be required during the operational phase of the Proposed Development, as follows:

- Site-based Staff and visitors – 3.6 m^3/day ; and
- Process Water – ranging between 10 m^3/hr and 32.25 m^3/hr (240 m^3/day to 774 m^3/day); and
- Fire water supply – non-continuous - to fill or top up onsite firewater storage tanks periodically.

Potable and service water for the operational phase of the Proposed Development will be purchased from Irish Water, supplied from a connection to an upgraded 200mm mains water supply to be constructed by KCC along the L1010 (Coast Road from Ballylongford).

Irish Water have confirmed (email dated 9th June 2021) that the source supply for the area does have the capacity to supply the demand for the Proposed Development.

6.6.8 Flood Risk

The Stage 3 – Detailed Flood Risk Assessment concluded that with the exception of crossings of the watercourses for the access road, there is no development proposed within either Flood Zone ‘A’ or

[6] http://geoservergisweb2.hrwallingford.co.uk/uksd/irish_suds/guidance_criteria.htm#Estuary

Flood Zone 'B' and therefore the Proposed Development, including the excavations required for the terminal and power station platform, has a negligible impact on the existing flood regime in the area.

The proposed crossings of the watercourses within the Proposed Development site have been adequately sized to have a minimal impact on the existing hydraulic regime in the area to the Ralappane Stream.

6.7 Embedded Mitigation Measures

The assessment of impacts assumes the implementation of embedded mitigation measures, as set out in Chapter 2 - Project Description. These will include:

- Separation of drainage from paved and other impermeable areas from other stormwater drainage;
- The provision of an attenuation system for stormwater runoff from paved/ impermeable areas, including silt traps and a Class 1 interceptor fitted with control valves;
- A firewater retention basin and associated stormwater diversion infrastructure;
- Dedicated process effluent and sanitary drainage and treatment systems; and
- Provision of designated bunded storage facilities for potentially-contaminating chemicals and fuels.

6.8 Assessment of Impact and Effect

The Proposed Development can give rise to potential impacts on the drainage regime and hydrology of the Proposed Development site both during the construction and operational phases as outlined below.

Due to the inter-relationship between land, soils and water (hydrology), the following impacts are considered applicable to Chapter 5 - Soils and Geology. Chapter 16 - Waste Management is also considered to comprise an interaction.

6.8.1 Construction Phase

Excavation and infilling of soil and subsoil will be required for levelling of the Proposed Development site to render it suitable for building the LNG Terminal platform and to construct the access roadway and associated swale draining road runoff to the platform area.

Beneath the proposed Terminal platform, a process of 'cut and fill' will be employed in order to level the footprint of the proposed process infrastructure and buildings and achieve the desired platform level of 18 m OD from which to commence construction works. Outside of the Terminal footprint 'cut and fill' will also be undertaken in order to construct roadways, facilitate firewater retention pond construction and achieve desired ground levels across the Proposed Development.

The civil works which may impinge upon the water environment will comprise the following activities:

- Preliminary works, including clearance, levelling, site roads/ pedestrian access, establishment of lay-down and fabrication area and firewater retention pond;
- Laying of foundations for plant and buildings; and
- Landscaping and reinstatement.

The risk of potential significant impacts occurring during the construction phase (in the absence of adequate management and mitigation measures) can arise from a range of activities , principally:

- Discharge of vehicle wash-down water;
- Discharge of construction materials, e.g. uncured concrete;
- Uncontained spillage of wastewater effluent;
- Uncontrolled sediment erosion and contaminated silty runoff;
- Construction vehicle refuelling areas and chemical and waste storage or handling areas;

- Polluted drainage and discharges from site;
- Changes to the existing drainage network including interception and redirection of natural and artificial watercourses (e.g. drainage channels);
- Discharge of groundwater to surface water at platform level due to natural springs or man-made spring lines due to topographical changes (cuttings);
- Increased runoff from cleared areas;
- Watercourse crossings;
- Construction works within water; and
- Outfall points.

Groundwater vulnerability beneath the Proposed Development site is classified as 'Low'. However, removal of the relatively thin soil cover will slightly increase the vulnerability to underlying bedrock aquifer.

During construction, pollution from elevated alkalinity (relating to use of concrete/ cement) and mobilised suspended solids from excavation and piling will generally be the prime concerns, but spillage of fuels, lubricants, hydraulic fluids and cement from construction plant may lead to incidents, especially where there are inadequate pollution mitigation measures.

6.8.1.1 Dewatering Due to Cuttings

The construction of cut faces into bedrock due to excavation for the 18 m platform will lead to seepage of groundwater into the excavation/ platform area from upgradient areas. The rate of seepage is anticipated to be low, due to the presence of clay-dominated soils and the relatively low permeability sandstone bedrock, as indicated by the unproductive pumping test at well PW1. Localised dewatering of the bedrock within 10-50 m of the cut faces of the excavation is anticipated; however, as all groundwater in the bedrock aquifer in this area is flowing towards the Shannon Estuary under baseline conditions, the interception and discharge of groundwater discharging to the platform area of the Proposed Development will not lead to a net change to the quantities of groundwater ultimately discharging to the Shannon Estuary from this portion of the Proposed Development site.

Localised dewatering due to cuttings will result in a **permanent direct** effect on water levels and runoff volumes of **neutral** quality which will have an **imperceptible** effect on the character of the environment but is certain to occur and **irreversible**. This is considered to be a **moderate** effect on a groundwater environment of **low** sensitivity and the significance of the effect is considered **slight.**

6.8.1.2 Sedimentation (Suspended Solids)

Pollution of surface waters by mobilised suspended solids can have significant adverse ecological effects. Various construction activities have the potential to release sediment and cause unacceptable SS levels in the catchment area. Site stripping and bulk earthworks as part of landscaping and building and infrastructure construction will leave substrates exposed to erosion by wind or rain and this can potentially lead to increases in sediment loading of the drainage network or direct runoff to the estuary or to the Ralappane Stream and its tributaries. Contamination from suspended sediments may also be caused by runoff from material stockpiles.

Runoff containing large amounts of suspended solids can adversely impact on surface water. The impact of runoff is considered a temporary effect, as it is only associated with certain phases of the 32 month construction programme.

Control of runoff and release of suspended sediment from construction activities will be managed under the Outline Construction Environmental Management Plan (OCEMP); therefore, uncontrolled runoff containing large amounts of suspended solids is considered unlikely to occur and, should it occur, is likely to be infrequent and short-term. Therefore, it is considered to be a temporary **small adverse** effect to an **extremely high** sensitivity surface water environment (estuary) and the significance of the impact is considered **significant**.

Piling and construction operations in the near-offshore area for the jetty and outfall pipe have the potential to generate suspended sediment, which can travel with marine currents, be deposited elsewhere and can adversely impact aquatic habitat quality. Hydrodynamic modelling of marine sediment transport due to offshore piling has been conducted using Telemache software, assuming

10% loss of material (2,225 tonnes) from the installation of bored piles into the bedrock using a reverse circulation drilling technique over a 90 day continuous piling programme. This modelling is reported in Chapter 7A and Appendix A7A-5, Vol. 4 and indicates that suspended sediments will be dispersed laterally along the coastline by tidal currents, extending to the east of Tarbert at high tide and extending over 10 km downstream in the estuary under low water conditions. The model predicts sediment deposition rates in this area would be low, less than 0.01 mm per square metre across the majority of the suspended sediment deposition area, other than a localised area up to 0.2 mm per square metre on the east side of Ballylongford Bay, which is regarded as insignificant in relation to OSPAR guidance on sediment deposition (see Chapter 07A – Section 7.5.4.2). Piling operations are therefore considered to be a temporary **small adverse** effect to an **extremely high** sensitivity surface water environment (estuary) and the significance of the impact is considered **significant**.

6.8.1.3 Accidental Spillage and Leaks

Any construction activities carried out close to surface waters involve a risk of pollution due to accidental spillage and leaks. While liquids such as oils, lubricants, paints, bituminous coatings, preservatives and weed killers present the greatest risk, fuel spillages from machinery operating close to watercourses or the estuary also present a risk. The refuelling of general construction plant also poses a significant risk of pollution, depending on how and where it is carried out. Pollution as a result of accidental spillage can potentially affect fish, aquatic flora and can also have an effect on invertebrate communities.

As main site works are generally located within the area of moderate to high vulnerability due to its proximity to the estuary, fuels or chemicals, if inappropriately handled or stored, during construction can potentially impact on surface water quality in the estuary adjacent to the Proposed Development site.

Accidental spillage may result in the indirect impact to surface water at the Proposed Development site shall contaminants enter surface waters directly or migrate through the subsoils/ bedrock and underlying groundwater to surface waters. The impact is considered a direct effect of a negative nature and temporary duration, given it is only associated with one-off events during the construction programme.

Measures to prevent accidental spillages and leaks will be implemented in accordance with the OCEMP and are considered unlikely to occur and, shall they occur, are likely to be a temporary direct small adverse effect.

Therefore, accidental spillage and leaks during the construction phase is considered to be a **small adverse** effect to an **extremely high** sensitivity surface water environment (Lower River Shannon cSAC) and the significance of the effect is **significant**.

6.8.1.4 Use of Concrete and Lime

Lime and concrete (specifically, the cement component) are highly alkaline and any spillage can enter surface water directly or migrates though subsoils and groundwater impacting surface water quality. The activities most likely to result in contamination include piling and pouring of concrete foundations during building construction, roadway construction and construction of concrete culverts and watercourse crossings.

The impact is considered a direct effect of a negative nature and of a temporary duration given it is only associated with the construction programme. Impacts associated with the use of concrete and lime are considered unlikely to occur and, should they occur, are likely to be rare events of short duration. Therefore, the construction phase use of lime and concrete is considered to result in a temporary **small adverse** effect to an **extremely high** sensitivity surface water environment (Lower River Shannon cSAC) and the significance of the effect is **significant**.

6.8.1.5 Piling activities for Jetty and Outfall Construction

Due to the presence of shallow bedrock, the piles for the jetty and surface water outfall structures' foundations will be drilled and socketed into the rock. This operation will require a jack-up platform supporting a large crane-mounted drill and a large barge-mounted support crane. Spoils from the drilling operation will be conveyed to the surface via reverse-circulation through the drill stem and contained within designated scows or other vessels. Transport and deposition of suspended sediment caused by piling operations is discussed in Section 6.8.1.2. Follow-on construction work will maximise the use of precast concrete elements, such as pile caps, beams, and deck planks, to minimize in-water construction. Any in-situ concrete work will be staged in a manner to prevent concrete from entering the water.

Piling activities are therefore considered to result in a **small adverse** effect on an **extremely high** sensitivity environment (Lower River Shannon cSAC) and the significance of effects is **significant.**

6.8.2 Operational Phase

Potential adverse impacts which can occur due to unplanned events during the operational phase, in the absence of adequate management and mitigation measures, are as follows:

- Uncontained spillage of wastewater effluent;
- Uncontained spillage of polluting materials stored onsite, e.g. diesel fuel, glycol heat transfer fluid or oil, cleaning chemicals and lubricants for maintenance;
- Excessive demand on the water main/ water network resulting in reduced supply or loss of pressure in the surrounding area;
- Potential flooding of the Proposed Development site resulting in contaminated floodwaters;
- Siltation of storm water drainage system and attenuation ponds; and
- Emergency overflow discharge from the foul sewage networks.

Direct discharges to the water environment during the operational phase will consist of the following:

- Surface water runoff from paved/ impermeable areas of the Shannon Technology and Energy Park and access road will be collected via a dedicated, sealed storm drainage network, which will pass through a silt trap and Class 1 hydrocarbon interceptor, and discharge to the shared constructed outfall to the Shannon Estuary. The resulting discharge will be similar in composition and will have similar flow rates to existing drainage, which discharges directly from the agricultural lands to the Ralappane Stream and the Shannon Estuary. On this basis it is not envisaged that the surface water discharge will have an adverse impact on receiving water bodies;
- Groundwater discharging to the excavated area of the Proposed Development will be intercepted at the toe of the cut faces by drains and will be discharged to the Shannon Estuary via the storm water outfall, but will not lead to a net change to the quantities of groundwater ultimately discharging to the Shannon Estuary from this portion of the Proposed Development site;
- A minor portion of surface water from the immediate vicinity of the streams will enter directly through overland flow;
- Surface water from undeveloped areas in the west and south of the Proposed Development site will continue to discharge to the existing drainage ditch network, other than the access road runoff, which will be routed to the storm water drains serving the paved/ impermeable area of the developed area;
- Drainage from unpaved/ permeable areas of the developed area will be collected via a separate storm drainage network consisting of swales and catch basins and discharge directly to the shared constructed outfall to the Shannon Estuary;
- All foul water generated at the onshore part of the Proposed Development will be pumped or fall by gravity to a single WWTP onsite. The WWTP will be a package treatment system which will treat the effluent to required discharge standards. The WWTP will be sized to cater for a population of approximately 67 people. The treated effluent will be discharged to the estuary via the same discharge outfall pipe as the surface water. All sanitary effluent from the FSRU will be retained onboard and discharged ashore via vacuum lorry to a licensed waste facility;
- Process effluent streams principally comprising process water treatment effluent, steam cycle blowdown/ drains and auxiliary boiler blowdown/ drains will be collected separately, monitored and, if necessary, treated before being discharged to the effluent sump prior to discharge to the shared constructed outfall to the Shannon Estuary; and
- Other process effluent streams comprising Turbine Building Floor Drains and other liquid wastes not suitable for discharge to surface water will be collected and removed from site to an appropriate licenced waste facility.

6.8.2.1 Hazardous Materials Storage

The storage or use of materials hazardous to the aquatic environment during the operational phase of the Proposed Development will be limited to:

- Diesel – The firewater pumps, black start generator and emergency generators will be fuelled by diesel which will be stored in bunded facilities;
- Chemical odorant – Odorant NB, a liquid odorant consisting of a tertiary butyl mercaptan (78-82%) and dimethyl sulphide (18-22%) which is classified as Toxic to the aquatic environment (Category 2) (Hazard Code H411) will be stored onshore in two bunded bulk tanks (each 22.7 m^3 capacity) at the AGI Gas Metering/ Odorization Area and will be injected into the gas stream under controlled conditions; and
- Minor quantities of maintenance oils, greases, lubricants, cleaning chemicals, etc. A designated chemical cage is included within the design of the proposed warehouse/ workshop building.

LNG itself is not considered to be a potential source of contamination to groundwater or surface waters, because in view of its extremely low vaporisation temperature (approximately -160°C) it will never be present as a liquid or solid under ambient conditions.

The storage of materials hazardous to the aquatic environment during the operational phase will be in secondary contained areas, such as fixed or mobile bunds, and will be controlled in accordance with any IE licence conditions; therefore the risk of accidental discharge during storage or use of materials hazardous to the aquatic environment during the operational phase will be considered to result in a **small adverse** effect to an **extremely high** sensitivity surface water environment (Lower River Shannon cSAC) and the significance of the effect is **significant**.

6.8.2.2 Accidental Spillage and Leaks

Accidental spills and leaks are considered to be direct impacts of a negative nature and of a temporary duration given that they will be confined to one-off releases. Measures incorporated by design into the building will minimise the risk of spills entering surface waters and the potential for spills impacting on surface water is considered unlikely arising from rare events. Accidental spills and leaks are therefore considered to result in **small adverse** effect on an **extremely high** sensitivity environment (Lower River Shannon cSAC) therefore the significance of potential effects is **significant.**

6.8.2.3 Flooding and Drainage

The Stage 3 – Detailed Flood Risk Assessment (see Vol. 4, Appendix 6-3) concluded that with the exception of crossings of the watercourses for the access road, there is no development proposed within either Flood Zone ‘A’ or Flood Zone ‘B’ and therefore the Proposed Development has a negligible impact on the existing flood regime in the area.

The proposed crossings of the watercourses within the Proposed Development will be adequately sized at detailed design stage to have a minimal impact on the existing hydraulic regime in the area draining to the Ralappane Stream.

The LNG Terminal and Power Plant site will have a constructed stormwater drainage system capable of handling anticipated stormwater volumes (up to be 162 L/s/ha (3,125 L/s) for a 100 year, 24 hour rain event) and which will incorporate monitoring equipment and firewater retention facilities.

Impacts from flooding and drainage are considered to be unlikely arising from rare events resulting in a **small adverse** effect on an **extremely high** sensitivity environment (Lower River Shannon cSAC) therefore the significance of potential effects is **significant**.

6.8.2.4 Combined Operational Stormwater, Sanitary and Process Effluent Discharges to Surface Water

The combined stormwater flows and treated sanitary effluent and process effluent from the Proposed Development will be discharged via a common outfall to the estuary below low tide level. The potential impact of this discharge on the marine environment is discussed under Chapter 7 - Biodiversity. The Surface Water Outfall pipeline outflow will be monitored prior to the discharge point for a range of parameters at frequencies specified under the site’s IE licence and will allow for retention of the combined effluent stream in the Fire Water Retention Pond in the event of exceedances of the allowed Emission Limit Values under the IE licence. An average flow of 0.4 L/s (34.5 m^3/day) is expected to be discharged from the WWTP via the outfall pipe.

3-D hydrodynamic modelling of the wastewater discharge plume in the estuary using Telemache software has indicated negligible impact on the estuary, because of significant dilution and dispersion will occur due to the high water volume and tidal flux in the estuary. Modelling of water flow and direction for a flooding tide and mid-ebb tide indicates predominantly east-west water flow beyond a distance of approximately 250 m offshore.

Suspended sediment (see piling discussion in Section 6.8.1.2) and treated effluent (modelled as E. Coli bacteria) are predicted by the hydrodynamic modelling to undergo extremely high levels of dilution and dispersion within a short distance (approximately 1 km) of the site. Also, the predicted current directions on the ebb tide indicate little or no interaction of the outfall or FRSU discharges from the site with intertidal or subtidal habitats or species in the estuary, including the SCA, SPA, pNHA and the oyster production sites in inner Ballylongford Bay (see Chapter 07A – Marine Biodiversity). Maximum predicted E. coli concentrations from the site wastewater discharge are predicted to decline to below 1 per 100 ml before reaching either Tarbert Island or inner Ballylongford Bay.

Operational discharges to the estuary will be controlled under the site's IE licence and the operational phase Environmental Management Plan. Impacts from site drainage are considered to be unlikely, arising from rare events, resulting in a **small adverse** effect on an **extremely high** sensitivity environment (Lower River Shannon cSAC) and the significance of potential impacts is **significant**.

6.8.2.5 Discharges from FSRU Operations

Seawater used for regasification will be returned from the FSRU to the estuary at up to 8 ºC colder than the receiving ambient seawater. The cold water discharge from the FSRU to the estuary has been modelled using Telemache software and indicated negligible impact on the estuary, because of significant dilution and dispersion due to the high water volume and tidal flux in the estuary.

Cold water discharges from the FSRU were modelled as 8 ºC below ambient seawater temperature at a rate of up to 22,000 m^3/hr) and indicated that the cold water plume parallels the coastline and dissipates quickly (< 0.5 ºC below ambient seawater temperature within 200m of the discharge point and <0.1 ºC within 3 km of the discharge point). A plume at between 0.01 and 0.05 ºC below ambient seawater temperature was modelled throughout the water column (from the surface to the bottom layer) and extending west from the discharge point at the FSRU at mid-ebb and low water on a spring tide to the north of Carrick Island (>4km from the discharge point). The maximum reduction in temperature within the Ballylongford Bay area is between 0.05 and 0.1 ºC, which is insignificant and is not predicted by the model to impact the oyster production sites in the bay (see Chapter 07A – Marine Biodiversity).

Similarly, a plume at between 0.01 and 0.05 ºC below ambient seawater temperature extends >3km east of the discharge point at mid-flood and high water on a spring tide.

Seawater returned to the estuary from the seawater circulation system will contain residual chlorine from sodium hypochlorite used as a biocide. The concentration of residual chlorine at the FSRU seawater discharge will be monitored and will not exceed 0.5 mg/L. Modelling indicates it will undergo significant and rapid dilution and dispersion in the estuary. Maximum residual chlorine concentration above 0.1mg/l are shown to occur only within 20m of the FRSU discharge point and for a short period of time. Within 1.5km both east and west of the discharge point the predicted maximum residual chlorine concentration is predicted to decline to less than 0.01mg/l and is assessed as being negligible/undetectable (see Chapter 07A – Marine Biodiversity).

Approximately 100 m^3/hr of seawater will also be required for the operation of the onboard freshwater generation plant. The reject stream from these freshwater generators will have elevated salt content and will be discharged to the estuary from the FSRU and will undergo significant and rapid dilution and dispersion, similar to the other FSRU discharges to the estuary.

Discharges from FSRU operations are therefore considered to result in a **small adverse** effect on an **extremely high** sensitivity environment (Lower River Shannon cSAC); therefore, the significance of potential effects is **significant.**

6.9 Cumulative Impacts and Effects

The cumulative impacts of the Proposed Development and nearby consented projects in the vicinity of the Proposed Development are discussed below. A planning search of granted and pending planning applications made within the vicinity of the Proposed Development site is presented in Chapter 4 - Planning and Development.

6.9.1 Summary of Schemes Considered in Cumulative Impact Assessment

6.9.1.1 LNG Pipeline

Permission was granted in 2009 for a pipeline to connect the Proposed Development site to the existing national gas network near Foynes, Co. Limerick. The application was accompanied by an EIAR.

No significant residual effects were identified to hydrogeology and surface water in the EIAR for the LNG pipeline.

6.9.1.2 Data Centre Campus

As part of the Masterplan, a Data Centre Campus is to be constructed to the west of the Proposed Development. This will be subject to its own EIAR and planning application.

6.9.1.3 220 kV and Medium Voltage (10/ 20 kV) Power Transmission Networks

An application to connect to the national electrical transmission network via a 220 kV high voltage connection was submitted to EirGrid in September 2020. An offer has yet to be received. It is expected that the high voltage connection will run 5 km east under the L1010 road to the ESBN/ EirGrid Kilpaddoge 220 kV substation.

The LNG Terminal may need to be operational before the Power Plant and/ or 220 kV high voltage grid connection are completed or operational (Chapter 02 – Project Description). Therefore, the LNG Terminal design will also require an onsite substation and a separate medium voltage (10/ 20 kV) connection, from the existing Electricity Supply Board Networks (ESBN)/ EirGrid Kilpaddoge substation. This will be used as a back-up electricity system when the Power Plant is undergoing maintenance.

The medium voltage (10/ 20 kV) and 220 kV power connections will be constructed in parallel with the Proposed Development but will be subject to separate planning design and planning applications.

6.9.1.4 Construction Impact

If works associated with these three schemes (described above) in close proximity to the Proposed Development are concurrent with works at the Proposed Development, there is potential for cumulative impacts and effects on surface water and groundwater features, notably the Ralappane Stream and associated protected habitats. Should this situation arise, construction activities will be planned and phased, in consultation with the construction management team for the Shannon Technology and Energy Park.. As outlined in Section 6.10 , mitigation measures proposed to manage and control potential impacts during the Proposed Development will reduce the magnitude and significance of effects to a minimum.

Taking account of mitigation measures proposed, the cumulative effect of all schemes proceeding simultaneously is considered to be a **negligible** impact to an **extremely high** sensitivity environment and the significance of the effect has been assessed as **imperceptible**.

6.9.1.5 Operational Impacts

Potential impacts from consented development elsewhere, combined with the potential impacts of the Proposed Development, can result in a temporary minor adverse impact to water supply.

Irish Water have confirmed that there is sufficient capacity to supply drinking water and process water to the Proposed Development. There is no requirement for sanitary and process effluent discharge to a local sewerage network (due to the onsite wastewater treatment proposed and the onsite containment of selected effluent streams for Offsite disposal).

Potential effects to surface water and groundwater from the Proposed Development range from **small to moderate** and mitigation measures proposed to manage and control potential impacts during operation will further reduce the magnitude and significance of effects. Potential impacts primarily relate to accidental releases, which on independent sites cannot be considered to be cumulative. Therefore, the cumulative operational effect of the Proposed Development and other consented or potential developments in the vicinity surface water and groundwater is considered to be **imperceptible**.

6.10 Mitigation and Monitoring Measures

6.10.1 Construction Phase

6.10.1.1 Construction Environmental Management Plan

An Outline Construction Environmental Management Plan (OCEMP) has been prepared as part of this application. The contractor will prepare and implement a Construction Environmental Management Plan (CEMP) for the Proposed Development during the construction phase. This will incorporate relevant environmental avoidance or mitigation measures to minimise potential environmental impact of the construction works. It will cover all potentially polluting activities and include an emergency response procedure. All personnel working on the Proposed Development site will be trained in the implementation of the procedures. The CEMP will be reviewed and updated on a regular basis and modified and extended by any relevant construction related requirements imposed as conditions of any planning permission granted.

The CEMP will include a Waste Management Plan (WMP) (see Appendix A16-1, Vol.4 for the OCEMP), to be prepared in accordance with Department of Environment, Community & Local Government guidelines (DoEHLG, 2006) and an Oil and Hazardous and Noxious Substances Plan (Appendix A2-5, Vol. 4). It will also include details of environmental monitoring to be implemented for the duration of the construction works.

6.10.1.2 Soil Removal and Compaction

Temporary storage of soil and stone will be carefully managed in such a way as to prevent potential negative impact on the receiving environment. Spoil and temporary stockpiles including stone stockpile areas will be positioned in locations which are distant from the shoreline, drainage systems and retained drainage channels and away from areas subject to flooding, so as not to cause potential silt runoff to surface waters. Stockpiles will be managed to prevent dust generation during dry weather. The CEMP will outline proposals for the excavation and management of excavated material. Movement of material will be minimised in order to reduce degradation of soil structure and generation of dust. Further detail on mitigation measures in relation to soil management is given in Chapter 5 - Land and Soils.

6.10.1.3 Bedrock Excavation

Where bedrock is to be removed as part of the cut/ fill exercise onsite, it is anticipated that rock breaking and blasting may be required to achieve the 18 m OD formation level. Mitigation measures relating to the associated noise impacts are set out in Chapter 9 - Noise & Vibration. Excavation of bedrock to 18 m OD will be below the pre-construction groundwater level in some areas of the Proposed Development site and will result in discharges of groundwater from the cut faces. This will be routed via the stormwater drainage system at platform level, as described below.

6.10.1.4 Surface Water/ Storm Water

During the construction phase the mitigation measures will ensure that no sediment contamination, contaminated runoff or untreated wastewater will enter watercourses on or near the Proposed Development site. Drainage channels and water streams will be clearly identified onsite and shown on method statements and site plans.

Groundwater from the upgradient area to the south discharging onto the main construction site at the cut faces to the south, east and west of the 18 m platform will be intercepted by drainage at the toe of the slopes and diverted away from the active construction areas, to the extent possible. In case of impact by construction activity and machinery, this groundwater will pass through a sediment trap and oil: water separator prior to discharge under licence to the estuary via the outfall.

Temporary surface water drainage and silt ponds will be constructed to control runoff from the earthwork stages. Drains carrying high sediment load will be diverted through silt ponds, located between the construction area and the surface water outfall. Surface water runoff from working areas will not be allowed to discharge directly to the local watercourses or to the estuary. To achieve this, the drainage system and silt ponds will be constructed prior to the commencement of major site works. All design and construction will be carried out in accordance with the Construction Industry Research and Information Association (CIRIA) C532 Control of Water Pollution from Construction Sites Guidance for Consultants and Contractors (CIRIA, 2001). During the construction activities there will be a requirement for diverting rainwater runoff away from the construction areas, into the nearby estuary. Rainwater runoff will be treated to prevent sediment from entering the estuary. Discharge water quality targets will be agreed with KCC and included in the CEMP. Regular water inspection and sampling regimes will be put in place via the CEMP on the foreshore during construction activity onsite to monitoring compliance with the discharge conditions.

Where possible, excavations will only remain open for limited time periods to reduce groundwater ingress and water containing silt will be passed through a settlement tank/ silt pond or adequate filtration system prior to discharge. Discharge consent under the CEMP will be obtained for disposal of ground water arising from pumping or such water may be disposed of as construction site runoff, having first passed through a settlement tank or filtration system, where appropriate. A discharge licence will be required for temporary construction phase storm water discharges to the estuary; operational phase discharges will be regulated under the site's IE licence.

To minimise impact from material spillages, all oils, chemicals and waste materials will be stored within temporary bunded areas with a volume of 110% of the capacity of the largest tank/ container within it. Fuel, oil and chemical filling and draw-off points will be located entirely within the bunded area(s). Drainage from the bunded area(s) will be diverted for collection and disposal.

Vehicle/ equipment refuelling and maintenance with hydraulic oil or lubricants will take place in bunded areas where possible. If it is not possible to bring the machine to the refuelling point, fuel will be delivered in a double-skinned mobile fuel bowser. Drip trays will be used to contain spillages with spill kits and hydrocarbon absorbent packs stored in vehicle cabs with operators fully trained in their use. Vehicles and equipment will not be left unattended during refuelling operations. Regular inspection and maintenance measures for site machinery will be included in the CEMP to minimise the likelihood of losses of hydraulic fluids or fuels to ground during the construction works.

Spoil and temporary stockpiles including stone stockpile areas will be positioned in locations which are distant from drainage systems and retained drainage channels, away from areas subject to flooding. Runoff from spoil heaps will be prevented from entering watercourses by diverting it through onsite settlement ponds and removing material as soon as possible to designated storage areas.

Culverts beneath the access road will be located at or close to the locations of existing natural flow paths to allow existing flows to continue. Lateral drainage will be within shallow geotextile and rock lined drainage channels to avoid the drainage of surrounding soils. The outer perimeter fence line will be set back from the L1010 to avoid crossing watercourses as far as possible. The outer perimeter fencing is not expected to impact surface water flow where two minor watercourses are crossed, as there will not be a requirement for this fencing to be extended below the water's surface. The inner security fence surrounding the Power Plant and LNG Terminal will not cross any existing watercourse.

All watercourse crossings will be planned in accordance with applicable guidelines. No permanent watercourse diversions are proposed as part of the Proposed Development.

The access road will be designed to conduct road runoff to an engineered swale adjacent to the west side of the road. This swale will be profiled to grade continuously northward and to transfer the runoff from the access road to the sealed stormwater drainage system at the LNG Terminal and Power Plant area in the north of the Proposed Development.

Silt traps will be placed at crossing points to avoid siltation of watercourses. These will be maintained and cleaned regularly throughout the construction phase. Attention will also be paid to preventing the build-up of dirt on road surfaces, caused by lorries and other plant entering and exiting the Proposed Development site, via wheel washes and road sweepers as required.

6.10.1.5 Fuel and Chemical Handling

Construction phase mitigation will be implemented to prevent spillages to ground of fuels, and to prevent any consequent soil, groundwater or surface water quality impacts. These include but are not limited to the following:

- Designating a bunded storage area at the contractor's compound for all oils, solvents and paints used during construction. Oil and fuel storage tanks will be bunded to a volume of 110% of the capacity of the largest tank/ container within the bunded area. Drainage from the bunded area will be diverted for collection and safe disposal. All containers within the storage area will be clearly labelled, so that appropriate remedial action can be taken in the event of a spillage. When moving drums from the bunded storage area to locations within the Proposed Development, a suitably-sized spill pallet will be used for containing any potential spillages during transit;

- Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles, will take place in a designated area, which will be away from surface water gullies or drains. Spill kit facilities will be provided at the fuelling area in order to provide for accidental releases or spillages in and around the area. Any used spill kit materials will be appropriately disposed of using a hazardous waste contractor; and
- Where mobile fuel bowsers are used on the Proposed Development in the event of a machine requiring refuelling outside of the designated area, fuel will be transported in a mobile double skinned tank. Any flexible pipe, tap or valve will be fitted with a lock where it leaves the tank and locked shut when not in use. The pump or valve will also have a lock and be locked shut when not in use. Each bowser will carry a spill kit and each bowser operator will have spill response training.

6.10.1.6 Control of Concrete and Lime

Measures for protection of watercourses from wet concrete will be implemented and the following measures will be implemented to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil/ groundwater or nearby surface water, as follows:

- Ready-mixed concrete will be either produced onsite in a batching plant or brought to the Proposed Development by truck.
- A suitable risk assessment for wet concreting will be completed prior to works being carried out which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil or to the marine environment.
- The pouring of concrete will take place within designated areas as required, using a geosynthetic material to prevent concrete runoff into the soil.
- Washout of concrete-transporting vehicles will take place at an appropriate facility, offsite where possible, alternatively, where washout takes place onsite, it will be carried out in carefully-managed onsite wash out areas.
- Rainwater will be diverted away from the construction areas into the estuary or nearby ditches and streams. Water from construction areas will be filtered and treated to prevent sediment from entering surface waters. A regular water sampling regime will be put in place for the D1, D2 and D3 streams and the Surface Water Outfall on the Proposed Development site and other potentially-impacted runoff points to the shoreline during construction activity onsite. Water samples will be taken at specified locations to be agreed with the local authority.
- Works requiring discharge of water from excavations or areas of water which may have come in contact with concrete or cementitious material will require a site Permit to Pump under procedures outlined in the OCEMP. All such water will be tested for pH by contractors, and discharging water must go through a series of filtration systems before final discharge.

6.10.1.7 Piling Operations for Jetty and Outfall Construction

Piling operation and follow on construction in the estuary have the potential to impact on the marine environment. However, 3-D hydrodynamic modelling of sediment generated during piling has been completed using Telemache software and indicated negligible impact on the estuary, because of significant dispersion due to the high water volume and tidal flux in the estuary leading to low sediment loadings. Follow-on construction work will maximise the use of precast concrete elements, such as pile caps, beams, and deck planks, to minimize in-water construction. Any in-situ concrete work below the high water mark will be staged in a manner to prevent concrete from entering the water.

6.10.1.8 Sources of Aggregates and Clean Fill for the Project

While it is anticipated the Proposed Development will have a net zero cut/ fill balance, there is potential for small quantities of clean fill materials to be required to facilitate construction works, for example where site-won soils or crushed rock are not of sufficient geotechnical or chemical quality for re-use. The source of this fill material will be vetted in order to ensure that it is of a reputable origin and that it is 'clean' (i.e. will not introduce contamination to the groundwater or surface water environment). All potential suppliers will be vetted for the following criteria:

- Environmental management status; and
- Regulatory and legal compliance status of the company.

Clean fill material will be sourced from local suppliers which comply with the above requirements. If recycled aggregate is used as imported fill, rigorous chemical testing will be undertaken to confirm that it is ‘clean’ (i.e. will not introduce contamination to the environment).

6.10.1.9 Water Supply

The details of the water supply for the construction phase of the Proposed Development will be agreed with the water services section of Kerry County Council/ Irish Water prior to commencement. It is anticipated that a water supply of up to 98 m^3/day will be required during construction of the LNG Terminal and up to 55 m^3/day during construction of the Power Plant, which will be supplied from the upgraded water main along the L1010 road south of the Proposed Development site.

6.10.1.10 Foul Sewer

Foul sewage arising from kitchen facilities and temporary toilets and sanitary facilities during the Construction Phase on the Proposed Development site will initially be discharged to an onsite receptacle which will be appropriately managed by the service contractor with relevant licences and emptied by tanker on a regular basis for disposal at a licensed waste facility.

It is anticipated that, due to the scale of the Proposed Development, a canteen will be provided onsite during construction. Provisions will be made for a grease trap at the canteen drain outlet and this drain will connect to the onsite receptacle and later to the WWTP. Drumming of waste cooking oil within the canteen will also be provided.

6.10.2 Operational Phase

6.10.2.1 Surface Water

All hazardous or water polluting materials will be handled or stored in a manner to prevent/ minimise potential impact to surface water.

With regard to the emergency back-up generators associated with the Proposed Development, the diesel will be stored in fuel tanks located in bunded areas. If a leak from one of the tanks were to occur this will be identified by the leak detection system that will be present on each tank. The generator will be disabled in this event and the fuel will be allowed to collect within the second skin of the tank, which will have a 110% capacity. All bunded areas will have valved discharge points.

Emissions from chemical spills/ leaks or runoff from rainwater that has passed over impermeable surfaces will be prevented from polluting local surface water, as all surface water runoff from the Terminal, Power Plant and parking areas will be directed to hydrocarbon interceptors prior to discharge to the Shannon Estuary. The use of hydrocarbon interceptors will significantly reduce the likelihood of water contamination from vehicle fuel or chemical spills.

Spill kits will be located at strategic points around the Proposed Development in order to ensure a quick response to any spillages should they occur. Any used spill kits will be disposed of using a hazardous waste disposal contractor and in accordance with all relevant EU and Irish waste management legislation (i.e. the Waste Management Acts 1996 – 2011 and any regulations made thereunder, and the Waste Framework Directive). The EPA Guidance Note ‘Storage and Transfer of Materials for Scheduled Activities’ (EPA 2004) shall be taken into account when designing material storage and containment at the Proposed Development.

The transformers will be installed in bunds designed to retain a minimum of 110% of the total quantity of oil present in the transformer, below the fire trap. These bunds will be tested after construction and during maintenance to ensure the water depth loss is no more than 1 mm/hour over a continuous 6 hour period. Automatic emptying of rainwater from the bund will be achieved with a BundGuard© system or similar.

In the event of a fire, the fire water will drain through the storm sewerage system and hydrocarbon interceptors (where present) and be diverted to the firewater impoundment basin, sized and designed in accordance with the Irish EPA Guidance on Retention of Firewater, prior to inspection and discharge to the estuary. The retention pond will be rendered impermeable by use of an appropriate liner, and periodically integrity-tested in line with the requirements of the site’s IE licence. All process area site storm drainage will pass through the retention pond. An automatic shut-off valve linked to the site’s fire detection system would be installed on the drainage outlet point.

6.10.2.2 Foul Sewer

All foul water from the Proposed Development will be pumped or fall by gravity to a WWTP. The WWTP will be an pre-engineered biological treatment system which will treat the effluent to required discharge standards set out by the IE licence.

Table 6-5 Anticipated Characteristic of WWTP Discharge

Parameter	Emission Limit Value	Proposed Monitoring Frequency
Volume	35 m^3/day	Continuous
pH	6-10	Continuous
Biochemical Oxygen Demand	25 mg/L	Bi-annual
Suspended Solids	35 mg/L	Bi-annual
Ammonia	5 mg/L as N	Bi-annual
Total Phosphorous	2 Mg/L as P	Bi-annual

The WWTP will be sized to cater for a population of approximately 67 people. The treated effluent will be monitored in accordance with the site's IE licence requirements prior to discharge to the estuary via the same discharge outfall pipe as the surface water.

Effluent leaving the WWTP will be continuously monitored for flow rate and pH before discharging to the estuary. The automatic control system associated with the WWTP will sound an alarm if pH falls outside of the expected range. This will alert the operator to take corrective action to remedy the problem. If the problem continues to go outside the pre-set range, this will automatically close the discharge valve.

6.10.2.3 Water Supply

The water supply system will be metered to determine water consumption and facilitate leakage detection and will be in accordance with Irish Water requirements.

6.10.2.4 Storm Water Drainage

To minimise sediment build up within the storm water drainage network, trapped inlets will be used at all points of entry and key manholes will have sumps to collect material. A regular maintenance regime, including monitoring, will be put in place to remove any excess build-up of material.

6.10.2.5 Flood Risk

Flood Risk Assessment (Vol. 4, Appendix 6-3) concluded that the Proposed Development has a negligible impact on the existing flood regime in the area, with the exception of crossings of the watercourses for the access road. These will be culverted at an adequate size to have a minimal impact on the existing hydraulic regime in the area to the Ralappane Stream.

The LNG Terminal site will have a constructed stormwater drainage system capable of handling anticipated peak stormwater volumes for a 100 year, 24 hour rainfall event (162 L/s/ha, which equates to a total discharge rate of approximately 3125 L/s peak flow) and which will incorporate a firewater retention pond and discharge monitoring and flow control devices.

6.10.2.6 Discharges from FSRU Operations

Seawater used for regasification will be returned from the FSRU to the estuary at up to 8 ºC colder than the receiving ambient seawater. The cold water discharge from the FSRU to the estuary has been modelled using Telemache software and indicated negligible impact on the estuary, because of significant dilution and dispersion due to the high water volume and tidal flux in the estuary.

Seawater returned to the estuary from the seawater circulation system will contain residual chlorine from sodium hypochlorite used as a biocide. The concentration of residual chlorine at the seawater discharge from the FSRU will be monitored and will not exceed 0.5 mg/L.

Approximately 100 m^3/hr of seawater will also be required for the operation of the onboard freshwater generation plant. The reject stream from these freshwater generators will have elevated salt content and will be discharged to the estuary from the FSRU.

6.10.2.7 Environmental Management Plan

An environmental management plan for the Proposed Development will be implemented during the operational phase incorporating all mitigation measures and emergency response measures, as described in this chapter.

6.11 Do Nothing Scenario

Under a 'Do Nothing' scenario it is expected that the Proposed Development site will continue to be utilised for agricultural purposes. As is, the Proposed Development site potentially represents a source of contamination to the water environment, as diffuse agricultural sources continue to be the main threat to the quality of water in Ireland.

6.12 Residual Impacts

6.12.1.1 Construction Phase

The implementation of mitigation measures highlighted above will significantly reduce the likelihood and magnitude of the potential impacts on the groundwater and surface water environment occurring during the construction phase.

Residual impacts may be negative but are unlikely to occur if mitigation measures are properly implemented. Residual impacts will be of localised effect, in that they will only impact locally and impacts will be of temporary duration.

The magnitude of the potential residual effects during construction phase is therefore considered to be **negligible** on a surface water environment of **extremely high** sensitivity, and the potential impact of the Proposed Development on water is considered to be **imperceptible**.

6.12.1.2 Operational Phase

The implementation of measures inherent to the Proposed Development design and mitigation measures highlighted above will significantly reduce the likelihood and magnitude of effects on the groundwater and surface water environment occurring during the operational phase.

In relation to the operational phase, the magnitude of the potential residual effects is considered to be **negligible** on a surface water environment of **extremely high** sensitivity, and the potential effect of the Proposed Development on water is considered to be **negligible** on a surface water environment of **extremely high** sensitivity, and the potential effect of the Proposed Development on water is considered to be **imperceptible**.

6.13 Decommissioning

As outlined in Chapter 2 - Project Description, in the event of decommissioning, measures will be undertaken by the Applicant to ensure that there will be no significant, negative environmental effects during the decommissioning phase. Examples of the measures that will be implemented are outlined in Section 2.9, Chapter 02 – Project Description and will include removal of subsurface utilities such as the site drainage and surface water management systems. As a result, additional potential impacts and associated effects arising during the decommissioning phase are not anticipated above and beyond those already assessed during the construction phase.

A monitoring programme of all potential emissions including surface water and dust would be conducted after the decommissioning process in order to ensure that emissions from the facility have ceased.

6.14 Summary

The Proposed Development consists of an onshore Liquified Natural Gas (LNG) Terminal and Power Plant and an offshore jetty, together with associated infrastructure, on an approximately 14 ha area in the north east of the overall 41 ha Proposed Development site, which comprises grassland on the southern shore of the Shannon Estuary and is surrounded by a mixture of agricultural land, rural housing, public highway and the Shannon Estuary.

The onshore portion of the Proposed Development site itself is not a designated site but is bordered to the west, north and east by designated sites (Lower River Shannon cSAC, Ballylongford Bay pNHA and River Shannon and River Fergus Estuaries SPA). The jetty and surface water outfall elements of the

Proposed Development are located within the Lower River Shannon cSAC and the River Shannon and River Fergus Estuaries SPA.

Onshore and Offshore site investigations were undertaken in 2006 and 2007. The Proposed Development site and its surroundings have shown no change in use or significant development since a previous extensive surface water assessment in 2007.

Soil deposits are 'till derived from Namurian sandstones and shales', from 0.5 to 8.0 m depth, with small amounts of alluvium in localised areas. Groundwater was encountered in place within the till, with low rates of inflow. The upper till is moderately permeable (hydraulic conductivity of 3 to 4 x 10^{-6} m/s (metres per second)). The lower till layer overlying bedrock is stiff, of low permeability and no water strikes were recorded in this material.

The bedrock underlying the Proposed Development site is a mix of mudstone, siltstone and sandstone of the Shannon Group, which outcrops at the coast along the majority of the site's northern boundary. Groundwater in the bedrock is classified as a 'Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones'. The Proposed Development site is not located within a groundwater drinking water source protection area and public records indicate no springs and a relatively small number of low-yielding groundwater abstraction wells between 1 and 2 km from the Proposed Development site.

Depth to rock varies from 0.75 m (in the east of the site where the LNG Terminal and Power Plant will be situated to up to 9.8 m near the western boundary. Groundwater vulnerability is classified as 'High to Extreme' due to the limited subsoil thicknesses. Monitoring wells in bedrock on the Proposed Development site generally have moderate permeability and a poor yield.

The Proposed Development site is drained by several short streams or drainage channels which discharge to the Ralappane Stream (also termed the D1 Stream) or directly to the Shannon Estuary. The Ralappane Stream drains directly to the Shannon Estuary via a tidal wetland area to the west of the Proposed Development site; it has not been sampled by the EPA and its Water Framework Directive status is Unassigned.

Groundwater wells and surface water courses on the Proposed Development site were sampled in February 2020 and were found to be relatively unpolluted, other than pressures associated with the coastal, agricultural setting, including anaerobic conditions, slightly elevated salinity and some localised hydrocarbon detections.

Construction stage spill and leaks, including concrete and lime products and fuels, may give rise to a small adverse effect on an **extremely high** sensitivity environment (Lower River Shannon cSAC) with the significance of the effect being significant, but such activities will be set back from the coast, and managed in accordance with the OCEMP resulting in a negligible impact after mitigation.

Other construction phase risks arise from excavation, localised dewatering near rock cuttings and silt runoff to surface waters from material stockpiles on the Proposed Development site. Dewatering of bedrock will be a permanent but localised direct impact and will not lead to a net volume change in groundwater discharge to the estuary, resulting in an imperceptible effect. Excavated materials storage areas and stormwater runoff will be carefully managed in accordance with the OCEMP to prevent potential negative effect on the receiving environment. Stormwater discharge from the Proposed Development to the estuary will be carried out in compliance with a discharge licence. Sediment impact on the marine environment due to piling for jetty and outfall construction will have imperceptible impact and offshore construction will be managed to minimise use of wet concrete in contact with marine waters.

Operational Phase risks to groundwater and surface water will arise principally from discharges of stormwater, process effluent and sanitary water via a Surface Water Outfall to the estuary. These effluent streams will be collected via separate constructed drainage networks and will be treated and monitored prior to discharge as required by the site's IE licence from the EPA, resulting in a negligible adverse effect on an extremely high sensitivity environment and the significance of any residual effect is imperceptible.

FSRU operations may impact the marine environment via discharges of cold water from the regassification process with low residual chlorine concentrations from the electro-chlorination unit and of water with elevated salinity from the freshwater generators. The impact of these operational discharges from the FSRU on the estuary has been assessed as imperceptible. The FSRU will be operated and monitored in compliance with the site's IE licence requirements during the operational phase.

Other Operational Phase risks to groundwater and surface water will arise from losses of diesel fuel, transformer oils, odorant chemical and other chemicals used onsite. These risks will be managed by siting sensitive chemical storage and equipment within bunded areas, resulting in a low adverse effect to an extremely high sensitivity environment and the residual significance will be imperceptible.

Mitigation measures associated with both the construction and operational phases of the Proposed Development have been proposed, which may also interact with waste management and land and soils aspects of the development.

A CEMP will be prepared for the Construction Phase of the Proposed Development which will incorporate relevant environmental avoidance or mitigation measures to reduce potential environmental impact of temporary storage of soil or rock fill, road runoff, runoff of contaminated waters from constructions areas, storage and use of oils, chemicals, fuels and waste material onsite, concreting operations and vehicles onsite. Site waste management, including control of sewage and other key effluents, will be managed under the CEMP.

Operational Phase mitigations include:

- Handling all hazardous or water-polluting materials in a manner to prevent/ minimise potential impact on groundwater and surface water.
- Secondary containment (bunding) and spill kits will be provided for other hazardous materials to be stored onsite, such as fuels, maintenance oils, odorant and cleaning chemicals.
- An Environmental Management Plan will be prepared for the operational phase.
- The environmental aspects of the operational phase will be licensed and controlled by the EPA via an Industrial Emissions Licence.

Hydrodynamic modelling of constructions stage sediment deposition from offshore piling operations and from operational stage outfall or FRSU discharges from the site indicated no significant impacts to the intertidal or subtidal habitats or species in the estuary, which includes the cSAC, SPA, pNHA and the commercial oyster production sites in inner Ballylongford Bay (see Chapter 07A – Marine Biodiversity).

Cumulative impacts arising from the related LNG Pipeline, Power Transmission Systems and Data Centre Campus developments envisaged under the Master Plan were considered, no significant residual impacts were identified to groundwater and surface water and the cumulative operational impact is considered to be imperceptible. The Power Transmission and Data Centre Campus developments will be subject to separate EIAR.

Should the Proposed Development not take place, the groundwater and surface water will remain in their current state and there will be no change.

The residual effect of the Proposed Development on the surrounding groundwater and surface water environments is considered to be imperceptible at both the construction and operational phases.

Table 6-6 Summary

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Effect Significance
Construction	Dewatering due to cuttings	Low	Cut faces into bedrock will lead to seepage of groundwater into platform localised dewatering of the bedrock within 10-50 m of the cut faces. Permanent, direct, irreversible moderate effect	Neutral	Localised dewatering of the bedrock within 10-50 m of the cut faces of the excavation is anticipated, however, as all groundwater in the bedrock aquifer in this area is flowing towards the Shannon Estuary under baseline conditions, the interception and discharge of groundwater discharging to the excavated platform area of the Proposed Development will not lead to a net change to the quantities of groundwater ultimately discharging to the Shannon Estuary from this portion of the Proposed Development site. Groundwater seepage from cut faces will be managed via the Proposed Development site drainage systems in such a way as to prevent potential negative impact on the receiving environment The CEMP will outline proposals for the control and monitoring of groundwater seepages from the cut faces of the platform area.	Imperceptible
Construction	Sedimentation (Suspended Solids)	Extremely high	Runoff containing large amounts of suspended solids from site stripping, earthworks and material stockpiles can potentially adversely impact on surface water and marine environments. Installation of bored piles in the offshore area may generate low suspended sediment loads which will be transported by tidal currents. Temporary small adverse effect to an medium extremely high	Significant	Surface water runoff from working areas will not be allowed to discharge directly to the local watercourses. To achieve this, the drainage system, settlement ponds and surface water outfall will be constructed prior to the commencement of major site works. Spoil and temporary stockpiles will be positioned in locations which are distant from drainage systems and retained drainage channels, away from areas subject to flooding. Runoff from spoil heaps will be prevented from entering watercourses by diverting it through onsite settlement ponds and removing material as soon as possible to designated storage areas. Pile installation will use reverse circulation drilling to minimise loss of drilling spoil and generation of suspended sediment in the marine environment. Control of runoff from construction activities will be managed under the CEMP therefore runoff containing large amounts of suspended solids is considered unlikely to occur and, shall it occur, is likely to be rare and short-term.	Imperceptible

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Effect Significance
			sensitivity surface water environment.			
Construction	Accidental Spills and Leaks • Use and Storage of liquid chemicals; • Spillage or leakage of oils and fuels from construction machinery or site vehicles; and • Spillage of oil or fuel from refuelling machinery onsite.	Extremely high	Adverse effect on fish, aquatic flora and invertebrate communities. the Proposed Development. Direct negative small effect of temporary duration.	Significant	In order to prevent spillages to ground of fuels or other chemicals, and to prevent any consequent soil or groundwater quality impacts, it will be necessary to adopt mitigation measures during the construction phase, which include: • Designating a bunded storage areas and handling procedures for all oils, solvents and paints used during construction; • Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles, will take place in a designated area with appropriate facilities; and • Refuelling outside of the designated area will be via a mobile double skinned tank with lockable fittings and an onboard spill kit. Accidental spillages and leaks will be managed under the CEMP and are considered unlikely to occur and, shall they occur, are likely to be a temporary	Imperceptible
Construction	Use of Concrete and Lime	Extremely high	Lime and concrete (specifically, the cement component) is highly alkaline and can impact surface water quality during construction. Direct negative small effect of temporary duration	Significant	Hazardous materials will be controlled via the CEMP and stored in bunded areas. A suitable risk assessment for wet concreting will be completed prior to works being carried out, which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil or to the marine environment. Use of pre-cast concrete structures for the jetty and outfall in the marine environment will be maximised to limit the use of wet concrete. Washout of concrete-transporting vehicles will take place at an appropriate facility offsite where possible, alternatively, where washout takes place onsite, it will be carried out in carefully-managed onsite wash out areas.	Imperceptible

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Effect Significance
Construction	Piling for offshore construction (Suspended Solids, Concrete use)	Extremely high	Mobilisation of sediment due to installation of steel piles into bedrock to support offshore structures. pH effect due to the use of concrete in the marine environment. Small adverse effect on an extremely high sensitivity environment.	Significant	Pile installation will use reverse circulation drilling to minimise loss of drilling spoil and generation of suspended sediment in the marine environment. Follow-on construction work will maximise the use of precast concrete elements, such as pile caps, beams, and deck planks, to minimize in-water construction. Any in-situ concrete work would be staged in a manner to prevent concrete from entering the water.	Imperceptible
Operational	Hazardous Materials Storage • Diesel • Chemical odorant • Minor quantities of maintenance oils, greases, lubricants, cleaning chemicals, etc.	Extremely high	Storage of materials that are potentially hazardous to the aquatic environment. Temporary small adverse effect to an extremely high sensitivity surface water environment.	Significant	The storage of materials hazardous to the aquatic environment during the operational phase will be in secondary contained area and will be controlled in accordance with any IE licence conditions,. All hazardous or water-polluting materials will be handled or stored in a manner to prevent/ minimise potential impact on soil. Secondary containment and spill kits will be provided for other hazardous materials to be stored onsite. Potentially hazardous materials will be stored and handled in compliance with the site's IE licence requirements during the operational phase.	Imperceptible
Operational	Accidental Spills and Leaks	Extremely high	Spills during handling of fuels and other liquid chemicals can result in discharge to groundwater or the surface water environment. Direct negative small adverse effect of temporary duration.	Significant	All hazardous or water-polluting materials will be handled or stored in a manner to prevent/ minimise potential impact on soil. Secondary containment and spill kits will be provided for other hazardous materials to be stored onsite, such as maintenance oils and cleaning chemicals. Diesel fuel tanks for the fire water pumps and generators will be stored within bunded areas. Fuel will be prevented from entering the soil around the generators, as drainage will be directed to an oil/ water interceptor prior to discharge to the storm water drainage system. In addition, there will be a shut	Imperceptible

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Effect Significance
					off valve from the generator yard to the external surface water drainage network. Potentially hazardous materials will be stored and handled in compliance with the site's IE licence requirements during the operational phase.	
Operational	Flooding and Drainage	Extremely high	Direct discharges to the water environment during the operational phase will consist of • Stormwater water runoff from the developed and undeveloped areas of the Proposed Development site; • Groundwater discharges from cut faces; • Foul water from welfare facilities on the Proposed Development site; and • Process effluent streams. Small adverse impact effect on an extremely high sensitivity environment	Significant	The proposed crossings of the watercourses within the Proposed Development along the access road have been adequately sized to have a minimal impact on the existing hydraulic regime in the area draining to the Ralappane Stream, and therefore the Proposed Development has a negligible impact on the existing flood regime in the area. The LNG Terminal and Power Plant site will have a constructed stormwater, effluent and sanitary drainage systems capable of handling anticipated effluent volumes and which will incorporate treatment facilities and monitoring equipment appropriate to each effluent stream (including silt trap, Class 1 hydrocarbon interceptor, a firewater retention facility, package waste water treatment plant and pH adjustment). Outfall discharges to the estuary were modelled and indicated that the treated effluent will be rapidly diluted and dispersed within a short distance of the outfall and does not compromise the water quality at the aquaculture sites in Ballylongford Bay. The site's drainage systems will be operated and monitored in compliance with the site's IE licence requirements during the operational phase.	Imperceptible
Operational	Combined Operational Stormwater, Sanitary and Process Effluent Discharges to Surface Water	Extremely high	Direct discharges to the marine environment during the operational combined Surface Water Outfall Small adverse impact effect on a medium	Significant	The LNG Terminal and Power Plant site will have a constructed stormwater, effluent and sanitary drainage systems capable of handling anticipated effluent volumes and which will incorporate treatment facilities and monitoring equipment appropriate to each effluent stream (including silt trap, Class 1 hydrocarbon interceptor, a firewater retention	Imperceptible

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Effect Significance
			extremely high sensitivity environment.		facility, package waste water treatment plant and pH adjustment). The Proposed Development site's drainage systems will be operated and monitored in compliance with the site's IE licence requirements during the operational phase.	
Operational	FSRU Operational Discharges to Surface Water	Extremely high	Discharges of cooled water from regassification process, electro-chlorination and freshwater generators.	Significant	FSRU operations may impact the marine environment via discharges of cold water from the regassification process, with low residual chlorine concentrations from the electro-chlorination unit, and of water with elevated salinity from the freshwater generators. Temperature and residual chlorine modelling indicates that discharges from the FSRU are rapidly diluted and dispersed within a short distance of the FSRU discharge. The impact of these operational discharges from the FSRU on the estuary has been assessed as imperceptible. The FSRU will be operated and monitored in compliance with the site's IE licence requirements during the operational phase.	Imperceptible

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CHAPTER 07A
Marine Ecology

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park
Environmental Impact Assessment Report

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7A. Marine Ecology

7A.1 Introduction

7A.1.1 Overview

AQUAFACT International Services Ltd (AQUAFACT) was commissioned to assess the potential impact of the proposed Shannon Technology and Energy Park (STEP) development on marine ecology The impact assessments presented here have been prepared by Dr. Brendan O'Connor (B.Sc., Ph.D., MCIEEM) and Dr James Forde (B.Sc., M.Sc., Ph.D., MCIEEM). Brief descriptions of Dr. O'Connor's and Dr. Forde's expertise in marine ecology are provided in Section 7A.1.2 below. Other experts who contributed include Tony Cawley (B.Sc., MSc., BE, M.Eng.Sc, C.Eng, M.I.E.I) (Hydro Environmental), Dr. Simon Berrow (BSc Ph.D.) (Irish Whale and Dolphin Group), Darren Ireland (B.A, M.Sc.) (LGL Ecological Research Associates), and Per Trøjgård Andersen (B. Eng) (Vysus (formerly Lloyds Register)).

This chapter describes the likely significant direct and indirect effects of the STEP development on marine ecology, including species and habitats, of the marine environment (below the mean high water spring mark).

This chapter describes and evaluates aspects of the marine environment at the site of the Proposed Development in order to describe and assess the impacts that would result from the Proposed Development. The chapter follows the protocols detailed in the Environmental Protection Agency's Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, 2017).

A detailed description of the STEP development is provided in Chapter 02; a summary of aspects of the Proposed Development relevant to marine species and habitats of the Shannon Estuary is presented in Section 7A.2 below. Section 7A.2 outlines the specific potential impact mechanisms associated with the development relevant to marine biodiversity and ecology.

Chapter 05 – Land and Soils and Chapter 06 – Water address the changes in hydrology and hydrogeology that can have an impact on biodiversity and ecology.

Chapter 07B assesses potential impacts to terrestrial environment (above mean high water spring mark) (including avifauna).

7A.1.2 Competent Experts

Brendan O'Connor is the marine ecology lead for the STEP development and has responsibility for all associated ecological surveys and reporting. He is expert in ecological matters and the full spectrum of environmental assessment techniques, methodologies, and statutes. Professionally, he is a member of relevant Institutes requiring the highest standards of professional competence and integrity. He is a member of the Chartered Institute of Ecology and Environmental Management (CIEEM).

Brendan has 40 years of experience in the field of marine science and has published approximately 75 scientific papers and numerous reports specialising in the biology and ecology of sea-floor communities. Brendan is an internationally recognised polychaete taxonomist and has led numerous international workshops in polychaete taxonomy including workshops as part of the UK BEQUALM/ NMBAQC. He has 33 publications on marine invertebrate taxa including descriptions of new species, revisions of families and additions to the European and Irish fauna.

As Managing Director of AQUAFACT Brendan has been responsible for all aspects of management including the design, execution and reporting of numerous desk studies, surveys, assessments, and environmental outputs including NIS, AA screening and EIARs.

James Forde has a Ph.D. in Marine Ecology and is a full member of the CIEEM. James has over fifteen years' experience in marine research and environmental consultancy. James specialises in marine ecology and has a full appreciation of the objectives and mechanisms of national and international environmental legislation and policy.

James' academic research has focused on benthic habitats and communities, and techniques used to assess ecological impacts under European environmental legislation including the Habitats Directive and the Water Framework Directive.

As part of James' consultancy work, he has delivered assessment reports to meet the provisions of the Habitats Directive and EIA Directive to accompany planning applications for a wide range of developments including pier enhancement projects, coastal defence projects, and aquaculture.

James was a member of the International Union for Conservation of Nature (IUCN) expert working group for marine red-list habitats for the North Atlantic and has collaborated with international experts on the designation of sensitive marine habitats including *Ostrea edulis* beds, *Mytilus edulis* beds, seagrass meadows and offshore biogenic and geogenic reef habitats. James has collaborated with national experts on the assessment of deep-water reef habitats in Irish waters to support Ireland's national assessment of reef as required under Article 17 of the Habitats Directive. Recently James has also worked with national experts on the classification of lagoon habitats, a Habitats Directive Annex I priority habitat.

Of particular relevance to this assessment of the marine ecological environment for the STEP development is Brendan's and James' specialist input on biodiversity for the recent EirGrid Cross Shannon 400 kV Cable Project (Capital Project 0970).

Anthony Cawley holds a honours degree in Civil Engineering and a post graduate master's degree in Engineering Hydrology. He is a Chartered Civil Engineer with Specialist education and 30years professional consulting experience in the water engineering field in a wide variety of activities relating to hydrology, hydrogeology and flooding, and hydrodynamic and hydraulic assessment of fluvial and tidal processes.

Anthony was expert witness on hydrology and flooding related issues at numerous Oral Hearings for major Infrastructure projects (such as many of the Motorways, M6, M20/ M21 N23, Landsdown Stadium redevelopment).

Anthony was a lecturer in hydrology and hydraulics at the Hydrology and Civil Engineering Department at NUI Galway and is currently Lectures in Hydrology at the University of Limerick (2011 to date). Mr Cawley has provided training courses in Hydrology to the Western and Northwestern Fisheries Board and to Engineers Ireland, and Irish Rail and NRA Design Offices.

Anthony is an expert hydraulic and coastal processes modeller and analyst with considerable experience in application of 1D, 2D and 3D models to rivers, estuaries and coastal waters. Anthony has estuarine and coastal modelling experience using Telemac Software system with recent projects that include the Shannon Estuary hydrodynamic model and tidal harmonic analysis of tide elevations and velocities for oil spill tracking, the sediment transport, wave climate and hydrodynamic assessment of the proposed New Port for Galway and the flood impact and scour assessment of Arklow Bridge and Kish Bank Wind Farm and numerous Sewage outfall and numerous aquaculture studies in Irish coastal waters

Dr Simon Berrow is a marine mammal biologist with over 30 years experience. He is CEO of the Irish Whale and Dolphin Group and lecturer at the Galway-Mayo Institute of Technology. He started the Shannon Dolphin Project in the estuary in 1993, which has been ongoing each year for the last 28 years. The IWDG have extensive knowledge of the bottlenose dolphins in the estuary, having built the most comprehensive database and published widely.

For the current Proposed Development Simon prepared a series of survey reports on the use of the site by bottlenose dolphins including two years fieldwork, to assess potential impacts and provide advice on mitigation.

Darren Ireland holds a master's degree in ecology (fish and wildlife management) from Montana State University where he conducted research on Weddell seals in Antarctica. He is currently a Senior Wildlife Biologist and Vice President at LGL Ecological Research Associates, Inc. where he began working in 2005. While at LGL, Darren has worked primarily on projects related to anthropogenic sound impacts on marine mammals from a variety of activities including pile driving for wind farm and port development projects, deep penetration seismic surveys, high-resolution geophysical surveys, geotechnical investigations, exploration drilling programs, underwater explosions, and ice breaking.

Darren has authored or co-authored more than 45 environmental impact assessments and permit applications related to impacts of these activities on marine mammals, there habitat, and other marine life. Many of these projects also included developing and managing the implementation of multi-disciplinary monitoring plans to record and estimate potential impacts using methods such as vessel-based observers, manned and digital aerial surveys, unmanned aerial systems, static and towed passive acoustic recorders, and infrared camera systems.

Darren has also conducted baseline research on marine mammal distribution and abundance, conducted studies of novel research tools like unmanned aerial systems, infrared cameras, and satellite imagery, and performed evaluations of the potential impacts from new technologies and low-impact seismic sources. Through this work Mr. Ireland has gained a high level of expertise with the scientific and policy issues related to impacts of sound in the marine environment.

Per Trøjgård Andersen graduated from the Technical University in Denmark with a degree in acoustics in 1995. He has worked as consultant within noise, vibration, acoustics (including underwater noise) for more than 10 years in the company Odegaard & Danneskiold-Samsøe, and since 2005 at Lloyds Registers Engineering dynamics Team in Copenhagen, Denmark.

As part of the carve out of the Energy division from Lloyds Register, the Engineering Dynamics team became part of the Vysus Group in 2020, where he currently holds the position as Operations Manager for Engineering dynamics. Per's experience with underwater noise include consultancy on numerous projects with prediction and measurement of underwater noise from ships, wind turbines, oil & gas installations, as well as EU and privately funded research and development. He is the main author of the Lloyds Register underwater noise notation. He has further participated in ISO Technical Committee TC43 workgroup, developing the international standards for underwater noise measurements, including the ISO 17208 series

7A.2 Summary of Proposed Development

The development can be split into three phases: operation, construction, and decommissioning. Key activities proposed for the phases of the development relevant to marine species and habitats of the Shannon Estuary are summarised in Section 7A.2.1 through Section 7A.2.3 below, while Section 7A.2.4 outlines the potential impact mechanisms associated with the phases relevant to the marine biodiversity and ecology.

7A.2.1 Summary of Construction Phase Activities

This phase of the development includes the construction of the LNG Terminal and jetty and a Power Plant.

Works required for the construction of the LNG Terminal include the construction of the jetty, the administration and security building, stores, workshops, various other buildings, and process equipment associated with the receiving facilities and the Above Ground Installation (AGI). Other construction works include the installation of structural steel piping and supports between the Floating Storage and Regasification Unit (FSRU) and the onshore receiving facility and AGI. The FSRU will arrive at the LNG Terminal fully fitted out. Only minor installation works are anticipated to facilitate the connection between the FSRU and the jetty based systems.

Construction of the LNG Terminal, the Power Plant, and the AGI will require extensive pre-construction site preparation works including earth moving and rock breaking, installation of temporary surface water drainage and silt ponds, and temporary site access roads. Site preparation works may also require controlled rock blasting. Works at the Power Plant include the installation of gas turbine generators, heat recovery steam generator, a steam turbine generator, and an air cooled condenser.

For the jetty, up to 203 construction piles for the structures' foundations will be required. The construction piles will support a jetty trestle on steel piles. The trestle will support a concrete deck constructed of reinforced concrete. The jetty trestle and platform will include docking locations alongside for tugs, and berthing facilities and unloading arms at the jetty head for the FRSU. During the construction phase a trenched water outfall will be constructed across the shoreline into the Shannon estuary extending approximately 5m beyond the low water mark.

7A.2.2 Summary of Operation Phase Activities

As part of operational activities the FRSU will be typically, but not permanently, moored at the jetty. LNG will be transferred to the FSRU via a ship to ship transfer from an LNG Carrier (LNGC) berthed alongside. The LNG will be returned to a gaseous state using the FRSU onboard regasification unit. Gas Loading Arms on the jetty connect to the FSRU via a 30 inch gas pipe, also installed on the jetty, to transfer the gas from the FSRU to the onshore receiving facility. Tugs will typically be used to moor the LNGC safely next to the FSRU. The heat required for the LNG vaporisation will be primarily via seawater, supplemented by gas fired heaters when the seawater temperature is inadequate. Up to 60 visits of LNGC are expected every year.

Seawater intakes will be located in the hull of the FSRU, approximately 2 metres below water level. Screens will be covering the intakes to prevent fish, crustaceans and debris from entering the seawater system within the FSRU. The design of the water intakes will be such that the approach velocity of the seawater entering the screens will not be greater than 0.3 m/s to allow mobile marine biota to swim away. The screen mesh size will be approximately 5 mm x 5 mm. It is anticipated that any silt entering the seawater circulation system will remain in suspension and carry right through the system.

A small amount of sodium hypochloride is injected into the FSRU seawater systems to control microbial growth. The sodium hypochlorite is generated onboard in an electro-chlorination unit. The electro-chlorination unit will consist of cells housing platinised titanium electrodes between which a direct electric current flows. The sodium chloride salts in the sea water passing between the electrodes dissociate to form residual sodium hypochlorite (chlorine) without the addition of any chemicals. As the seawater passes through the system and is discharged back into the estuary, the chlorine will dissipate back into the sea water from which it will have been produced. Other routine activities associated with the operational phase of the development include inspection and maintenance of the facilities at the LNG Terminal and Power Plant buildings including carpark surface, access roadways *etc.* Other operation phase activities include the periodic maintenance of the jetty structure and pipeline infrastructure, and electrical substation and pump station.

7A.2.3 Summary of Decommissioning Phase Activities

The Proposed Development is expected to have a design life of 50 years, but this could be extended by maintenance, equipment replacement and upgrades or by the transition of the site to use hydrogen capability (which would be subject to a future planning application).

The Proposed Development will be maintained in the long term by Shannon LNG. It is expected that it would be a condition for the Proposed Development that a closure and residuals management plan, including a detailed decommissioning plan, be submitted to the EPA for their approval. Strict adherence to the proposed plan will ensure no significant impacts associated with decommissioning will occur.

7A.2.4 Potential Impact Mechanisms

Table 7A-1 below lists the potential impact mechanisms associated with the phases of the Proposed Development relevant to receptors of the marine environment (see Section 7A.4). Brief descriptions of the impact mechanisms are presented in Section 7A.5.1, while assessment of impacts and effects of the impact mechanisms to the marine environment is presented in Section 7A.5.3 through Section 7A.5.14.

Table 7A-1 Potential Impact Mechanisms

Potential Impact Mechanisms		Development Phase
1.	Release of pollutants during construction	Construction Phase
2.	Release of spoil during piling	Construction Phase
3.	Underwater noise	Construction Phase **and** Operation Phase
4.	Seabed habitat loss	Construction Phase **and** Operation Phase
5.	Vessel physical disturbance and collision injury	Operation Phase **and** Operation Phase
6.	Discharge of treated cooled seawater	Operation Phase

Potential Impact Mechanisms		Development Phase
7.	Entrainment and impingement of fauna by the FSRU seawater system	Operation Phase
8.	Wastewater discharge and Power Plant Process Heated Water Effluent	Operation Phase
9.	Introduction of invasive species	Operation Phase
10.	Accidental large scale oil or LNG spill	Operation Phase

7A.3 Methodology

7A.3.1 Overview

The assessment addresses the likely significant direct and indirect effects of the Proposed Development on marine ecology and biodiversity, including flora, fauna and habitats.

The assessment has been carried out in three stages:

- A desk study was undertaken to review published data describing ecological conditions within the greater area of the Proposed Development. Data bases included the National Parks and Wildlife Service (NPWS), the National Biodiversity Data Centre (NBDC), Inland Fisheries Ireland (IFI), Birdwatch Ireland (BWI) and the Irish Whale and Dolphin Group (IWDG);
- Site visits and field surveys by specialist ecologists to establish the existing ecological conditions at the location of the Proposed Development. The field surveys included intertidal and subtidal habitat surveys, walk over surveys, and land-based Vantage Point (VP) watches and static acoustic monitoring (SAM) to describe the use of the locality by marine mammals; and
- Evaluation of the Proposed Development and determination of the scale and extent of likely direct and indirect significant effects on marine biodiversity (i.e. flora, fauna and habitats) and the provision of appropriate mitigation and monitoring.

The impact assessments and surveys undertaken for the marine ecology element of the EIAR was prepared by AQUAFACT ecologists. In addition to Brendan O'Connor and James Forde, specialist ecologists who contributed include:

- Tony Cawley (Hydro Environmental);
- Dr Simon Berrow – IWDG;
- Darren Ireland– LGL; and
- Dr. Per Trøjgård Andersen.

7A.3.2 Legislation and Policy

The biodiversity assessment has been prepared with reference to the following legislation and guidance:

- Wildlife Act 1976, as amended;
- European Communities (EC) (Birds and Natural Habitats) Regulations 2011, as amended;
- Directive 2011/ 92/ EU of the European Parliament and the Council on the assessment of the effects of certain public and private projects on the environment, as amended by Directive 2014/ 52/ EU (the 'EIA Directive');
- Council Directive 2009/ 147/ EEC, i.e. Birds Directive;
- Council Directive 92/ 43/ EEC (as amended), i.e. Habitats Directive;
- Heritage Council (2011) Best Practice Guidance for Habitat Survey and Mapping;

- Department of Arts, Heritage and the Gaeltacht – National Parks and Wildlife Service (DAHG NPWS) (2012) Marine Natura Impact Statements in Ireland Special Areas of Conservation, A Working Document;
- DEHLG (2009) Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities (Revised 2010);
- EC (2018) Managing Natura 2000 sites. The provisions of Article 6 of the Habitats Directive92/ 43/ EEC Commission Notice (2018);
- Office of the Planning Regulator (OPR) (2021) Appropriate Assessment Screening for Development Management. Practice Note PN01. March 2021;
- EC (2018) Managing Natura 2000 sites. The provisions of Article 6 of the Habitats Directive 92/ 43/ EEC Commission Notice (2018);
- EC (2001) Managing Natura 2000 Sites: The provisions of Article 6 of the Habitats Directive 92/ 43/ EEC;
- EC (2002) Assessment of plans and projects significantly affecting Natura 2000 sites;
- EU (2013) Guidelines on Climate Change and Natura 2000: Dealing with the impact of climate change on the management of the Natura 2000 Network of areas of high biodiversity value;
- CIEEM (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal;
- IFI (2016) Guidelines on Protection of Fisheries during Construction Works in and adjacent to Waters. Inland Fisheries Ireland;
- EPA (2017) Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports; and
- EU (2017) Guidance on the preparation of the EIA Report (Directive 2011/ 92/ EU as amended by 2014/ 52/ EU).

7A.3.3 Sources of Information

A review was carried out to collate the available information on the local ecological environment. The purpose of the review was to identify features of ecological value occurring within the Proposed Development site and those occurring in proximity to it. The review also allowed the key ecological issues to be identified early in the assessment process and facilitates the planning of surveys.

- Specialist surveys and studies carried out in 2020 and 2021 as part of the EIA process to assess the potential impact of the Proposed Development on the ecology of the receiving marine environment included:
    - Surveys of intertidal and subtidal marine habitats;
    - Marine mammal monitoring, comprising a combination of land-based Vantage Point (VP) watches and static acoustic monitoring (SAM).
    - Hydrodynamic and dispersion modelling study to inform assessments of the environmental impact of:
        - Sediment generated during piling operations;
        - Treated cooled seawater discharges;
        - Process water discharges; and
        - Wastewater discharges.
    - Detailed modelling of noise emissions to inform assessment of the impact of noise:
        - Fish species; and
        - Marine mammals.

Further details on the surveys undertaken in 2020 and 2021 are presented in Section 7A.3.5.

In 2008 Shannon LNG was granted permission[1] to develop a LNG Terminal at Ralappane and Kilcolgan Lower, Co Kerry. The planning application which was submitted on 24.09.2007 was accompanied by an Environment Impact Statement (EIS). As part of EIS the entire site of the LNG Terminal, including the area now intended for the Proposed Development, was surveyed in 2006/ 2007 and 2011/ 2012. Thus a large amount of existing background information of the Proposed Development site was obtained during the assessment process for the 2008 LNG terminal. This information has been used to inform the current planning application for the Proposed Development. Details of surveys undertaken in 2006/ 2007 and 2011/ 2012 are summarised in Section 7A.3.5.

In 2013 Shannon LNG was granted permission[2] to develop a combined Heat and Power (CHP) Plant at Ralappane and Kilcolgan Lower, Co Kerry. The planning application which was submitted on 21.12.2012. As part of the impact assessment undertaken for the proposed CHP Plant a range of surveys were carried out in 2011/ 2012 and impact assessment reports prepared; further details of these is presented in Section 7A.3.5.

Other sources of information utilised for this report include the following:

- Conservation Status Assessment Reports, Backing Documents and Maps prepared to inform national reporting required under Article 17[3] of the Habitats Directive and Article 12[4] of the Bird Directive;
- Site Synopsis, Conservation Objective Reports and Natura 2000 Forms available from NPWS;
- Published and unpublished NPWS reports on protected habitats and species including Irish Wildlife Manual reports, Species Action Plans, and Conservation Management Plans;
- Existing relevant mapping and databases *e.g.* waterbody status, species and habitat distribution *etc.* (sourced from the Environmental Protection Agency, 2021, the National Biodiversity Data, 2021 and the NPWS, 2021);
- National Parks and Wildlife Service (NPWS);
- Environmental Protection Agency (EPA);
- National Biodiversity Data Centre;
- Published academic papers and reports;
- National Biodiversity Action Plan 2017-2021 (NPWS 2017);
- Kerry Co. Council (KCC) (2019) *Council Climate Change Adaptation Strategy 2019-2024;*
- KCC (2008) *Biodiversity Action Plans 2008-2012*; and
- KCC (2015) *County Development Plan 2015 – 2021*.

7A.3.4 Limitations and Assumptions

Some general assumptions that have been made during preparation of this EIAR are set out below:

- In undertaking cumulative assessments, consented, but as yet un-built, developments have been assumed to have been built in accordance with and within the duration permitted by the associated grant of permission;
- Information provided by third parties, including publicly available information and databases, is correct at the time of publication;
- Local Authority and An Bord Pleanála public planning registers reviewed as part of the assessment process are up-to-date; and

[1] PL08B. PA0002 – Permission granted for a LNG terminal at Ralappane and Kilcolgan Lower, Co. Kerry. Application submitted on 24.09.2007. Permission granted on 31.03.2008.
[2] PL08. PA0028 – Permission granted for a CHP Plant at Ralappane and Kilcolgan Lower, Co. Kerry. Application submitted on 21.12.2013. Permission granted on 09.07.2013.
[3] Most recent Article 17 report is available at https://www.npws.ie/publications/article-17-reports/article-17-reports-2019
[4] Most recent Article 12 report is available at https://www.npws.ie/news/birds-directive-article-12-reporting

- Baseline conditions and assessments are accurate at the time of the surveys.

Some general limitations associated with the preparation of this chapter are set out below:

- The assessment of cumulative effects from built or consented developments is partially reliant on the availability of information provided by relevant third parties.

7A.3.5 Specialist Surveys and Studies

As outlined in Section 7A.3.3 the assessment of potential impact to intertidal and subtidal benthic marine habitats, marine mammals and fish is supported by specialist studies and extensive marine survey work carried out over several years at the site. The surveys which have been undertaken using standard methodologies are briefly described in Section 7A.3.5.1 while Section 7A.3.5.2 outlines the specialist studies undertaken to inform impact assessments.

7A.3.5.1 Surveys

Intertidal and Subtidal Marine Habitats

In 2005/ 2006 and in 2012, AQUAFACT undertook intertidal transect surveys to the west and east of the Proposed Development north of Ballylongford Bay to Carrowdotia east of Ardmore Point. In 2020, three of the transects previously surveyed (T3, T7, T8) were revisited and resurveyed (see Figure 7A-5). In 2020 an additional transect (T1) was identified and surveyed. In 2006/ 2007, a total of 31 subtidal sites were surveyed; of these sites, 10 sites were resurveyed in 2012 and 2020 (see Figure 7A-8). AQUAFACT survey reports are included in Appendix A7A-1. The intertidal and subtidal data collected are further augmented by data available on NPWS documents and data collated for the Lower River Shannon SAC. There are no limitations in relation to the suitability of the data to support the impact assessments presented within this chapter.

Lagoons

There is also a small undocumented lagoon located approximately 4.5 south west of Proposed Development. The Conservation Objectives report for the cSAC (NPWS, 2013) indicates that the site is designated for four lagoons. The lagoons are: Scattery Lagoon (5.9 km northwest of the development), Clooconeen Pool (18.1 km west), Quayfield and Poulaweala Loughs (26.5 km east), Shannon Airport Lagoon (35.5 km northeast of the development). To augment information included in the Conservation Objectives report, a specialist survey of the lagoon located at Knockfinglas Point was carried out in October 2007.

Marine Mammals

The assessment of potential impact to marine mammals is supported by extensive marine survey work. For the Proposed Development, the Irish Whale and Dolphin Group (IWDG) were contracted to monitor the use of the site of the proposed LNG Terminal by bottlenose dolphins and any other marine mammals present. Monitoring, comprising a combination of land-based Vantage Point (VP) watches and static acoustic monitoring (SAM), was used to describe the use of the site by bottlenose dolphins and any other marine mammals (seals) present, and their distribution and relative abundance at the site. Dedicated weekly VP watches were carried out over 6 months (April and September 2020) while CPOD passive acoustic devices were deployed at two sites for a period of 12 months to collect SAM data. These data augment marine mammal data collected in the Shannon Estuary over 20 years, which has spawned a wealth of scientific publications and datasets, including NPWS documents and data collated for the Lower River Shannon cSAC, for which the bottlenose dolphins are a conservation feature. There are no limitations in relation to the suitability of the data to support assessment of the occurrence of marine mammals in the development area. IWDG monitoring reports are presented in Appendix A7A-2.

Fish

Fish diversity in the Shannon Estuary was identified using a wide range of published reports, the most important of which are the stock surveys conducted by Inland Fisheries Ireland (IFI) in 2008 and in 2014 in the Upper and Lower Shannon Estuary using a beach seine, fyke net, or beam trawl and reported in Kelly et al., 2015. There are no limitations in relation to assessment of fish diversity in the Shannon Estuary. The assessment also relied on document prepared by NPWS for the Lower River Shannon cSAC. (NPWS, 2013).

7A.3.5.2 Specialist Studies

Shannon LNG Limited commissioned Lloyd's Register (now Vysus Group) (VG) to carry out a modelling study on various sources of noise that would arise during the construction and operation phases of the Proposed Development in the Shannon Estuary. The VG noise modelling report is presented in Appendix A7A-3.

The output of the VG noise modelling study was used by LGL Ecological Research Associates Ltd (LGL) to assess the impact of noise generated during the construction and operation phases of the development on fish and marine mammal species. The impact assessments undertaken by LGL were informed by published scientific literature on the effects of noise of fish and marine mammal species. LGL impact assessments were used as the basis for noise impact assessments in this chapter. There are no limitations in relation to the suitability of the VG noise modelling and the impact assessments undertaken by LGL. The LGL noise impact assessment report is presented in Appendix A7A-4.

AQUAFACT was commissioned by Shannon LNG to carry out a dispersion modelling study to determine the fate of sediment and water discharges generated during the construction and operation phases of the Proposed Development. The AQUAFACT Hydrodynamic and Dispersion Modelling report is presented in Appendix A7A-5. The dispersion modelling study was used as the basis of assessment of impact to aspects of the marine environment. There are no limitations in relation in relation to the suitability of the dispersion modelling and the impact assessments undertaken.

7A.3.6 Consultation

Consultations were carried out with statutory and non-statutory bodies. The bodies are listed in alphabetical order below.

- An Bord Pleanála (ABP);
- Commission for Regulation of Utilities (CRU);
- EirGrid;
- Environmental Protection Agency (EPA);
- Gas Networks Ireland (GNI);
- Health and Safety Authority (HSA);
- Inland Fisheries Ireland (IFI);
- Irish Whale and Dolphin Group (IWDG);
- KCC;
    - County Archaeologist,
    - Chief Fire Officer, and
    - Planning Department;
- National Monuments Service's Underwater Archaeology Unit;
- National Parks and Wildlife Service (NPWS) Development Applications Unit (DAU); and
- Shannon Foynes Port Company.

Of particular relevance to the assessment exercises undertaken for this chapter of the EIAR were consultations held with IFI and NPWS; the issues raised by these consultations are presented in Table 7A-2 and Table 7A-3 below. The tables indicate where the consultation comments have been addressed in the EIAR. Where possible, summary responses to the comments are alongside the consultation comments.

Table 7A-2 IFI (Letter Dated 13th April 2021)

Consultation Comment	Response
With regard to tanker access to the new jetty, will additional dredging of the channel be required and if so, the impact of this must be adequately assessed.	For the Proposed Development there will be no marine dredging.
IFI request modelling of the impact and dispersion of the outlet water and its impact on the temperature and salinity regime in the vicinity of the proposed plant. This is particularly important given the proximity of the plant to the West Shannon Ballylongford Designated Shellfish Area. This is also relevant to the spawning of estuarine fish and other invertebrate species.	Detailed Hydrodynamic and Dispersion Modelling of treated cooled water discharges is presented in Appendix A7A-5, Vol. 4. An assessment of impacts is presented in Section 7A.10 and no impacts are predicted.
IFI request detail of the proposals to prevent fish impingement/entrainment on any water intake pipes and the adequacy of any proposed systems to prevent same.	A description of the seawater intake and discharge system is provided in Chapter 02. Assessment of the likely impact of impingement/ entrainment impacts on fish and crustaceans is included in Section 7A.5.9. The seawater system has been designed to avoid significant impingement/ entrainment of fauna occurring.
Fire water will likely be required for the plant and the BESS, the source of this should be addressed.	Details of firewater are provided below in Chapter 02.
Detail should be provided as to the treatment and disposal of wastewater from on-site hygiene facilities.	Detailed Hydrodynamic and Dispersion Modelling of treated cooled water discharges is presented in Appendix A7A-5, Vol. 4. Assessment of impacts is presented below in Section 7A.5.10. Given the scale of effluent and treatment proposed, and the diluting factor of the Shannon estuary, significant impacts can be excluded.
A pollution prevention and rapid response plan should be prepared in the event of an oil spill during refuelling or a spill of LNG during the unloading/ regasification process.	Pollution Mitigation and Response Protocols are detailed below in Section 7A.7.5.
The management of ballast water to prevent the further introduction of alien invasive species should be dealt with.	Details of the ballast management plans that will be implemented are provided below in Section 7A.6.
The impact of construction/piling noise on the auditory and migratory response of resident estuarine and migrant fish species is of concern to IFI. Twaite Shad (*Allosa fallax fallax*) are particularly hearing sensitive and have been recorded in the estuary. The European Red Data Book species Smelt (*Osmerus eperlanus*) also migrates to spawn in the Upper Estuary at Limerick City during early Spring.	Detailed modelling of noise emissions is presented in Appendix A7A-3, Vol. 4 while assessment of the impact of noise on fish and marine mammal species in presented in Appendix A7A-4, Vol. 4. Assessments of impacts to fish and marine species are presented below in Section 7A.5.5.
The in-combination effects of all of the above with the Data Centre and 220kV connection should be addressed.	Cumulative impacts are considered in Section 7A.6. In-combination effects are considered in Section 2.16.6 and Section 3.7 of NIS Vol1[5].

[5] For the application for consent for the Proposed Development a *Screening Statement for Appropriate Assessment (AA) and Natura Impact Statement (NIS)* report has been prepared. The *Screening Statement for AA and NIS* report has been prepared to inform the AA determination in respect of the Proposed Development by the competent authorities, as required under Article 6(3) of the Habitats Directive. The report comprises the following two parts; Vol. 1 – Main Report, and Vol. 2 – Appendices.

Table 7A-3 NPWS DAU (Letter Dated 26th April 2021)

Consultation Comment	Response
LNG FRSU terminal	
Net loss of Annex I habitat: See conservation target for area on Conservation Objectives for the Lower River Shannon cSAC[6]. The estimated extent of the loss of this habitat, permanently and/or during the lifetime of the development, due to the construction of the jetty and FSRU infrastructure, will need to be calculated. Net loss of habitats may constitute an adverse effect on the integrity of the cSAC.	An estimation of the habitat lost during the lifetime of the Proposed Development is presented in assessed in Section 7A.5.6. An estimation of the habitat lost during the lifetime of the Proposed Development and an assessment of impact on the integrity of the cSAC is presented in *Screening Statement for AA and NIS*.
Where post-development decommissioning of the jetty and marine infrastructure is proposed, the expected maximum lifetime of the project needs to be clearly stated, as does the method of decommissioning envisaged, with comparable thoroughly researched examples of successful restoration carried out in similar circumstances elsewhere.	The Proposed Development is expected to have a design life of 50 years. Details of the decommissioning phase are presented in Chapter 02. Habitat recovery following decommissioning is discuss in Section 7A.5.6.
A thorough and comprehensive baseline survey of the benthic biodiversity of the total effective footprint of the jetty and marine infrastructure needs to be carried out.	The baseline surveys of the intertidal and subtidal environment are summarised in in Section 7A.4.3. Full survey reports are included in Appendix A7A-1, Vol. 4.
The area proposed for the jetty and FSRU infrastructure is within the area mapped as critical habitat for the bottle-nosed dolphin Map 16, Conservation Objectives). The conservation target for these areas is that they "should be maintained in a natural condition". The NIS will need to address the compatibility of the Proposed Development with the conservation objective for this species within the cSAC, and provide sufficient data and expert opinion to satisfy reasonable scientific doubt that the proposal will not adversely affect the integrity of the Lower River Shannon cSAC.	An assessment of the noise disturbance to bottlenose dolphin Section 7A.5.5.
Sublethal effects of pile-driving (jetty and FSRU infrastructure), and any near-shore blasting, on dolphins using adjacent part of the estuary. Unless adequate data is already available, a *two-year* survey of dolphin use of the estuary within 2 km of the proposed jetty and FSRU infrastructure is recommended, with a year being the minimum requirement, but open to query regarding its representivity.	Monitoring survey reports of marine mammals are presented in full in Appendix A7A-2, Vol. 4 with the key findings summarised in Section 7A.4.4. Assessment of noise disturbance impacts to species is presented below in Section 7A.5.5.
Any increase in the risk of oil spills from increased ship traffic need to be fully assessed.	A Marine Navigation Risk Assessment, which was prepared by the Shannon Foynes Port Company in presented in Appendix A2-2, Vol. 4. The risk assessment was used to assess potential risk of oil spills.
The risk of invasive organisms being imported in ballast water and as ship hull fouling need to be assessed.	Details of the ballast management plans that will be implemented are provided below in Section 7A.7.4.
Effect of the lighted jetty on bird mortality during poor weather condition, based on evidence from monitoring of jetties elsewhere.	An assessment of the likely impact of bird collisions with lighting of the jetty associated with the Proposed Development is presented in Chapter 07B – Terrestrial Biodiversity.

[6] https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002165.pdf

Consultation Comment	Response
	Bird surveys undertaken to inform the impact assessments for the Proposed Development are also detailed in Chapter 07B – Terrestrial Biodiversity
Effect of pile-driving on estuarine birds: The seasonal timing and type of pile driving needs to be clearly described, and its impact of estuarine birds assessed. Unless adequate data is already available, a *two-year* survey of bird use of the estuary within 2 km of the proposed jetty and FSRU infrastructure is recommended, with a year being the minimum requirement.	An assessment of the effects of the noise emissions on estuarine birds, including piling noise associated with the Proposed Development, and details of bird surveys undertaken to inform the impact assessments are presented in Chapter 07B EIAR Vol. 2.
Modelling of pool fires and accidents: The impact of shipping accidents and pool fires on estuarine and sea-birds needs to be assessed. Although there is a good safety record for LNG ship transport, nevertheless it is recommended that such risks are formally modelled (*e.g.* Woodward & Pitbaldo (2010)[7]. The feasibility of bird surveys at and on each side of the slip lane within the SPA need to be established and if feasible such data is recommended to be collected.	A discussion on the potential risk of accidents associated with the Proposed Development is included in Section 7A.5.12.
It needs to be established if dredging is required to facilitate ship access.	For the Proposed Development there will be no marine dredging.
Entrainment and/or impingement for fish and macrocrustaceans at water intake. An estimate of the number of fish and macrocrustaceans which are predicted to be killed by being entrained in the cooling water intake, or by being impinged on the filter screens of the intake, as a proportion of the fish and macrocrustaceans population available to predatory fauna in the estuary (see, for comparison, Henderson (1999)[8] and Hadderingh and Jager (2002)[9]	A description of the seawater intake and discharge system is provided in Chapter 02. Assessment of likely impingement/ entrainment impacts to fish and crustaceans is included in Section 7A.5.9. The seawater system has been designed to avoid significant impingement/ entrainment of fauna occurring.
If any chemicals are proposed to be used to remove intake and outlet pipe fouling by marine organisms, then this needs to be assessed for impact on the estuarine ecosystem.	To avoid fouling hypochlorite will be used to treat water. Modelling of treated cooled water discharge is discussed in Section 7A.5.8 while full the Hydrodynamic and Dispersion Modelling report is presented in Appendix A7A-5, Vol. 4. Dispersion of residual chlorine at 0.5 mg/l was modelled. Results show that within 1.5 km both east and west of the discharge point the predicted maximum residual chlorine concentration is less than 0.01 mg/l. Concentration above 0.1 mg/l are shown to occur only within 20 m of the discharge point and for a short period of time. Significant effects can be excluded.
Power plant at Ralappane	
The requirement for blasting for the construction of the proposed power plant need to be established, and it impact fully assessed.	Detailed modelling of noise emissions is presented in Appendix A7A-3, Vol. 4 while assessment of the impact of noise species in presented in Appendix A7A-4, Vol. 4. Assessments of impacts to species are presented below in Section 7A.5.5.
The full accounting of all excavated waste needs to be thoroughly controlled as part of a C & D waste management plan. The NPWS has been involved in several cases where construction	Details provided in Chapter 02.

[7] Woodward, J. L. & Pitbaldo, R. (2010). LNG Risk Based Safety: modelling and consequence analysis. John Wiley & Sons. https://www.wiley.com/en-us/LNG+Risk+Based+Safety%3A+Modeling+and+Consequence+Analysis-p-9780470317648

[8] Henderson, P.A. (1999). Stepping back from the brink: estuarine communities and their prospect British Wildlife 11: 85-91.

[9] Hadderingh, R.H. and Jager, Z. (2002). Comparison of fish impingement by a thermal power station with fish population in the Ems Estuary. Journal of Fish Biology 61: 105-124.

Consultation Comment	Response
waste has been illegally used for purposes of private coastal protection works in European sites.	
If any indirect effects are likely, a re-assessment of the small lagoon near the land bank site, for typical lagoonal species, is recommended; in particular the protected species *Lamprothamnium papillosum.*	The main source of potential indirect effects impacts to lagoons are pollutants and water discharges. Potential for impacts are considered in Section 7A.5.3, Section 7A.5.4, and Section 7A.5.8**.** Indirect effects of pollutants and water discharges to lagoons can excluded. There is potential that lagoon may be indirectly affected by invasive species, however, the risk of invasive organisms will be managed through the implementation of mitigation (see in Section 7A.7).
A re-assessment of the use of the terrestrial and shore development area by otter needs to be carried out.	A re-assessment of otter use of terrestrial and shore habitats at the Proposed Development is presented in Chapter 07B.
Gas pipeline to Foynes	
As more than 12 years have elapsed since the Environmental Impact Statement (EIS) for the gas pipeline, and this being an integral part of the whole project, a revised assessment (Screening for appropriate assessment (at least) and Environmental Impact Assessment Report (EIAR) supplement (at least) would appear to be necessary.	The 26 km gas pipeline that will connect the Proposed Development to the existing natural gas network is already permitted. By decision dated 17th February 2009, An Bord Pleanála granted approval for this gas pipeline under section 182D of the Planning and Development Act, 2000 (as amended) (Board ref. PL08.GA0003). It follows that the permitted pipeline is an 'approved project', to which Annex IV(5)(e) of the EIA Directive applies. This means the EIA of the Proposed Development must include effects resulting from the cumulation of effects with the permitted pipeline. Similarly, the permitted pipeline is a project for the purposes of the 'in combination' assessment under the Habitats Directive. The pre-application observations made by the Development Applications Unit of the Department of Tourism, Culture, Arts, Gaeltacht, Sport and Media suggest that a revised assessment of the permitted pipeline would appear to them to be necessary. That revised assessment will be included within the required future application for consent under section 39A of the Gas Act 1976 (as amended). We are advised that no such revised assessment is necessary to complete necessary cumulative and in combination assessments. The necessary cumulative and in combination assessments have been completed, on the basis that the permitted pipeline is built in accordance with its existing approval. The potential for cumulative impacts with the gas pipeline are considered in Section 7A.6 below**.**
Powerlines exporting electricity	
It is understood that an underground cable is the preferred means of exporting electricity. However, if powerlines remain an option then the impact on birds dispersing between different parts of the SPA need to be assessed, with particular reference to mortality and/or electrocution.	The export of power from the site will form part of a separate application.
It is recommended that the following conservation issues are addressed in the Environmental Impact Assessment Report (EIAR) for the proposed development.	
White-tailed sea eagles There is a current release site for white-tailed sea eagles, under Phase II of the White-tailed Sea Eagles Reintroduction Project, within 7 km of the proposed development, and the potential impact on recently-released young eagles needs to be assessed. This species is particularly	Addressed in Chapter 07B – Terrestrial Biodiversity. An application to connect to the national electrical transmission network was submitted to EirGrid in September 2020 under the Enduring Connection Policy 2 (ECP2) process. As part of this grid connection application, Shannon LNG Limited made a specific connection method request for underground cabling, in lieu of overhead lines. Given the expressed preference for underground cabling by the Applicant, and the resistance of the Applicant to

Consultation Comment	Response
susceptible to powerline collision and electrocution.	overhead powerlines, no assessment of the impact of collision to birds from overhead powerlines is required.
Protected mammals A re-assessment of the use of the terrestrial and shore development area by the strictly protected species, otter needs to be carried out. Use of the terrestrial development site by dispersing and migrating bats also needs re-assessment.	Addressed in Chapter 07B – Terrestrial Biodiversity.
Fracked gas source – USA It is noted from the pre-planning meeting mentioned above that the project is not dependent on the use of shale (fracked) gas. However, in the event that this remains a possible option which is not strictly excluded from the proposed project, the following may need to be taken into account in the EIAR. There is concern of potential threats from gas fracking in Pennsylvania (in the Marcellus shale formation) to the listed species, rayed bean (*Villosa fabalis*), and snuffbox mussel (*Epioblasma triquetra*)[10]. While the obligation to assess impacts on jurisdictions outside of the European Union is not clear, nonetheless, it would be best practice to examine the impact of source gas extraction on protected wildlife, where such data is available.	The application does not propose or request permission for any extraction, refining or liquefaction of natural gas. The potential sources of liquefied natural gas (LNG) are varied and, although not possible to identify, will all be located outside of the State and almost all will be located outside of the European Union. The pre-application observations made by the Development Applications Unit of the Department of Tourism, Culture, Arts, Gaeltacht, Sport and Media suggest that the impacts of source gas extraction should be examined, where such data is available. In accordance with the decision of the High Court in An Taisce v. An Bord Pleanála [2021] IEHC 254 and 422, any impacts on the environment from extraction, refining or liquefaction of source gas are too remote from the Proposed Development to require examination, analysis and evaluation within the environmental impact assessment and appropriate assessment of the Proposed Development. We are advised that, for this reason, it is neither necessary nor appropriate to include particulars of any one place where source gas might be extracted.

[10] Federal Register (2012) 77:8650 https://www.govinfo.gov/content/pkg/FR-2012-04-14/pdf/2012-2940.pdf

7A.4 Baseline Environment

7A.4.1 Site Area Description

The Proposed Development will be located on the Shannon Estuary, 4.5 km from Tarbert and 3.5 km Ballylongford in Co. Kerry. The site for the Proposed Development is 52 hectares. The Shannon Landbank on which the site is located has a total area of 243 ha (603 acres).

The site boundary is shown in Figure 7A-1. The site consists primarily of agriculturally improved grassland, which runs along the southern shore of the Shannon estuary. The proposed jetty extends from the shoreline into the estuary. The shoreline in the general area is relatively sheltered and composed of shingle or low earthen cliffs. The land within the site is primarily used for grazing or hay/ silage. The type of grassland varies considerably with topography with some waterlogged sections. The lower section of a small watercourse forms the western boundary of the Proposed Development site. To the west of the Proposed Development site boundary, this stream forms a tidal creek and dense reed beds adjoin parts of its lower reaches near its discharge into the Shannon Estuary. Some drier land occurs close to the coast and there are larger, drier fields to the east of the site where the land is more intensively farmed. The site boundary is partly within and adjacent to the Lower River Shannon candidate Special Area of Conservation[11] (cSAC) and the River Shannon and River Fergus Estuaries Special Protection Area (SPA) (see Section 7A.4.2 below). SACs and SPAs are designated respectively due to their significant ecological importance for habitats and species protected under Annex I and Annex II respectively of the Habitats Directive, and for the protection of populations and habitats of bird species protected under the EU Birds Directive (Council Directive 2009/ 147/ EC).

Figure 7A-1 Proposed Development Site Boundary

[11] Candidate SAC sites (cSAC) or candidate SPA sites (cSPA) have the same level of protection as fully designated sites under Irish Law. Candidate sites are those that have been submitted to the European Commission, but not yet formally adopted under Ministerial Statutory Instrument (S.I.) (OPR, 2021). Legal protection, and therefore, the requirement for AA, arises from the date that the Minister gives notice of his/her intention to designate the site.

7A.4.2 Designated Sites

Designated sites in Ireland include Special Area of Conservation (SAC) and Special Protection Area (SPA) sites designated respectively under the Habitats Directive and Birds Directive. SACs and SPAs are considered further in the following section.

In Ireland, areas considered important for the habitats present or which hold species of plants and animals whose habitat needs protection are designated as Natural Heritage Areas (NHAs). NHAs and proposed NHAs (pNHAs) are considered in Chapter 07B – Terrestrial Biodiversity.

7A.4.2.1 Overview

Sites of conservation importance hosting habitats and species needing to be either maintained at or, where appropriate, restored to favourable conservation status have been identified by each Member State. Sites, species, and habitats protected under Directive 92/ 43/ EEC (Habitats Directive) and Directive 2009/ 147/ EC (Birds Directive). These are referred to as Natura 2000 sites. Natura 2000 sites are referred to as European sites in the Planning and Development Act 2000 (as amended) and in other Irish legislation. These terms are synonymous. European sites in Ireland, which form part of the EU-wide Natura 2000 network of protected sites, comprise SAC sites designated due to their significant ecological importance for habitats and species protected under Annex I and Annex II respectively of the Habitats Directive, and SPA sites designated for the protection of populations and habitats of bird species protected under the EU Birds Directive (Council Directive 2009/ 147/ EC). A specific named habitat and/ or (non-bird) species for which a SAC or SPA is selected is called a 'Qualifying Interest' (QI) of the site, while a specific named bird species for which a SPA is selected is called a 'Special Conservation Interest' (SCI) of the site (OPR, 2021). QIs and SCIs can be collectively referred to as ‘conservation features’. European sites are formally designated under a statutory instrument.

Under Article 6(3) and 6(4) of the Habitats Directive, competent authorities are required to conduct a screening for Appropriate Assessment (AA) and, if necessary, an AA, on any plan or project for which it receives an application for consent, or which the authority itself wishes to undertake or adopt.

The Habitats Directive was originally transposed into Irish law by the *European Communities (Natural Habitats) Regulations, 1997* (S.I. No. 94 of 1997). The 1997 Regulations were subsequently revoked and replaced by the *European Communities (Birds and Natural Habitats) Regulations 2011*, as amended (herein referred to as the 2011 Birds and Natural Habitats Regulations).

Under Regulation 42 of the 2011 Birds and Natural Habitats Regulations, all competent authorities are required to conduct a *Stage 1 screening for Appropriate Assessment* (AA) and, if necessary, a *Stage 2 AA* on any plan or project on the foreshore for which it receives an application for consent, or which the authority itself wishes to undertake or adopt. This obligation derives from Article 6(3) and 6(4) of the Habitats Directive.

The AA provision of the Habitats Directive is also transposed in Ireland by the Planning and Development Act 2000 (as amended) in respect of land use plans and proposed developments requiring development consent.

For the Proposed Development a *Screening Statement for Appropriate Assessment (AA) and Natura Impact Statement (NIS)* has been prepared to provide information to enable the competent authority to carry out a *Stage 1: Screening for AA* and a *Stage 2: AA* of the Proposed Development as required under Article 6(3) obligations under the Habitats Directive. The *Screening Statement for Appropriate Assessment* is discussed in Section 7A.4.2.2 below.

7A.4.2.2 European Sites

The lower River Shannon cSAC site and the River Shannon and River Fergus Estuaries SPA site extend along the northern/ north-western boundary and also along part of the eastern boundary of the Proposed Development site (Figure 7A-2). The proposed jetty and outfall will extend into the Lower River Shannon cSAC and the River Shannon and River Fergus Estuaries SPA (see Figure 7A-3 and Figure 7A-4 respectively). The

Short descriptions of the SACs and SPA are provided below, while detailed site descriptions are included in the site synopsis reports presented in Appendix A7A-6.

Lower River Shannon cSAC (Site code: 002165) (overlaps development area) – This very large site stretches along the Shannon valley from Killaloe in Co. Clare to Loop Head/ Kerry Head, some 120 km. The site thus encompasses the Shannon, Feale, Mulkear and Fergus estuaries, the freshwater lower reaches of the River Shannon (between Killaloe and Limerick), the freshwater stretches of much of the Feale and Mulkear catchments and the marine area between Loop Head and Kerry Head. The site is designated for a wide range of Annex I marine, coastal, freshwater aquatic and terrestrial habitats, while Annex II species for which the site is designated include marine mammals, diadromous fish species and freshwater aquatic species.

River Shannon and River Fergus Estuaries SPA (Site code: 004077) (overlaps development area) – The estuaries of the River Shannon and River Fergus form the largest estuarine complex in Ireland. The site comprises the entire estuarine habitat from Limerick City westwards as far as Doonaha in Co. Clare and Dooneen Point in Co. Kerry. The site has vast expanses of intertidal flats which contain a diverse macroinvertebrate community which provides a rich food resource for wintering birds. Salt marsh vegetation frequently fringes the mudflats and provides important high tide roost areas for the wintering birds. Elsewhere in the site the shoreline comprises stony or shingle beaches. The site is designated for the following species: Cormorant, Whooper Swan, Light bellied Brent Goose, Shelduck, Wigeon, Teal, Pintail, Shoveler, Scaup, Ringed Plover, Golden Plover, Grey Plover, Lapwing, Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Redshank, Greenshank and Black-headed Gull. The site is also designated for wetlands.

Potential impacts on designated European sites are addressed in the *Screening Statement for AA and NIS* which has been prepared to provide information to enable the competent authority to carry out a *Stage 1: Screening for AA* and a *Stage 2: AA* of the Proposed Development as required under Article 6(3) of the Habitats Directive. The *Screening Statement for AA and NIS* report concluded that the there are no likelihood of significant adverse effects on European sites.

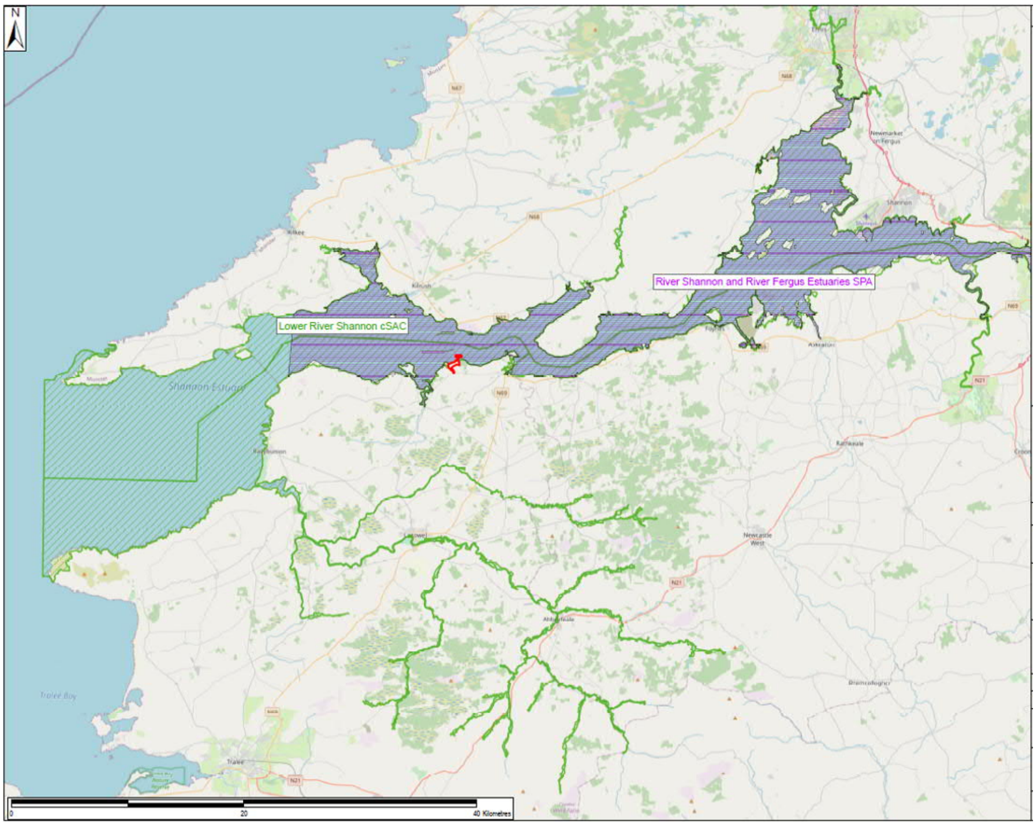

Figure 7A-2 Proposed Development Site Boundary Relative to the Lower River Shannon cSAC and the River Shannon and River Fergus SPA

Figure 7A-3 Proposed Jetty, Outfall and FRSU Relative to the Lower River Shannon cSAC

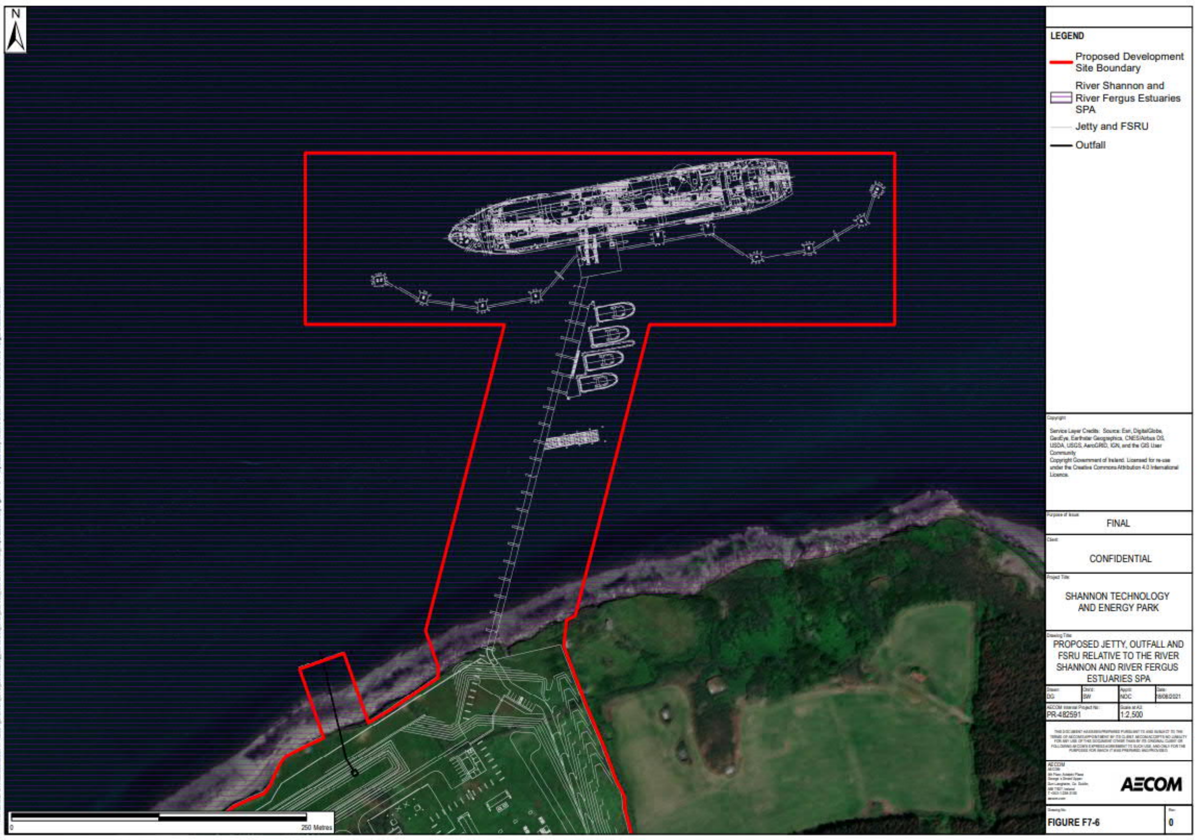

Figure 7A-4 Proposed Jetty, Outfall and FRSU Relative to the River Shannon and River Fergus SPA

7A.4.3 Habitats

7A.4.3.1 Marine/ Coastal Habitats

The Shannon and Fergus Estuaries form the largest estuarine complex in Ireland. They form a unit stretching from the upper tidal limits of the Shannon and Fergus Rivers to the mouth of the Shannon Estuary (considered to be a line across the narrow strait between Kilcredaun Point and Kilconly Point). Within this main unit there are several tributaries with their own ‘sub-estuaries’ *e.g.* the Deel River, Mulkear River, and Maigue River. To the west of Foynes, a number of small estuaries form indentations in the predominantly hard coastline, namely Poulnasherry Bay, Ballylongford Bay, Clonderalaw Bay and the Feale or Cashen River estuary. Both the Fergus and inner Shannon Estuaries feature vast expanses of intertidal mudflats, often fringed with saltmarsh vegetation (NPWS, 2013). The smaller estuaries also feature mudflats, but have their own unique characteristics, *e.g.* Poulnasherry Bay is stony and unusually rich in species and biotopes. Plant species are typically scarce on the mudflats, although there are some eelgrass (*Zostera* spp.) beds and patches of green algae (*e.g. Ulva* sp. and *Enteromorpha* sp.). The main macro-invertebrate community which has been noted from the inner Shannon and Fergus estuaries is a *Macoma-Scrobicularia-Nereis* community.

In the transition zone between mudflats and saltmarsh, specialised colonisers of mud predominate. For example, swards of Common Cord-grass (*Spartina anglica*) frequently occur in the upper parts of the estuaries. Less common are swards of Glasswort (*Salicornia europaea* agg.). In the innermost parts of the estuaries, the tidal channels or creeks are fringed with species such as Common Reed (*Phragmites australis*) and club-rushes (*Scirpus maritimus*, *S. tabernaemontani* and *S. triquetrus*). In addition to the nationally rare Triangular Club-rush (*Scirpus triqueter*), two scarce species are found in some of these creeks (*e.g*. Ballinacurra Creek), Lesser Bulrush (*Typha angustifolia*) and Summer Snowflake (*Leucojum aestivum).*

The site is an example of a large shallow inlet and bay. Littoral sediment communities in the mouth of the Shannon Estuary occur in areas that are exposed to wave action and also in areas extremely sheltered from wave action. Characteristically, exposed sediment communities are composed of coarse sand and have a sparse fauna. Species richness increases as conditions become more sheltered. All shores in the site have a zone of sand hoppers (small crustaceans) at the top, and below this each of the shores has different characteristic species giving a range of different shore types (NPWS, 2013)

The intertidal reefs in the Shannon Estuary are exposed or moderately exposed to wave action and subject to moderate tidal streams (NPWS, 2013). Known sites are steeply sloping and show a good zonation down the shore. Well-developed lichen zones and littoral reef communities offering a high species richness in the sublittoral fringe and strong populations of the Purple Sea Urchin (*Paracentrotus lividus*) are found. The communities found are tolerant to sand scour and tidal streams. The infralittoral reefs range from sloping platforms with some vertical steps, to ridged bedrock with gullies of sand between the ridges, to ridged bedrock with boulders or a mixture of cobbles, gravel and sand. Kelp is very common to about 18 m. Below this depth, it becomes rare, and the community is characterised by coralline crusts and red foliose algae.

Other coastal habitats that occur within the site include stony beaches and bedrock shores (these support a typical zonation of seaweeds such as *Fucus spp., Ascophyllum nodosum* and kelps), shingle beaches (with species such as Sea Beet, Sea Mayweed – *Matricaria maritima*, Sea Campion and Curled Dock – *Rumex crispus*), sandbanks which are slightly covered by sea water at all times (*e.g.* in the area from Kerry Head to Beal Head) and sand dunes (a small area occurs at Beal Point, where Marram – *Ammophila arenaria* is the dominant species) (NPWS, 2013).

The Conservation Objectives report for the cSAC (NPWS 2013) indicates that the site is designated for four lagoons. The lagoons are: Scattery Lagoon (5.9 km northwest of the development), Clooconeen Pool (18.1 km west), Quayfield and Poulaweala Loughs (26.5 km east), Shannon Airport Lagoon (35.5 km northeast of the development). There is also a small undocumented lagoon located approximately 4.5 km south west of Proposed Development. Saltmarsh vegetation also occurs around a number of lagoons within the site, two of which have been surveyed as part of a National Inventory of Lagoons. Clonconeen Pool (4-5 ha) is a natural sedimentary lagoon impounded by a low cobble barrier. Seawater enters by percolation through the barrier and by overwash. This lagoon represents a type which may be unique to Ireland since the substrate is composed almost entirely of peat. The adjacent shore features one of the best examples of a drowned forest in Ireland. Aquatic vegetation in the lagoon includes typical species such as Beaked Tassle Weed (*Ruppia maritima*) and green algae (*Cladophora* sp.). The fauna is not diverse, but is typical of a high salinity lagoon and includes six lagoon specialists (*Hydrobia ventrosa*, *Cerastoderma glaucum*, *Lekanesphaera hookeri*, *Palaemonetes varians*, *Sigara stagnalis* and *Enochrus bicolor*). In contrast, Shannon Airport Lagoon (2 ha) is an artificial saline lake with an artificial barrier and sluiced outlet. However, it supports two Red Data Book species of stonewort (*Chara canescens* and *Chara cf. connivens*).

A brackish lagoon (CW1) occurs within to the south west of the Knockfinglas Point. A specialist survey of the lagoon was carried out in October 2007. A report on these surveys which was prepared concluded: 'Despite the recorded salinity (0.8 – 1.1 parts per thousand) and presence of one plant, the brackish water Tassle Weed *Ruppia maritima*, none of the faunal taxa can be regarded as indicator species of coastal lagoons. One species, *Sigara concinna* has been listed by some authors as a lagoonal specialist in Britain but is found at inland sites in Ireland. The lake may have been a brackish water coastal lagoon in the past and still has a barrier typical of lagoons but is at present dominated by characteristically freshwater insects and molluscs with only a few species, *e.g.* Three-spined Stickleback, *Sigara concinna*, *Haliplus rufficollis*) that can tolerate any measure of salinity. In particular, the presence of Common newts indicate that the lake has been dominated by fresh water for some time. This water body is a marginal example of a lagoon as salinity barely exceeds 1 psu. Plants frequently found in lagoons include *Ruppia maritima*, *Ranunculus baudotii* and *Potamogeton pectinatus* (although this species also occurs in freshwater and is not indicative of lagoons). No lagoonal specialist animals were noted. However the pond's morphology-isolated from the sea by a shingle barrier is a typical lagoonal feature. On balance the pond may be regarded as a lagoon based on plants and morphology but with no fauna of note. Its conservation interest lies in its transitional nature between fresh and brackish conditions.'

7A.4.3.2 Intertidal and Subtidal Survey

Shannon LNG commissioned AQUAFACT to undertake a series intertidal and subtidal surveys in the vicinity of the Proposed Development. The details of the surveys undertaken in 2020 are provided in full in Appendix A7A-1. In April 2020, four intertidal transects (T1, T3, T7, T8) were surveyed. Transects T3, T7 and T8 were previously surveyed in 2012 while T1, T3, T7 and T8 were surveyed in 2006/ 2007. The locations of the transects are shown in Figure 7A-7. For the subtidal survey a total of 10 stations were sampled in April 2020. All stations sampled can be seen in Figure 7A-8 and their locations were selected in order to be representative of the previous survey sites. Station coordinates are presented in Table 7A-3. The intertidal habitats encountered are typical of cobbly rocky shores in Ireland being dominated by *Pelvetia canaliculata*, Fucus sp. and *Ascophyllum nodosum*. No rare, protected or unusual species were observed, and no changes were observed compared to previous surveys undertaken.

The subtidal fauna was dominated by species typical of fine sandy habitats *e.g.* the polychaetes *Nephtys cirrosa*, *Paradoneis lyra*, *Travisia forbesii*, *Pholoe inornata* and *Scoloplos armiger*, the bivalve *Nucula* spp. and the amphipods *Metaphoxus simplex* and *Harpinia antennaria*. In areas with boulders or cobbles there were abundant populations of the tunicate *Dendrodoa grossularia*. No rare, protected or unusual species were observed. One-way ANOVA shows a significant difference between the Shannon-Weiner Diversity and the Effective Number of Species between the 2020 and 2012 results. Whether this is a seasonal variation due to the difference in time of surveys (October in 2012 and April in 2020) is unknown. Despite the significant decreases in these indices from 2012 to 2020, the dominant taxa present are similar in both surveys and indicate similar community types between surveys. All species observed are typical of this area of the Lower River Shannon Estuary cSAC. AMBI analysis indicated that all sites were either undisturbed or slightly disturbed due to the high proportion of sensitive species at each station. Slight variations in the substrate type were observed between this survey and the previous one. Given the strong current speeds and mobile sediments in the area, this is not unusual.

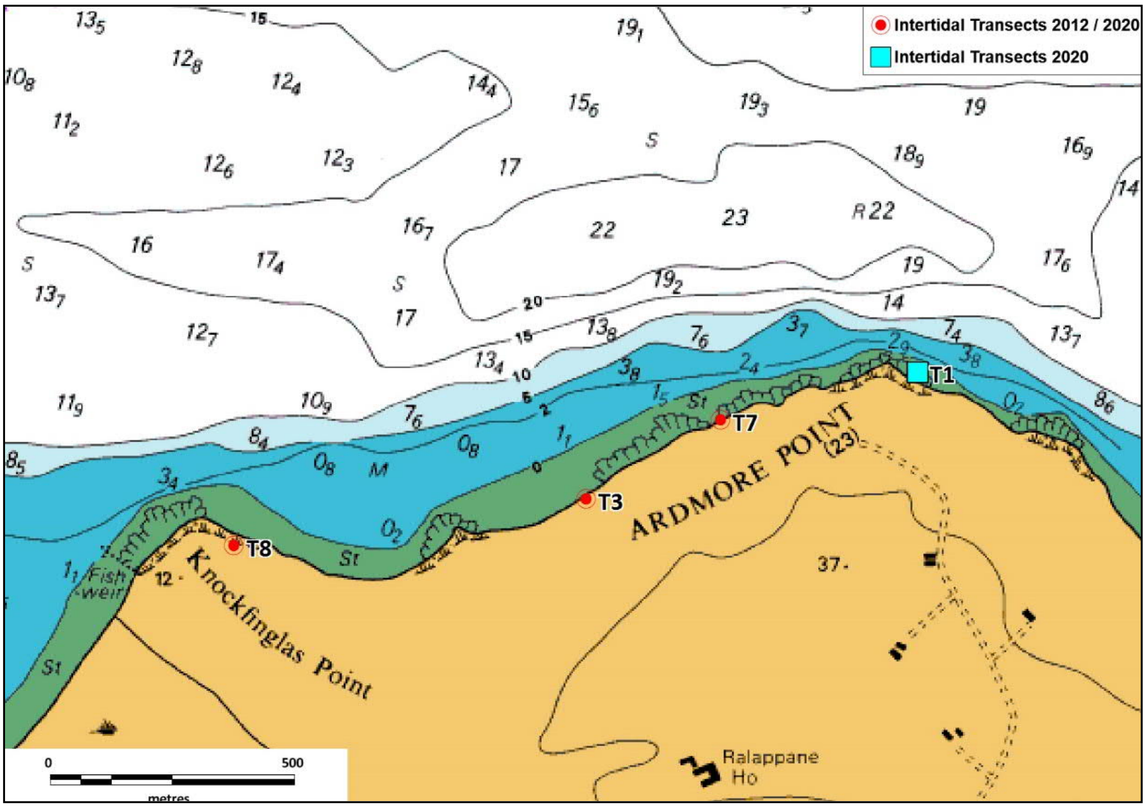

Figure 7A-5 Location of the Intertidal Transects Surveyed

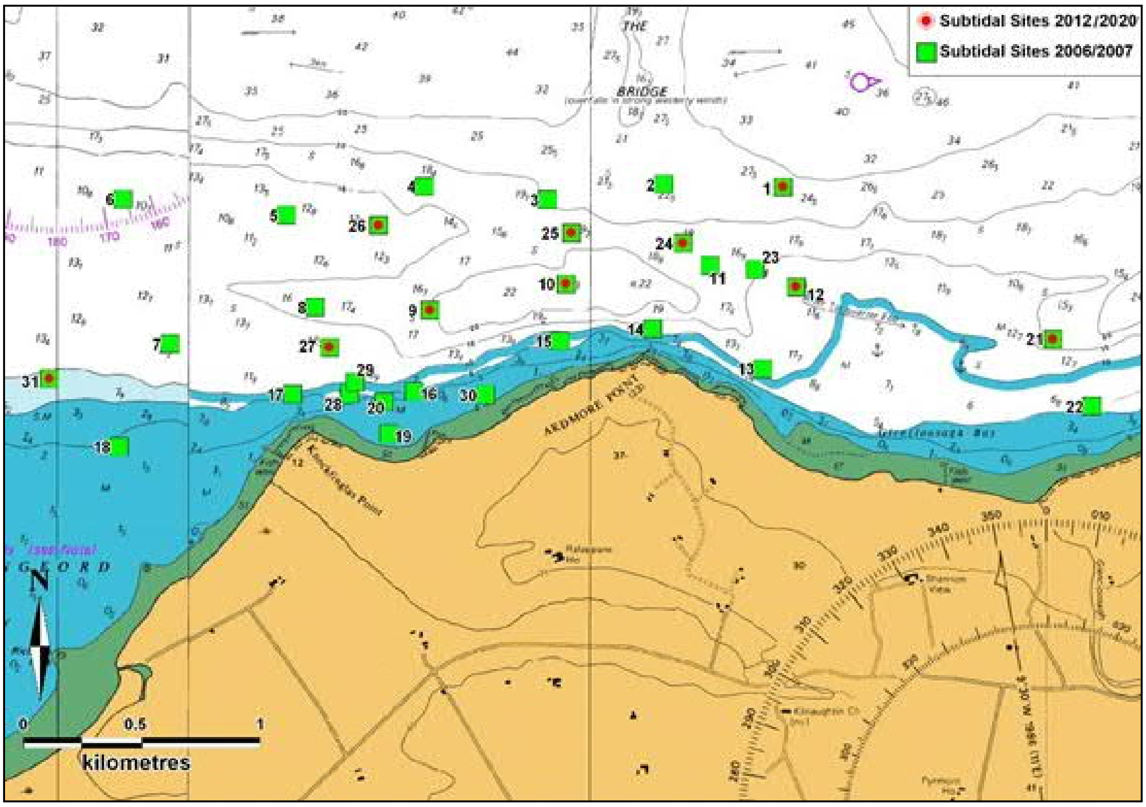

Figure 7A-6 Location of all 10 Stations Sampled in April 2020 and October 2012, and the 31 Stations Sampled in 2006/ 2007

Table 7A-4 Coordinates

Station	Longitude	Latitude	Longitude	Easting	Northing
S1	-9.42206	52.59132	-9.42206	103676.3	149798.2
S9	-9.44401	52.58662	-9.44401	102178.6	149304.8
S10	-9.43554	52.58762	-9.43554	102754.8	149404.6
S12	-9.42125	52.58752	-9.42125	103722.9	149374.3
S21	-9.40523	52.58555	-9.40523	104804.4	149134.3
S24	-9.42828	52.58917	-9.42828	103250.1	149567.5
S25	-9.43522	52.58955	-9.43522	102781.1	149619.4
S26	-9.44723	52.58982	-9.44723	101967.3	149665.4
S27	-9.45025	52.5852	-9.45025	101752.5	149155.8
S31	-9.4677	52.58398	-9.4677	100567.1	149044.3

7A.4.4 Marine Mammals

Bottlenose Dolphin (*Tursiops truncatus*)

The Lower River Shannon cSAC is one of five sites designated for bottlenose dolphins in Irish waters. Studies on the resident bottlenose dolphin population in Shannon Estuary have been occurring since 1993 by the Irish Whale and Dolphin Group (IWDG) and by the National Parks and Wildlife Service (NPWS) of Ireland as part of the EU's obligation to ensure conservation of this species (Blázquez *et al.,* 2020).

Data collected over 20 years show that the Shannon Estuary dolphin population is genetically and demographically isolated from other coastal dolphins (Mirimin *et al.,* 2011; O'Brien *et al.,* 2016; Rogan *et al.,* 2018). Mark-recapture photo-identification studies indicate that bottlenose dolphins in the Shannon Estuary exhibit long-term site fidelity and seasonal residency (*e.g.*, Ingram 2000; Ingram and Rogan 2002; Ingram and Rogan 2003; Englund *et al.,* 2007, 2008; Berrow 2009; Rogan *et al.,* 2018). The most recent photo-identification study occurred during June–October 2018, resulting in a mark-recapture abundance estimate of 139 individuals (CV=0.11, 95% CI=121–160) (Rogan *et al.,* 2018). Baker *et al.,* (2018a) provided an estimate of 145 individuals for 2015, based on direct counts. The median group size based on boat surveys throughout the estuary is 6 (*e.g.*, Englund *et al.,* 2007, 2008; Rogan *et al.,* 2018), and the average group size has been reported as 9.71 (Barker and Berrow, 2016). The mean group size (±SD) at the proposed LNG site at Ardmore Point was estimated at 6.2 ± 3.1 dolphins, based on watches from shore (Berrow *et al.,* 2020).

Although the dolphins inhabit the Shannon Estuary year-round, the greatest number appear to occur there between June and August (Garagouni *et al.,* 2019), with decreasing numbers during the winter (Ingram 2000; Englund *et al.,* 2007; Rogan *et al.,* 2018). The lower numbers during winter may be due to animals dispersing over a wider region in pursuit of prey affected by the seasonal changes (Garagouni *et al.,* 2019); however, data on the distribution of the population during winter is generally lacking. However, dolphin sightings were made off Ardmore Point each month during monitoring from October 2020 to March 2021 (Berrow, 2020 a,b,c, 2021 a,b,c). One photo-identification study found that at least 62% of individuals from the Shannon bottlenose dolphin population also use waters outside of the Shannon Estuary during the summer (May–August), including Brandon Bay and Tralee Bay located adjacent to estuary (Levesque *et al.,* 2016).

Bottlenose dolphins in the Shannon Estuary prefer areas with the greatest slope and depth (Ingram and Rogan 2002). Two critical habitat areas occur within Shannon Estuary that at least part of the population migrates between throughout the year; the larger of the two areas is located near the mouth of the estuary closest to Kilcredaun, and the smaller is located off Moneypoint, close to the proposed STEP development (see Figure 7A-9; NPWS 2012, Ingram and Rogan, 2002; Rogan *et al.,* 2018). In general, a smaller proportion of the population is found in the eastern part of the estuary compared to the western part (Baker *et al.,* 2018b). The distribution of sightings in 2018 showed that dolphin presence throughout the estuary was similar to past studies but noted greater activity within the inner estuary where it constricts near Tarbert/ Killimer and farther upriver (see Figure 7A-10 and Figure 7A-11) (Ingram and Rogan, 2002; Rogan *et al.,* 2018). Baker *et al.,* (2018b) found that only 25% of the population regularly uses the inner estuary; those dolphins were also seen in the outer estuary. Within the critical habitat areas, the dolphins appear to most commonly be found near northern-facing slopes (Garagouni *et al.,* 2019). Dolphin distribution in the estuary is also correlated with tide level, with higher presence in bottleneck areas during ebb and slack low tides (Garagouni *et al.,* 2019).

The area around the proposed LNG site at Ardmore Point has not been identified as a hot spot for bottlenose dolphin occurrence based on commercial dolphin-watching activities (see Berrow *et al.,* 2020 (see Appendix A7A-2). However, sightings have been made in the area during several vessel-based surveys (*e.g.*, Ingram and Rogan, 2003; Englund *et al.,* 2007, 2008; Berrow *et al.,* 2012). Visual observations from shore at Ardmore Point show that the site is regularly used by the dolphins, which pass by the area but rarely stop and socialize or forage there; it is more likely used as a transition corridor to move between the outer and inner estuary (Berrow *et al.,* 2020). During 23 days of observations from April through September 2020, 21 sightings of dolphins were made on 13 separate watch days. Most sightings were made off Moneypoint, near the ferry, near Scattery Island, and mid-channel; six sightings were made within 500 m of Ardmore Point, and a total of 22 individual dolphins were identified. During 23 observation days from October 2020 to March 2021, 20 dolphin sightings were made on 15 different watch days (Berrow, 2020 a,b,c, 2021 a,b,c). Thus, the encounter rates of bottlenose dolphin groups were similar during spring/ summer and fall/ winter, at 0.2 groups/hour of observation.

Passive acoustic monitoring with C-POD porpoise detectors was also conducted at two sites off Ardmore Point from August 2019 through May 2020; dolphin clicks were detected on 62% of monitoring days at each of the two sites (Berrow *et al.,* 2020). The C-POD located closest to the LNG site (LNG1) had a mean detection positive minutes (DPM) per day of 4.4, whereas LNG2 had a DPM of 3.6; DPM was lower at LNG1 during the winter than during other seasons. The low DPM per day at these two sites supports evidence from visual monitoring that the area around Ardmore Point is primarily a transit corridor (Berrow *et al.,* 2020). There were significantly more detections during the evening than during the day at LNG1, and significantly more detections in the evening and at night than during the day at LNG2 (Berrow *et al.,* 2020).

The Shannon Estuary also acts as a calving area for the species, with neonates most frequently observed from July to September (Ingram, 2000; Baker *et al.,* 2018a). An average of seven calves are born each year, with weaning taking place at a mean age of 2.9 years (Baker *et al.,* 2018a). During watches from Ardmore Point, 10 calves were recorded, including four that were born in 2018 and 2019 (Berrow *et al.,* 2020).

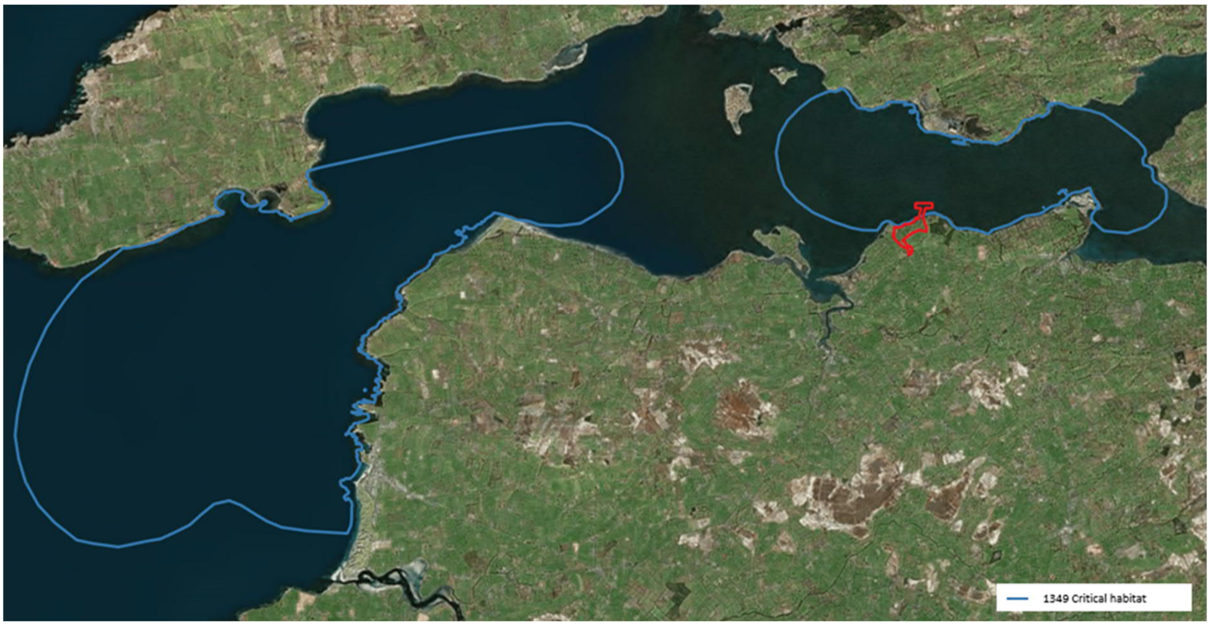

Figure 7A-7 Bottlenose Dolphin Critical Areas, Representing Habitat Used Preferentially by the Species (adapted from NPWS 2012, Ingram and Rogan 2002; Rogan *et al*. 2018).

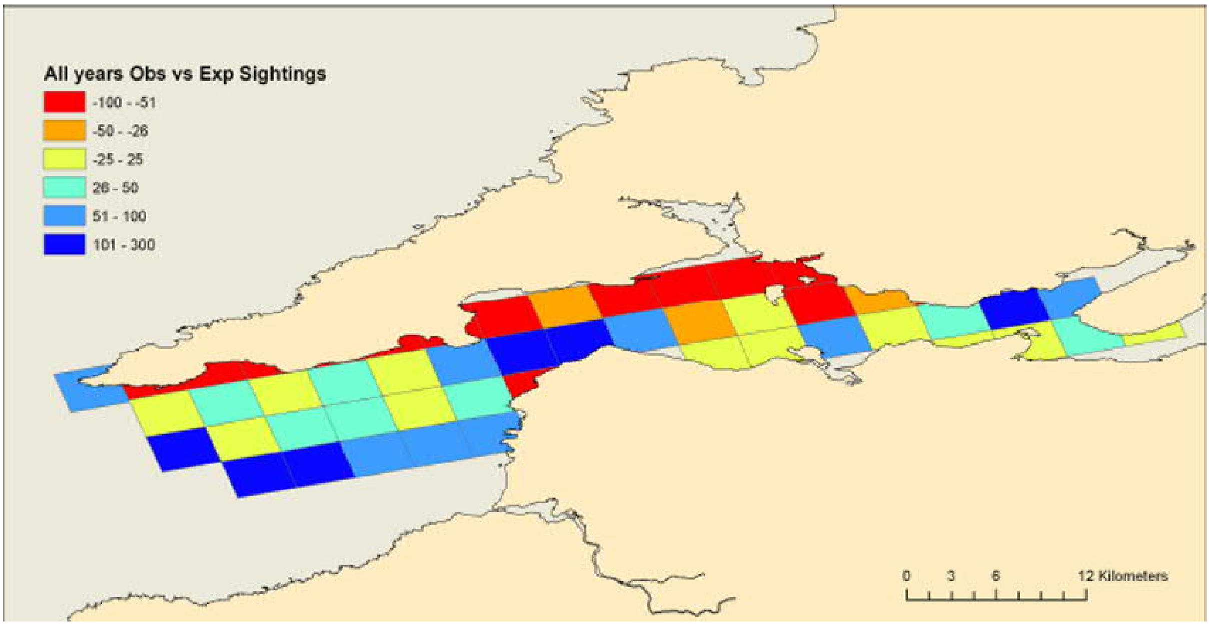

Figure 7A-8 Scoring Assessment for Habitat Suitability for Bottlenose Dolphins in the Shannon Estuary (adapted from Berrow *et al*., 2012)

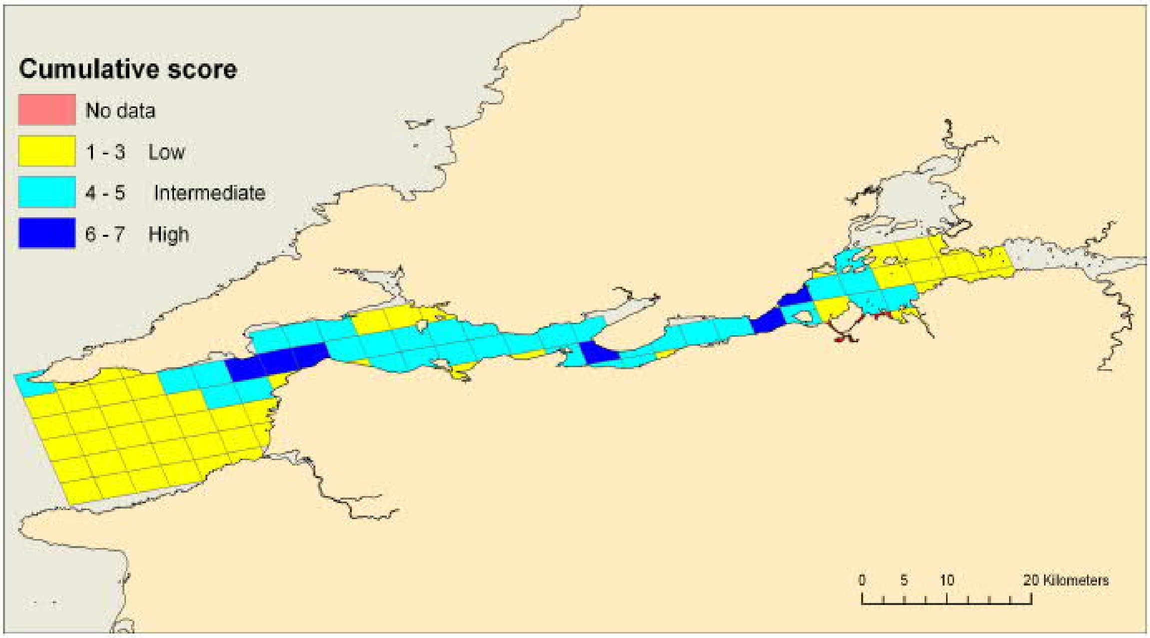

Figure 7A-9 Scoring assessment for Habitat Suitability for Bottlenose Dolphins in the Shannon Estuary (adapted from Berrow *et al.,* 2012)

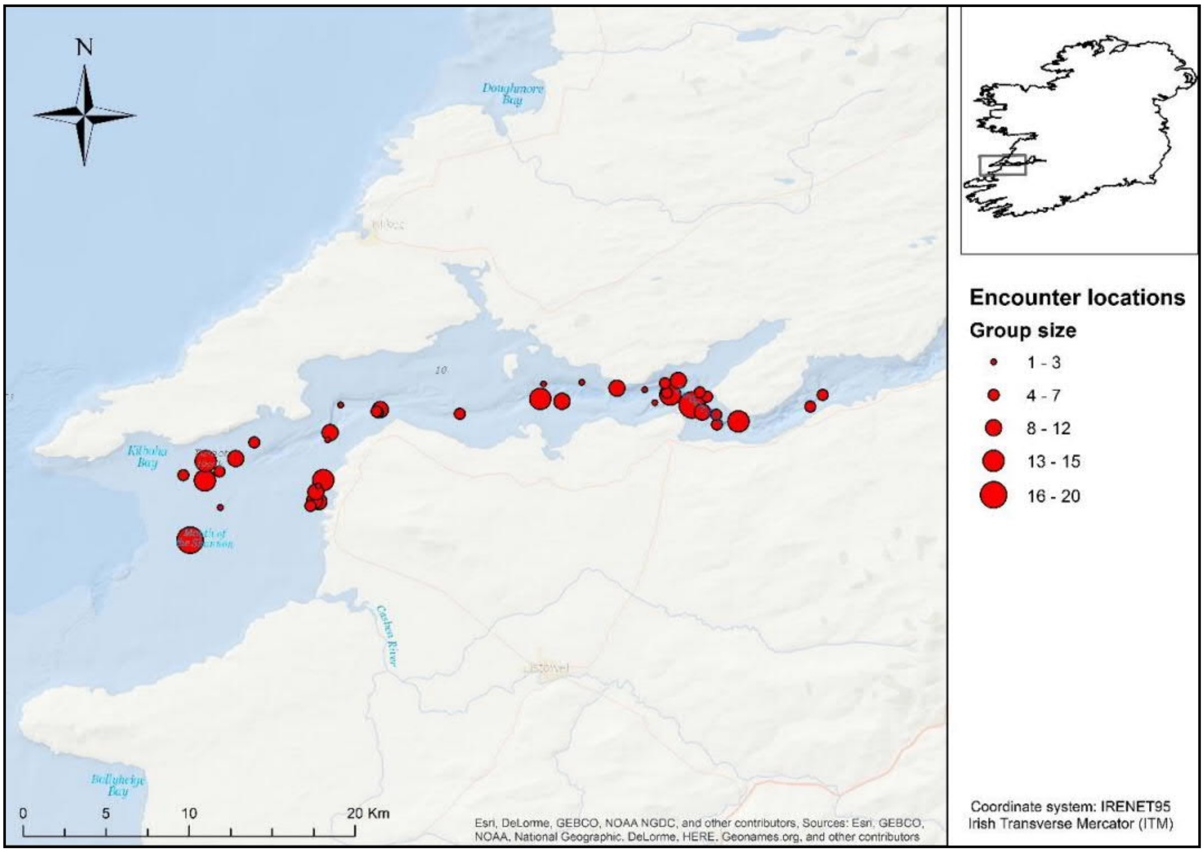

Figure 7A-10 Locations of Bottlenose Dolphin Schools Encountered during Surveys of the Lower Shannon Estuary, 2018. Estimated Group Sizes are Denoted by Symbol Diameters (adapted from Rogan *et al*., 2018)

Harbour Porpoise (*Phocoena phocoena*)

The Harbour Porpoise (*Phocoena phocoena*) (Linnaeus, 1758) is the most widespread and abundant cetacean species present in Irish waters (Berrow, 2001). Harbour Porpoise have been recorded all along the Irish coast but are most abundant off the south west and south east coasts (Wall *et al.* 2013). Harbour porpoise are listed on Annex II of the EU Habitats Directive and thus Special Areas of Conservation are required in order to protect a representative range of the habitats for this species in the member state. The sites are designated as Special Areas of Conservation (SACs) and must be surveyed regularly to ensure favourable conservation status of the qualifying interest is achieved.

Although harbour porpoise occurs regularly along the coast of Ireland (O'Brien, 2016), they are rarely seen in the Shannon Estuary (O'Callaghan *et al*. 2021). Sightings have occurred in the inner estuary (Berrow, 2020a, Berrow *et al.,* 2020; O'Callaghan *et al*,. 2021). One sighting was made on 22 October 2020 of a single harbour porpoise that was foraging for ~1 hr near Moneypoint (Berrow, 2020a; O'Callaghan *et al*., 2021). Another sighting of an adult and juvenile was made near Scattery Island in 2018 (O'Callaghan *et al.,* 2021). One sighting of two porpoise was made in the outer estuary during July 2005 (O'Callaghan *et al.,* 2021). In addition, six strandings have been reported in the Shannon Estuary (O'Callaghan *et al*., 2021). Possible porpoise clicks have also been detected during monitoring in summer/ fall 2018 at two sites off Ardmore Point (Berrow *et al.,* 2020) and off Moneypoint (O'Brien *et al.,* 2013). However, O'Callaghan *et al*., (2021) note that these high-frequency clicks could have been generated by dolphins.

Grey seal (*Halichoerus grypus*)

The grey seal (*Halichoerus grypus*) is the larger of two species of true seal (Phocidae) that commonly breed around the coast of Ireland and that travel, find food and engage in other ecological functions in its inshore and offshore waters. Grey seals in Ireland are generally considered part of a larger interacting population or metapopulation that also inhabits adjacent jurisdictions (*i.e.,* the UK and France at least). They occur widely in estuarine, coastal and offshore marine areas while individual seals may also occasionally travel upstream within river systems to a distance several kilometres from the coast (Ó Cadhla *et al*., 2013).

Grey seals are common in the Shannon Estuary. The National Biodiversity Data Centre (NBDC) database contains 231 records of the species in the Shannon Estuary, 46 of which are within close proximity to the proposed project. Rogan *et al*. (2018) reported four sightings of grey seals in Shannon Estuary during dolphin surveys in the summer/ fall of 2018, including two pups hauled out on a beach. During shore-based observations from Ardmore Point from April to August 2020, individual grey seals were seen on six occasions, five of which occurred within 500 m of the site (Berrow *et al*., 2020). Sightings of individual grey seals were also made during monitoring in October 2020, January 2021, February 2021 (Berrow, 2020a, 2021a,b). Cronin *et al.,* (2011) also reported movement of grey seals from the outer coast into the estuary and Cadhla and Strong (2007) documented a breeding site in the outer estuary. Duck and Morris (2013) reported two sightings in the Inner Shannon Estuary during summer surveys in 2003, but no sightings during surveys in 2012.

Harbour seal (*Phoca vitulina vitulina*)

The harbour seal *Phoca vitulina vitulina* is one of two seal species native to Irish waters. Like their larger grey seal (*Halichoerus grypus*) relatives, harbour seals have established themselves at terrestrial colonies (or haul-outs) along all coastlines of Ireland, which they leave when foraging or moving between areas, for example, and to which they return to rest ashore, rear young, engage in social activity, etc. (Cronin *et al.,* 2004). These seals come to shore during June to give birth and mate again around this time but usually in the water. Pups are capable of swimming within a few hours of being born but stay with their mother until weaned. Common Seals also come to shore to moult (shed their fur) during July and August often forming large groups on sheltered shores that have ready access to the sea. During this period when the majority of seals are ashore is when counts of animals are undertaken to estimate population size (Cronin *et al*., 2004).

Sightings reported through the NBDC identify three records of sightings of harbour seal in the inner Shannon Estuary, in the Fergus Estuary. The NBDC also identifies seven sightings of harbour seal close to the vicinity of the project, three at Kilrush, three at Scattery Island, and one at Tarbert.

Cronin *et al*., (2010) reported a gap in harbour seal distribution in the Shannon Estuary. Sightings reported through the NBDC include three records for the Fergus Estuary, and seven records near the proposed project location — three at Kilrush, three at Scattery Island, and one at Tarbert. Duck and Morris (2013) reported one harbour seal sighting in the Inner Shannon Estuary during surveys in 2012, and eight sightings during surveys in 2003; no sightings were made in the Outer Shannon Estuary during either survey.

Other Species of Marine Mammal

The NBDC online database records sightings and strandings of marine mammal species around the Irish coast. A total of 4 other whale and dolphin species have been recorded in the Shannon Estuary see Table 7A-5.

Table 7A-5 Marine Mammals Recorded in the Shannon Estuary (source NBDC)

Odontocetes (Toothed Whales and Dolphins)
Atlantic White-sided Dolphin (*Lagenorhynchus acutus*)
Common Dolphin (*Delphinus delphis*)
Long-finned Pilot Whale (*Globicephala melas*)
Striped Dolphin (*Stenella coeruleoalba*)

Atlantic White-sided Dolphin (*Lagenorhynchus acutus*)

This dolphin often occurs in groups from tens to hundreds, and can occur in groups of up to 1,000, most often offshore. Their distribution in northwest Europe is predominantly clustered in an area from west of Ireland, to the north and north-west of Britain. Smaller numbers occur around the west of Ireland. It is possible that they follow mackerel as they spawn off the south-west of Ireland's coast in February/ March. The only record of an Atlantic White-sided dolphin in the Shannon Estuary was a stranded animal observed in 2005.

Common dolphin (*Delphinus delphis*)

Common dolphin is the most widespread and abundant dolphin species in Ireland, occurring throughout all Irish waters to varying densities with the bulk of the records from offshore waters on the Irish Shelf off the south and southwest coasts (Wall *et al*., 2013). Recorded all year round, the highest densities were recorded off the south and south-west coasts in the summer and autumn. Extremely large pods (100 – 1000s) can occur in the southern approaches of the Irish Sea in spring and summer. There are three records of Common Dolphin strandings from 2005-2015.

Long-finned Pilot Whale (*Globicephala melas*)

The long-finned pilot whale is one of the largest dolphins, with lengths averaging 6.7m for males and 5.7m for females, they have a square bulbous head with a lightly protruding beak. The body is dark grey to black with a grey-white anchor shaped patch on the chin. The species is typically found in water depth of 200 – 3,000 m beyond the Irish shelf edge where bottom relief is greatest but can also swim into coastal bays and fjords. They are often seen with other cetaceans, notably bottlenose dolphins. Most often, pilot whales occur in large pods (approximately 20 individuals), and large numbers of up to 1,000 have been observed off the British Isles during April, coinciding with the start of peak conception. There have been 4 events involving long-finned pilot whales in the Shannon Estuary according to the NBDC. These events occurred at Ballybunnion, Kerry; Carrigaholt, Clare; Beal Strand, Kerry and Poulnasherry, Clare.

Striped Dolphin (*Stenella coeruleoalba*)

These dolphins are sleek in appearance, with a body coloration consisting of dark grey cape extending from the beak to the dorsal fin, lighter grey flanks, leading to a pink-white underside. Sightings of striped dolphin in Ireland are very rare. By-catch data indicate their presence in the deep waters to the southwest of the Irish Shelf. This data is insufficient to infer seasonal or temporal trends. The NBDC database includes a number of 4 recorded strandings of the species in the Shannon Estuary, 1 at Carrigaholt, Clare, in 1993 and 3 at Ballybunnion between 2007 and 2012.

7A.4.5 Fish

A number of Ireland's native diadromous species pass through the Lower Shannon Estuary on their way to or from freshwater spawning grounds or reside there for feeding as they mature. These include four species of nature conservation interest in the area, namely twaite shad (*Allosa fallax fallax*), sea lamprey (*Petromyzon marinus*), river lamprey (*Lampetra fluviatilis*), and Atlantic salmon (*Salmo salar*). These are all listed on Annex II of Council Directive 92/ 43/ EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (EU Habitats Directive). The Habitats Directive ensures the conservation of a wide range of rare, threatened, or endemic species in Europe. Annex II species are classified as such when core areas of their habitat are designated as sites of community importance (SCIs), which must be managed corresponding to the species' ecological requirements. Additionally, the twaite shad and the sea lamprey are listed under Annex V, which mandates that EU Member States are required to manage exploitation of the species so that conservation status remains favourable (EU Commission 2021).

Fish stock surveys were conducted by Inland Fisheries Ireland in September to November 2008 and in October 2014 in the Upper and Lower Shannon Estuary using a beach seine, fyke net, or beam trawl (Kelly *et al*. 2015). Within the Upper Shannon Estuary, 15 and 22 species of fish were recorded during 2008 and 2014, respectively, and flounder, sprat and sandy goby were the most abundant species during the 2014 survey. Within the Lower Shannon Estuary, 31 fish species were recorded in a 2008 survey and 29 were recorded in 2014. Out of these species, sprat was the most abundant, followed by sand goby, thick-lipped mullet, and sand smelt (Kelly *et al*., 2015). European eels were caught in the Upper Shannon Estuary in 2008 and 2014, and the Lower Shannon Estuary in 2014 only (Kelly *et al.,* 2015).

Twaite Shad (*Alosa alosa fallax*)

Twaite shad is an anadromous fish and member of the herring (Clupeidae) family that is distributed across the north-eastern Atlantic, with Iceland as the northernmost extent of its range, Morocco as the southernmost and the Baltic Sea as the easternmost (Aprahamian *et al*., 2003). They are listed as *least concern* globally on the IUCN Red List (IUCN 2021) but as *vulnerable* in the Ireland Red List (King *et al*., 2011), a version of the IUCN Red List (using the same population status evaluations) in which regional species population statuses in Ireland are assessed, established by the National Parks and Wildlife Service. Adult twaite shad generally migrate from the marine environment into freshwater environments to spawn from February in the south of its range to May and June in the north (Davies *et al.,* 2020). The river migration period can last for three months, and seaward migration occurs for surviving adults after spawning and for young-of-the-year in the summer and fall (Maitland and Hatton-Ellis, 2003; Davies *et al*., 2020).

Four rivers in Ireland have been shown to support spawning grounds and spawning populations of twaite shad including the Munster Blackwater and the three rivers within the Barrow-Nore-Suir river system (King and Roche, 2008; Davies *et al*., 2020; Gallagher *et al*,. 2020), entries to which are located on the southwestern coast of Ireland.

Sea Lamprey (*Petromyzon marinus*) and River Lamprey (*Lampetra fluviatilis*)

Sea lamprey and river lamprey are anadromous species found in the Northern Hemisphere. The sea lamprey is listed as near threatened in the Ireland Red List (King *et al*., 2011), but as least concern globally on the IUCN Red List (IUCN, 2021), and the river lamprey is listed as least concern on both Red Lists. Their populations are declining in Ireland and Europe due to overharvesting, habitat destruction, and the loss of spawning and nursery grounds from the construction of anthropogenic barriers blocking upstream access (Igoe *et al*., 2004; Bracken *et al*., 2018). For example, Silva *et al*. (2019) found that sea lampreys in the River Ulla experience a mean delay of 6.3 days per river obstacle during upstream migration. Lampreys typically spend their first years (two to eight for sea lampreys, three to five for river lampreys) in freshwater before migrating out to sea following a period of metamorphosis (Igoe *et al*. 2004). During this period of metamorphosis, lampreys will spend up to ten months without feeding and will begin early feeding in estuarine or coastal waters (Silva *et al.* 2012). Sea and river lampreys return to freshwater as adults and will spawn in areas with fast-flowing water and gravel bottoms where they can create shallow depressions or nests. All lampreys are semelparous and will die after a single spawning event (Bracken *et al*., 2018).

Sea lampreys are found in all suitable rivers in Ireland and have been particularly noted in the River Shannon, River Suir, River Nore, River Moy, and the River Corrib (Igoe *et al.*, 2004). On the Mulkear

River, a main tributary of the River Shannon, adult sea lamprey have been found spawning over nests until mid-May, and most adults leave by early August (Igoe *et al.,* 2004). A study by Bracken *et al.* (2018) used environmental DNA (eDNA) to identify critical habitat for sea lamprey in Ireland. The eDNA sampling technique allows for the detection of low-density species and enables more effective and accurate deployment of resources and time allocation when collecting biological samples. Over a three-year period (2015-2017), they surveyed two different catchments in Ireland that included the Munster Blackwater and the Mulkear, the latter of which forms part of the Lower River Shannon cSAC. Sea lamprey spawning aggregations and habitat use within both catchment areas were confirmed following eDNA collection and eDNA concentrations were higher within the Mulkear catchment (Bracken *et al.,* 2018). River lampreys are less apparent than sea lampreys due to smaller body size, and documentation of distribution information in Ireland is less thorough, although its riverine range seems to largely overlap with that of the sea lamprey (Igoe *et al.*, 2004). Key populations of river lamprey have been documented in the Mulkear River, and large numbers have been recorded in the Lower River Shannon and its tributaries. Additionally, they inhabit rivers including the Slaney, Barrow, Nore, Munster Blackwater, Laune and Boney (Igoe *et al*., 2004), and lamprey larvae have been found in the Mulkear and Munster Blackwater rivers

European Eel (*Anguilla anguilla*)

The common or European eel, *Anguilla anguilla* (Linnaeus, 1758), occur throughout Ireland. The European eel is not listed as part of the EU Habitats Directive; however, it is considered critically endangered on the IUCN Red List (IUCN, 2021) and the Ireland Red List (King *et al.,* 2011) and is listed as a CITES Appendix II species, meaning the species is not currently threatened with extinction but trade is controlled to prevent this from occurring (CITES, 2021). Recruitment of juveniles into Irish catchments has declined dramatically.

European eels are a catadromous species that undergo five principal stages throughout their life history including the *leptocephalus*, glass eel, elver, yellow eel, and silver eel (adult) stages. Adult eels spawn in the Sargasso Sea, and larvae and *leptocephali* drift on the Gulf Stream until they are transported across the Atlantic Ocean (Arai *et al.*, 2006). *Leptocephali* metamorphose into glass eels and then elvers, with both stages typically arriving on the Irish coast during December and increasing in numbers during spring (Moriarty, 1999). At this point they typically migrate upstream, approximately six to eight months after hatching, with elvers using freshwater habitats to grow into yellow eels and mature as silver eels. However, not all eels undergo full upstream migration and are instead estuary-dependent, relying entirely on the estuarine environment for food resources, shelter, and nursing grounds. The estuarine environments in Ireland, however, are limited by high altitude land patterns; therefore, most eels are constrained during their growth period to either freshwater or marine environments (Arai *et al*., 2006). Mature adults will then migrate downstream to the sea in autumn with possible continuation through late spring.

The River Shannon is Ireland's largest river system, and it has a network of lakes which are important habitats for the European eel. Within the river system, otolith analysis has determined that male silver eels are 11 years old on average, and females are 15 years old (McCarthy *et al*., 2008). Stocking programs of juvenile eel have been in place to address adverse effects of the Shannon hydropower structures on eel recruitment and were most successful during the 1970s and 1980s; however there are still steady declines in both yellow and silver eel populations in the Shannon system (McCarthy *et al.,* 2008). The fishery for European eel in the River Shannon is long established, with detailed records dating from 1960 onwards (McCarthy *et al.,* 1999).

Atlantic Salmon (*Salmo salar*)

Atlantic salmon is an anadromous species that is found in Europe and North America. Adult salmon migrate from the sea into rivers to spawn, usually in the same river that they spent time as a juvenile (CEFAS, 2021). Salmon require clean, well oxygenated rivers with gravel beds for the female to bury her eggs in redds. Spawning in Europe typically takes place from November to December. Juveniles hatch as alevins, emerge from the redds as fry and grow into parr. After approximately four years, parr become smolt through a process called smoltification and migrate to sea where they can mature (CEFAS, 2021). Atlantic Salmon are listed as vulnerable in Europe under the IUCN Red list (IUCN, 2021) and in Ireland under the Ireland Red List (King *et al*., 2011). Atkinson *et al.* (2020) studied the effects of river obstacles to anadromous species including Atlantic salmon and concluded that the removal of river obstacles such as bridges, culverts, would improve connectivity between river catchments and habitats.

Atlantic salmon has been observed spawning in the Lower Shannon Estuary and its tributaries. Catch and release studies of Atlantic salmon have estimated that the annual rod catch between 2009-2013 in the Mulkear, a large tributary of the Shannon catchment, was 970 salmon, while the Feale had an annual catch average of 1,350 (Gargan *et al*., 2015). Salmon monitoring programs conducted in the Shannon River Basin district since 2007 have concluded that three rivers (the Feale, Kilmastula, and Old Shannon) meet the conservation threshold of 17 salmon fry/ 5 min during electrofishing surveys showing healthy juvenile salmon abundance (Gargan *et al*., 2020).

Hearing

All fish have hearing and skin-based mechanosensory systems, such as the inner ear and the lateral line, that provide information about their surroundings (Popper *et al*., 2019a; Putland *et al*., 2019). While all fish are likely sensitive to particle motion, not all fish (*e.g.*, cartilaginous fish, such as sharks and jawless fish) are sensitive to the sound pressure component. Potential effects of exposure to anthropogenic sound on fish can be behavioural, physiological, or pathological.

Several authors have reviewed the hearing ability of fish (*e.g.* Popper and Fay, 1993, 2011; Popper *et al*., 2014, 2019a; Putland *et al*., 2019). At least two major pathways for sound transmittance between sound source and the inner ear have been identified for fish. The most primitive pathway involves direct transmission to the inner ear's otolith, a calcium carbonate mass enveloped by sensory hairs. The inertial difference between the dense otolith and the less-dense inner ear causes the otolith to stimulate the surrounding sensory hair cells. This motion differential is interpreted by the central nervous system as sound. The second transmission pathway between externally received sounds and the inner ear of fish is via the swim bladder, a gas-filled structure that is much less dense than the rest of the fish's body. The swim bladder, being more compressible and expandable than either water or fish tissue, will differentially contract and expand relative to the rest of the fish in a sound field. The pulsating swim bladder transmits this mechanical disturbance directly to the inner ear.

Some fish have been described as being hearing 'generalists' or 'specialists' where generalists conventionally detect sound to no more than 1-1.5 kHz and only detect the particle motion component of the sound field. Whereas specialists detect sounds above 1.5 kHz and detect both particle motion and pressure. However, Popper and Fay (2011) have suggested that the terms be dropped due to vagueness in the literature, and that the most common mode of hearing in fishes involves sensitivity to acoustic particle motion via direct inertial stimulation of the otolith organs. Additionally, they found that any possible sensitivities to pressure were the result of the presence of a swim bladder in the fish and that hearing sensitivity may be enhanced if the fish has a specific connection between the inner ear and the swim bladder (Popper and Fay, 2011).

Popper and Fay (2011) have also noted that there is a range of hearing abilities across fish species that is like a continuum, presumably based on the relative contributions of pressure to the overall hearing abilities of a species. One end of this continuum is represented by fish that only detect particle displacement because they lack pressure-sensitive gas-filled body parts (*e.g.* swim bladder). These species include elasmobranchs (*e.g.* sharks) and jawless fish and some teleosts including flatfish. Fish at this end of the continuum are typically capable of detecting sound frequencies <1.5 kHz *(e.g*., Casper *et al*., 2003; Casper and Mann, 2006; 2007; 2009). The other end of the fish hearing continuum is represented by fishes with highly specialized otophysical connections between pressure receptive organs, such as the swim bladder and the inner ear. These fishes include some squirrelfish, mormyrids, herrings and otophysan fishes (freshwater fishes with Weberian apparatus, an articulated series of small bones that extend from the swim bladder to the inner ear). Rather than being limited to 1.5 kHz or less in hearing, these fishes can typically hear up to several kHz. One group of fish in the anadromous herring sub-family Alosinae (shads and menhaden) can detect sounds to well over 180 kHz (Mann *et al*., 1997, 1998, 2001). This is one of the widest hearing ranges of any vertebrate that has been studied to date. While the specific reason for this very high frequency hearing is not totally clear, there is strong evidence that this capability evolved for the detection of the ultrasonic sounds produced by echolocating dolphins to enable the fish to detect, and avoid, predation (Mann *et al*., 1997; Plachta and Popper, 2003). All other fishes have hearing capabilities that fall somewhere between these two extremes of the continuum. Some have unconnected swim bladders located relatively far from the inner ear (*e.g*. salmonids, tuna) while others have unconnected swim bladders located relatively close to the inner ear (*e.g*. Atlantic cod, *Gadus morhua*).

Trout *(Salmo trutta)*

Trout share many of the biological features of its close relative, the salmon, but forms two basic types, the migratory sea trout and the non-migratory brown trout, *Salmo trutta* (Linnaeus, 1758). Trout spawn in winter from October to January. The eggs are shed in redds cut by the female in the river gravel, usually in upstream reaches, although many spawn in the gravel below weirs.

The Rivers Shannon, Fergus and Ballycorick are important habitats for trout (Michael Fitzsimons, Shannon Regional Fisheries Board, pers. comm.)

Smelt *(Osmerus eperlanus)*

The smelt, *Osmerus eperlanus* (Linnaeus, 1758), is considered an indigenous species in Ireland despite being recorded from only six locations. It is primarily a marine pelagic fish which congregates in river mouths before moving upstream to spawn in February to April (Whitehead *et al.*, 1984). The adults spawn in rivers and estuaries before returning to the sea. Juvenile fish remain in the estuary for the rest of the summer.

Smelt are one of the rarest fish in Ireland and are listed as vulnerable in the Irish Red Data Book. Smelt have been recorded from the River Shannon (Kennedy, 1948) and river Fergus where breeding populations have been confirmed (Quigley & Flannery, 1996). Their main breeding grounds are in the Shannon, upstream of Limerick to the Ardnacrusha Power Station Tailrace canal (M. Fitzsimmons, pers. comm.).

Resident fish species

The lower Shannon estuary, the River Fergus and Ballycorick Creek are typical estuarine environments and support diverse communities of small fish species, juvenile flatfish, gobies and sticklebacks. They are rich feeding grounds for adults and juvenile fish of many species including bass (*Dicentrarchus labrax*) plaice (*Pleuronectes platessa*) and flounder (*Platichthys flesus*).

In addition to diadromous species, the Shannon Estuary hosts a number of resident species, comprising rich species diversity. A survey was carried out by Inland Fisheries Ireland in 2014 and looked at the composition of fish species in the Lower Shannon estuary. A total of 29 fish species were recorded in the Lower Shannon Estuary in October 2014. Sprat was the most abundant fish species, followed by sand goby, thick-lipped mullet and sand smelt. Flounder was well distributed throughout this water body.

A number of species were newly recorded in 2014, including bib, coalfish/ saithe, grey gurnard, mackerel and sand sole. A number of species were previously caught in 2008 but not captured in the 2014 survey, including black goby, cod, European sea bass and European eel. This was the only water body surveyed during 2014 in which thornback ray was recorded.

Other species which account for a large proportion of the biomass in the Shannon Estuary include flounder (*Platichthys flesus*) and common goby (*Pomatoschistus microps*). The Shannon estuary provides rich feeding grounds for many other species such as sand smelt (*Atherina presbyter*), dab (*Limanda limanda*), three-spined stickleback (*Gasterosteus aculeatus*) and cod (*Gadus morhua*).

7A.5 Assessment of Impact and Effect

7A.5.1 Likely Significant Effects

Annex III of the amended Directive 2014/ 52/ EU requires that the EIAR should assess:

- The magnitude and spatial extent of the impact (for example geographical area and size of the population likely to be affected);
- The nature of the impact;
- The transboundary nature of the impact;
- The intensity and complexity of the impact;
- The probability of the impact;
- The expected onset, duration, frequency and reversibility of the impact;
- The cumulation of the impact with the impacts of other existing and/ or approved projects; and
- The possibility of effectively reducing the impact.

The potential impact mechanisms of the construction and operational phases of the Proposed Development on marine ecology are presented in Table 7A-6. Impact mechanism 1 and 2 are associated with the construction phase, impact mechanism 3, 4 and 5, are common to both the construction and operation phase, while impact mechanism 6, 7, 8, 9 and 10 are associated with the operation phase. Table 7A-6 also indicates where in this chapter impacts are assessed (Section 7A.5.3 through Section 7A.5.11).

Table 7A-6 Potential Impact Mechanisms

Potential Impact Mechanisms	Development Phase	Description	Assessed in
1. Release of pollutants during construction	Construction Phase	As with any construction project there is a risk that activities proposed for the construction of the LNG Terminal, Power Plant and jetty, and the installation of the gas pipeline may result in the accidental release of chemical pollutants or other waste material pollution to nearby habitats, watercourses and waterbodies. Potential chemical pollutants associated with construction plant equipment include fuels, oils, greases, hydraulic fluids (hydrocarbons). There is also risk of the accidental release of construction materials including concrete. Runoff from construction excavated material may result in the release of sediment, potentially impacting habitat and water quality. Given the nature and scale of the proposed works, there is potential that conservation features located adjacent to the works and immediately downstream and upstream of the works may be affected.	Section 7A.5.3
2. Release of spoil during piling	Construction Phase	The construction of the jetty structure will require piles to be installed. Underwater pile drilling operations will result in the generation and release of spoil (rock particles and sediment) to the water column potentially affecting local water quality (*e.g.* turbidity) and result in the generation of sediment plumes in the water column extending beyond the immediate works area. There is potential that the plume of spoil released may extend a significant distance from the works area. The increase in	Section 7A.5.4

Potential Impact Mechanisms	Development Phase	Description	Assessed in
		turbidity could result in a significant reduction of light in the water column. Spoil generated and released by piling operation may be deposited on benthic habitats resulting in smothering effects.	
3. Underwater noise	Construction Phase **and** Operation Phase	Piling operations will result in the generation of underwater noise. Noise emissions could potentially cause disturbance, physical injury and behavioural changes in fauna. The vessel activity (including the FRSU, tugs and LNGC) will result in the generation of noise, potentially affecting local ambient noise levels resulting in disturbance to fauna. There is potential that controlled rock blasting on land will generate underwater noise disturbance.	Section 7A.5.5
4. Seabed habitat loss	Construction Phase **and** Operation Phase	The installation of the jetty requires drilled piles to be installed in the seabed which will result in the direct loss of habitats and associated fauna. During the construction phase a trenched water outfall will be constructed across the shoreline into the Shannon estuary, which will result in the direct loss of habitats and associated fauna.	Section 7A.5.6
5. Vessel physical disturbance and collision injury	Operation Phase **and** Operation Phase	Additional vessel activity (including the construction scows and storage vessels, and FRSU, tugs and LNGC) will increase the potential for physical disturbance and collision injury to fauna. There is potential that mobile conservation feature species (*e.g.* marine mammals, bird species) may occur in the area where the vessels are operating and thereby be affected.	Section 7A.5.7
6. Discharge of Wastewater and Power Plant Process Heated Water Effluent	Operation Phase	Cooled sea water discharged to the estuary close to the head of the jetty and will contain sodium hypochlorite, potentially affecting local water conditions in the vicinity of the proposed discharge points.	Section 7A.5.8
7. Entrainment and impingement of fauna by the FSRU seawater system	Operation Phase	Potential that abstracting and pumping of seawater will result in fish and macrocrustaceans being entrained in the FRSU water intake and/ or impinged on the filter screens of the intake.	Section 7A.5.9
8. Discharge of Wastewater and Power Plant Process Heated	Operation Phase	Potential environmental impact associated with the treatment and disposal of secondary treated wastewater from onsite hygiene facilities. Heated water will be discharged to the estuary via the storm water outfall point, potentially affecting local water conditions in the vicinity of the proposed discharge points.	Section 7A.5.10

Potential Impact Mechanisms		Development Phase	Description	Assessed in
	Water Effluent		Given local water currents, the plume of discharge waters may extend over a large area.	
9.	Introduction of invasive species	Operation Phase	Potential increase in the risk of invasive organisms being imported by LNGC and FRSU in ballast water and as ship hull fouling.	Section 7A.5.11
10.	Accidental large scale oil or LNG spill	Operation Phase	Potential habitat loss, changes in water quality and fauna mortality from oil spill and/ or fire associated oil/ LNG spill during operation.	Section 7A.5.12

7A.5.2 Impact Assessment

7A.5.2.1 Potential Impacts

When describing changes/ activities and impacts on ecosystem structure and function, important elements to consider include positive/ negative, extent, magnitude, duration, frequency and timing, and reversibility.

Section 3.7 of the *Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports'*, (EPA, 2017) provides standard definitions which have been used to classify the effects in respect of ecology. This classification scheme is outlined below in Table 7A-7.

Table 7A-7 EPA Impact Classification

Impact Characteristic	Term	Description
Quality	Positive	A change which improves the quality of the environment.
	Neutral	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
	Negative	A change which reduces the quality of the environment.
Significance	Imperceptible	An effect capable of measurement but without significant consequences.
	Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences
	Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
	Moderate	An effect that alters the character of the environment in a manner consistent with existing and emerging trends.
	Significant	An effect, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
	Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
	Profound	An effect which obliterates sensitive characteristics.
Duration and Frequency	Momentary Effects	Effects lasting from seconds to minutes.
	Brief Effects	Effects lasting less than a day.

Impact Characteristic	Term	Description
	Temporary Effects	Effects lasting less than a year.
	Short-term	Effects lasting one to seven years.
	Medium-term	Effects lasting seven to fifteen years.
	Long-term	Effects lasting fifteen to sixty years.
	Permanent	Effects lasting over sixty years.
	Reversible Effects	Effects that can be undone.
	Frequency	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)
	Irreversible	When the character, distinctiveness, diversity, or reproductive capacity of an environment is permanently lost.
	Residual	Degree of environmental change that will occur after the proposed mitigation measures have taken effect.
	Synergistic	Where the resultant effect is of greater significance than the sum of its constituents.
	'Worst Case'	The effects arising from a development in the case where mitigation measures substantially fail.

7A.5.2.2 Determining Impact Significance

According to the EPA (2017), significance of effects is usually understood to mean the importance of the outcome of the effects and is determined by a combination of objective (scientific) and subjective (social) concerns.

The EPA further notes that:

'*While guidelines and standards help ensure consistency, the professional judgement of competent experts plays a role in the determination of significance. These experts may place different emphases on the factors involved. As this can lead to differences of opinion, the EIAR sets out the basis of these judgements so that the varying degrees of significance attributed to different factors can be understood*'.

With this in mind, the geographic frame of reference applied to determining impact significance by the NRA (2009) in Ireland and CIEEM (2019) in Ireland and the UK, has been adopted in this report in tandem with the EPA's qualitative significance criteria**.** Table 7A-8 compares the qualitative versus geographic approaches to determining the significance of effects.

Table 7A-8 Equating the Definitions of Significance of Effects Using a Geographic vs. Qualitative Scale of Reference

Geographic Scale of Significance (NRA, 2009; CIEEM, 2019)	Qualitative Scale of Significance of Effects (EPA, 2017)
Negligible or Local Importance (Lower Value). No significant effects predicted to significant ecological features.	**Imperceptible**. An effect capable of measurement but without significant consequences. **Not significant**. An effect which causes noticeable changes in the character of the environment but without significant consequences.

Geographic Scale of Significance (NRA, 2009; CIEEM, 2019)	Qualitative Scale of Significance of Effects (EPA, 2017)
Local Importance (Higher Value), County, National, Regional, or International.	**Slight/ Moderate/ Significant/ Very Significant/ Profound** *i.e.* effects can be slight, moderate, significant, very significant, or profound at Local scale, subject to the proportion of the local population/ habitat area affected.

The geographic frame of reference can be a good fit to assessments of biodiversity impacts because it allows clear judgements to be made about the scale of significance, with reference to published estimates for the population size of a given species at county, national and/ or international scales or areas of habitats at such scales.

The proportion of a known feature impacted at county scale (*i.e.* 1% of the known or estimated population in a given county) is measurably different from that impacted at national scale (*i.e.* 1% of the known or estimated national population).

A non-geographic qualitative approach can be a poor fit to assessments of biodiversity since the definitions provided for the different qualitative terms do not relate to measurable units of space such as a county or national boundary. For instance, a significant effect is defined by the EPA as '*an effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment without affecting its sensitivities*', whilst a very significant effect is that which '*by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment*'.

7A.5.2.3 Summary Valuation of Significant Marine Ecology Features

As per the impact assessment methodology outlined in above, significant ecological features are considered to be those valued at Local Importance (Higher Value) or higher as per NRA (2009) and CIEEM (2019) definitions. Table 7A-9 summarises all significant ecological features identified within the ZoI of potentially significant impacts.

Table 7A-9 Summary Valuation of Significant Marine Ecological Features and Identification of Features

Feature		Highest Value within Zone of Influence	At risk of significant impact	Scoped into marine ecology assessment
Designated sites	Lower River Shannon SAC	International	Yes	Yes
	River Shannon and River Fergus Estuaries SPA	International	Yes	Yes
Habitats	Mudflats and sandflats not covered by seawater at low tide [1140]	International importance	Yes	Yes
	Large shallow inlets and bays [1160]	International importance	Yes	Yes
	Estuaries [1130]	International importance	Yes	Yes
	Reefs [1170]	International importance	Yes	Yes
	Sandbanks which are slightly covered by sea water all the time [1110]	International importance	Yes	Yes
	Coastal lagoons [1150]	International importance	Yes	Yes

Feature		Highest Value within Zone of Influence	At risk of significant impact	Scoped into marine ecology assessment
	Salicornia and other annuals colonising mud and sand [1310]	International importance	Yes	Yes
	Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330]	International importance	Yes	Yes
	Mediterranean salt meadows (*Juncetalia maritimi*) [1410]	International importance	Yes	Yes
Marine Mammals	*Tursiops truncatus* (Common Bottlenose Dolphin) [1349]	International importance	Yes	Yes
	Phocoena phocoena (Harbour Porpoise) [1351]	International importance	Yes	Yes
	*Halichoerus grypus (*Grey Seal) [1364]	International importance	Yes	Yes
	Phoca vitulina (Harbour Seal) [1365]	International importance	Yes	Yes
Fish species	*Salmo salar* (Atlantic Salmon) [1103]	International importance	Yes	Yes
	Lampetra fluviatilis (River Lamprey) [1099]	International importance	Yes	Yes
	Petromyzon marinus (Sea Lamprey) [1095]	International importance	Yes	Yes
	Alosa alosa fallax (Twaite Shad) [1103]	International importance	Yes	Yes
	Osmerus eperlanus (Smelt)	International importance	Yes	Yes
	Anguilla anguilla (European Eel)	International importance	Yes	Yes

7A.5.3 Impact Mechanism 1. Release of Pollutants During Construction

7A.5.3.1 Relevant Receptors

- Habitats;
- Marine Mammals; and
- Fish.

7A.5.3.2 Assessment

Impact mechanism 1 is associated with the construction phase.

Potential effects associated with construction activity include the accidental release of sediment and chemical pollutants to the Shannon Estuary immediately adjacent to, and upstream and downstream, of the Proposed Development.

Sediment

The Shannon Estuary is naturally turbid with background level suspended solids ranging from 1 mg/l up to 86 mg/l (McMahon and Quirke, 1992). Excessive suspended sediments can cause stress and affecting the gills of fish, resulting in injury or mortality and the loss of suitable fish spawning habitat and declines in egg and early life stage success rates. Increased turbidity can reduce feeding rates and affect prey abundance and predation efficacy in visual feeders such as salmon. Resident fish species in the Shannon Estuary including Lamprey, Salmon, Seatrout have evolved over geological time to migrate through estuaries on their way to spawning grounds and as many estuaries are naturally high in turbidity, these species evolved mechanisms to deal with high suspended sediment loads.

Bottlenose dolphin use echolocation as their principal means of navigation, communication, foraging and predator avoidance. In murky waters, the use of echolocation means that objects are often 'heard' before they are seen (Ansmann, 2005). As dolphin are accustomed to the naturally turbid nature of the Shannon Estuary impacts due to short-lived changes in turbidity are unlikely to impact the species.

Should sediments be released to the Shannon Estuary, the effect of increased turbidity, if realised, will be short lived with the local currents in the immediate area resulting in sediment being rapidly removed from the system and significant sediment deposition in the area will not occur. In the event of significant release of sediment from the construction works, local currents are such that any localised deposition of sediment will be short lived with sediments rapidly dispersed seaward.

In addition, any effects are not likely to be significant for local habitats and fauna, as the area is naturally turbid (see above) and hydrodynamically active and experiences a high degree of natural suspended solids. Consequently, there is no risk of significant effects to benthic habitats.

Through the implementation of construction best practice and mitigation and monitoring measures, the risk of activities during the construction resulting in the uncontrolled release of sediment material to the nearby river and habitat types is extremely unlikely to occur. Mitigation and monitoring measures and the general construction practices to be implemented are outlined in Section 7A.6 and the Outline Construction Environmental Management Plan (OCEMP) provided in Appendix A2-4, Vol. 4).

Chemical Pollutants

Accidental release of hydrocarbons from plant machinery and fuel stocks, and organic polymers or heavy metals associated with cementing/ concreting materials used for construction activities. These materials are toxic to organisms in sufficient quantities and will potentially contaminate the seabed sediments adjacent to the project, inhibiting recolonisation of the area.

Chemical contamination of the river and river sediments could also occur from accidental spillages, such as oil and other chemicals through poor operational management, the non-removal of spillages, poor storage, handling and transfer of oil and chemicals. Hydrocarbon spills from poorly secured or non-bunded fuel storage areas, leaks from vehicles or plant or spills during re-fuelling can all give rise to the escape of hydrocarbons from construction sites.

Wash off from poorly cured cement can also be highly alkaline and potentially dangerous to fish. Spills of hydrocarbons and chemicals can give rise to tainting of fish or, if large enough, fish kills and invertebrate kills. Accidental release of chemicals and pollutants must be controlled to ensure risk of impacts are minimised.

If suitable precautions are taken and best practice for the storage, handling and disposal of such material are followed, impacts should be minimal.

Mitigation measures specifically designed to avoid the introduction of runoff and contaminants to the Shannon Estuary are detailed in Section 7A.7.1 and the OCEMP provided in Appendix A2-4, Vol. 4).

Accidental spillages will be contained and cleaned up immediately. Remediation measures will be carried out in the unlikely event of pollution of the marine environment.

7A.5.3.3 Conclusion

Likely impacts during the construction phase in the absence of mitigation are assessed as **negative**, **significant** and **short-term**.

Mitigation measures to prevent release of sediments, chemical and pollutants during construction are detailed in Section 7A.7.1.

With the implementation of mitigation likely impacts associated with impact mechanism 1 are predicted to be **not significant**.

7A.5.4 Impact Mechanism 2. Release of Spoil During Piling

7A.5.4.1 Relevant Receptors

- Habitats;
- Marine Mammals; and
- Fish.

7A.5.4.2 Overview

Impact mechanism 2 is associated with the construction phase.

The construction of the 345-m jetty and access trestle will require the installation of approximately 203 piles.

Piling for the construction of the jetty will also commence during this period, initially from onshore (approximately four and half months) followed by approximately eleven months from the water. The jetty construction works will operate on a 24 hour basis, 6 days a week with maintenance works on Sundays and over approximately 15 ½ months. Security arrangements will also be in place full time. Note that impact piling activities will not commence during night-time hours.

The majority of the piles supporting the jetty would be driven, with some piles drilled and socketed into the underlying rock to ensure stability of the jetty. This operation would require a jack-up platform supporting a large crane-mounted drill and a large barge-mounted support crane.

There is potential that spoil (drilling rock particles and sediment) generated and released to the water column may increase turbidity resulting in a significant reduction of light for phytoplankton. There is also the potential that the deposition of solids on benthic habitats will result in the smothering of organisms. High levels of suspended solids settling on the seabed can alter habitats resulting in a potential loss of feeding and spawning grounds. Mobile species may move away from unfavourable conditions, however sessile, benthic fauna may be smothered and lost. Solid generated and released by piling may be deposited on benthic habitats.

Shannon LNG commissioned AQUAFACT to carry out a hydrodynamic and dispersion modelling study to determine the fate of sediment generated during piling operations required for the installation of the jetty for the Proposed Development. The full modelling report is included in Appendix A7A-5.

7A.5.4.3 Assessment

The average pile length will be approximately 20 m resulting in total pile volume of 1,980m^3. At a porosity of 20% the total mass of sediment spoil removed by the piling operation is estimated conservatively to be 5,500 tonnes. Spoil from the drilling operation will be conveyed to the surface using a reverse-circulation drilling rig (*e.g.* LD408 drilling rig) and collected in designated scows or other storage vessels.

Approximately 1000 m^3 pile arisings are anticipated from the socketed piles (approximately 80 no.), none of which will be from onshore piling operations. The spoils would be placed on a barge, dried, and then transferred to shore for drying and reused in general earthworks or in landscaped bunds. To allow for disturbance of sediments by the piling process and potential spillage of solids via reverse circulation drilling, a conservative factor of 25% of the sediment removed is used as a spillage rate of sediment. Sediment transport simulations are carried out based on a fine to very fine sand as identified in the geotechnical investigations. An 18-day simulation was performed with 0.9kg/s of sediment releases continuously from the site of the pilling operations. The full details of the model are included in the modelling report included in Appendix A7A-5.

Habitats

Modelling shows that while the predicted plumes of spoil extend significant distances from the operations deposition is largely spatially limited to areas along the south and north coasts of the estuary, and the islands to the north west of the jetty (see Figure 7A-13). This to be expected because, as noted above in Section 7A.5.3, the Shannon Estuary is naturally turbid (background suspended solids ranging from 1 mg/l up to 86 mg/l; McMahon and Quirke 1992) and hydrodynamically active and any release of sediment to the river will, at most, result in short lived and localised elevated turbidity levels with local water currents rapidly dispersing sediments seaward. On the south coast, sediment deposition rate in the majority of areas ranges is predicted to be between 0.01 and 0.001 mm/m^2 (see Figure 7A-13). In small discrete areas approximately 400 to 800 m downstream of the piling operations, predicted sediment disposition rate ranged between 2 to 5 mm/m^2 while further west at Ballylongford Bay and southwest of Carrig Island the deposition rate is predicted to be 2 mm/m^2 (see Figure 7A-14). Moving northward from the south coast and the piling operations, sedimentation rate drops below 0.001 mm/m^2 on account of fast moving currents resulting in all generated sediment being rapidly removed from the system. On the north coast, and around the islands to the north west of the jetty, the predicted rate of sediment deposition is low ranging from 0.01 to 0.001 mm/m^2.

The OSPAR Commission (OSPAR, 2008, 2009) note that benthic fauna can survive rapid sediment deposition up to depths of 100mm, 20 times the maximum depth predicted by the model (see Appendix A7A-5). Further, OSPAR (2008, 2009) also state that negative impacts to marine life are only expected when sediment deposition depths exceed 150 mm.

Likely impacts to habitats associated with the release of spoil during the construction phase is assessed as **negative**, **not significant** and **temporary**.

Species

As discussed in Section 7A.5.3, increased turbidity can reduce feeding rates and affect prey abundance and predation efficacy in visual feeders. Otter and cormorant are visual hunters with good eyesight both above and below the water. The release of sediments in the water column during piling and the resuspension of sediments during construction has the potential to significantly affect turbidity levels. Otter and cormorant are highly mobile species and while their eyes are adapted for seeing food item in murky or dark water, they will avoid areas of excessive turbidity. While significant increases in turbidity may result in the temporary displacement of the species, there are extensive alterative areas of otter and cormorant habitat available to the species away from the project area. Consequently, there is no risk of significant effects.

Prolonged suspension of sediments may also lead to reduced primary productivity in waters, in turn depressing oxygen levels. However, given the temporary nature of the work and the action of local water current removing suspended solids from the works area, there is no risk of significant effects.

Given the scale and temporary nature of piling works any significant elevated turbidity would be limited spatially and temporally to the immediate project area; consequently there is no risk of significant effects.

Diadromous fish species have evolved over geological time to migrate through estuaries on their way to spawning grounds and as many estuaries are naturally high in turbidity, these species evolved mechanisms to deal with high suspended sediment loads.

Likely impacts to species associated with the release of spoil during the construction phase is predicted to be **negative**, **not significant** and **short-term**.

7A.5.4.4 Conclusion

Based on the above, the likely impact of spoil released during piling operations the construction phase to habitats or species is predicted to be **negative**, **not significant** and **short-term**.

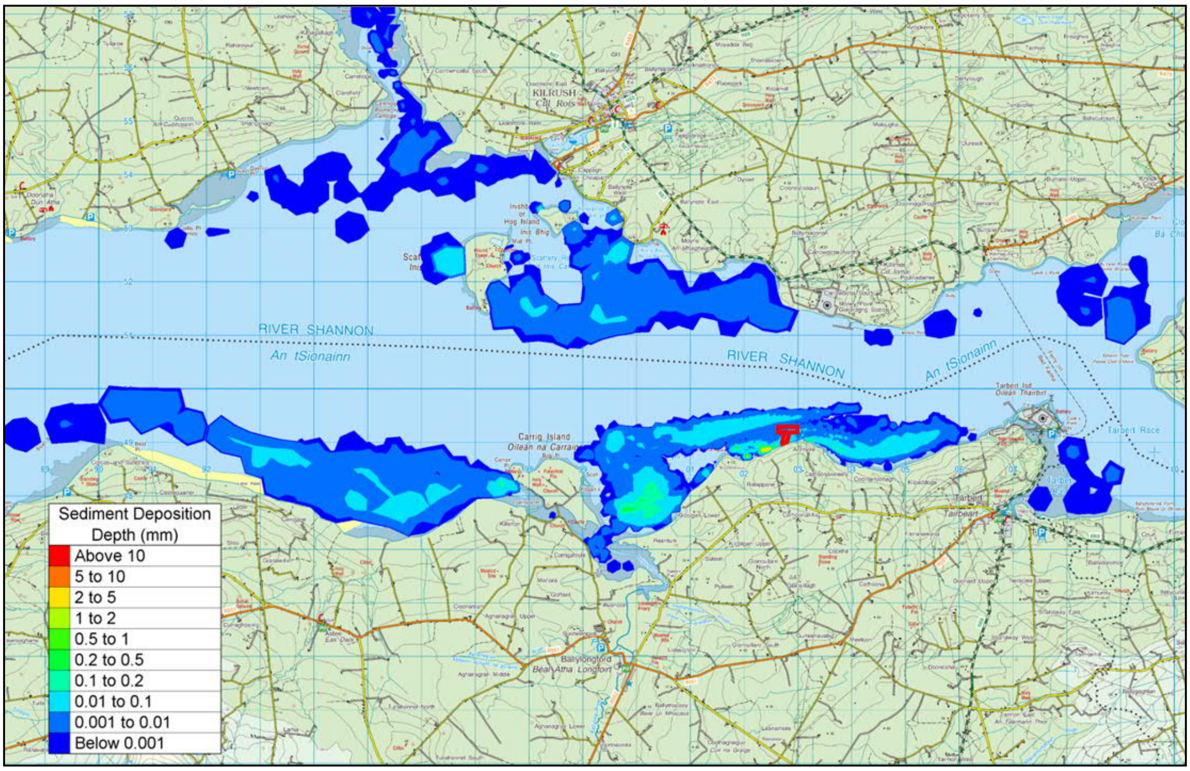

Figure 7A-11 Maximum Sediment Deposition Rate. Approximate Location of Jetty Shown in Red

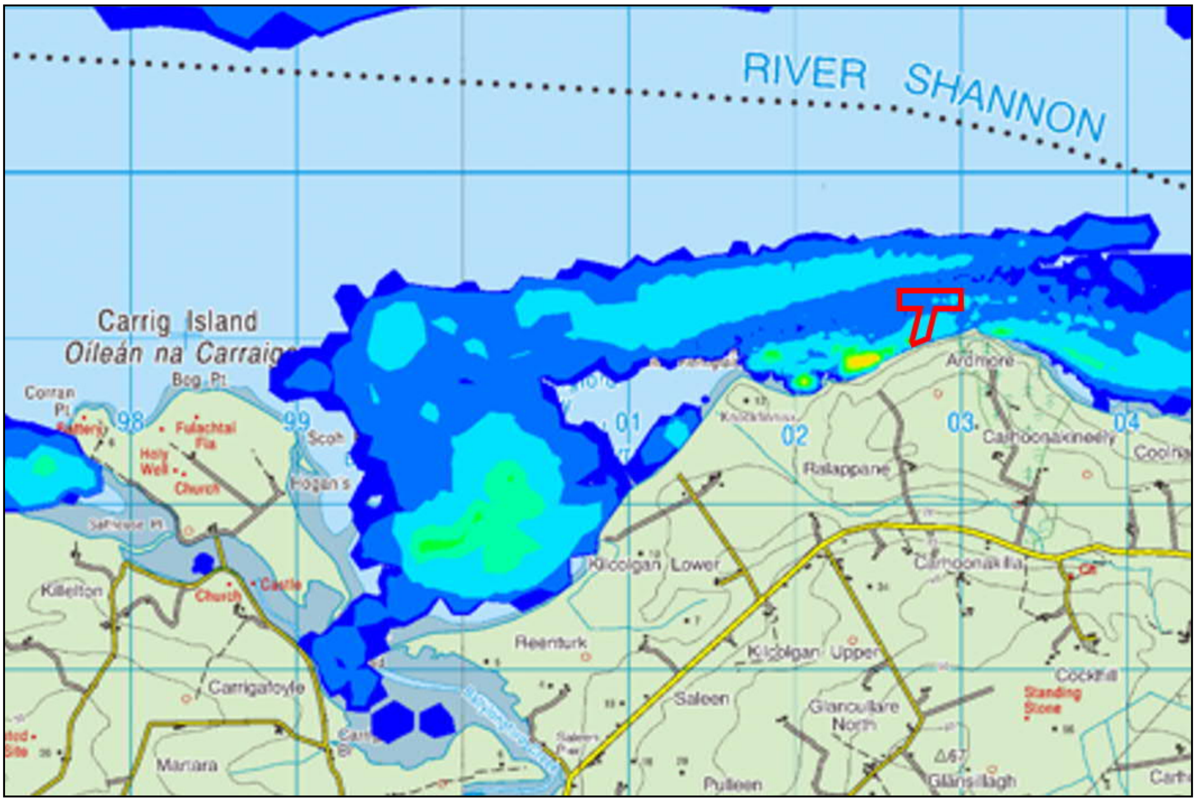

Figure 7A-12 Maximum Sediment Deposition Rate. Approximate Location of Jetty shown in Red

7A.5.5 Impact Mechanism 3. Underwater Noise

7A.5.5.1 Relevant Receptors

- Marine Mammals; and
- Fish.

7A.5.5.2 Assessment

Impact mechanism 3 is associated with the construction and operation phase.

Activities associated with the construction and operation of the LNG Terminal (*e.g.* pile driving, vessel noise) have the potential to impact marine mammals and fish by introducing sound into the marine environment.

To assess potential effects of project activities on bottlenose dolphins, the number of acoustic exposures that may occur during the planned activities was calculated based on the occurrence of dolphins in the area and the extent of the potentially affected area which was determined by underwater acoustic modelling and available sound threshold criteria.

In addition, the potential impact on other marine mammals and fish were also assessed, based on modelled distances to available sound threshold criteria. The results are discussed within the context of the Proposed Development and in light of the mitigation and monitoring measures that are anticipated to be implemented.

A 345-m jetty with a central loading platform, six mooring dolphins, and four breasting dolphins would be constructed to access the deeper waters of the estuary (Brown and Worbey 2020). Approximately 203 piles would be installed using a combination of techniques including a hydraulic impact hammer, vibratory hammer, and/ or continuous flight auger (CFA) techniques. The exact number of piles is subject to the final design. Piling for the construction of the jetty will commence, initially from onshore (approximately four and half months) followed by approximately eleven months from the water. The jetty construction works will operate on a 24 hour basis, 6 days a week with maintenance works on Sundays and over approximately 15 ½ months. Note that impact piling activities will not commence during night-time hours. The pile diameter would be ~1.067 m, and a 150 kJ impact hammer would be used. Noise from onshore blasting could also enter the water.

The FSRU would not be permanently moored at the jetty and would depart the jetty when necessary. Loading of LNG onto the FSRU would be via a ship-to-ship transfer from an LNG carrier berthed alongside. The FSRU would have an LNG storage capacity of up to 180,000 m^3. Up to one LNG carrier ship (LNGC) per week is expected to deliver its cargo to the FSRU (Brown and Worbey, 2020).

7A.5.5.3 Receptors

Common Bottlenose Dolphin

Bottlenose dolphin use echolocation as their principal means of navigation, communication, foraging and predator avoidance. The individual monitors its surroundings by emitting sound waves and waiting for them to reflect off different objects (Weilgart, 2007; Ansmann, 2005; Potter and Delroy, 1998). The time taken for these pulses to return to the animal, as well as the characteristics of the reflected pulse, gives an indication of the distance and nature of the object. Light propagates poorly in the viscous and opaque marine environment and is absorbed within a few tens of metres (Potter and Delroy, 1998; Nowacek *et al*., 2007). Low frequency underwater sound may travel for hundreds of kilometres without losing intensity (Nowacek *et al*., 2007). In murky waters, the use of echolocation means that objects are often 'heard' before they are seen (Ansmann, 2005). This ability is extremely effective; bottlenose dolphin, can differentiate between two aluminium plates varying by just 0.23 mm and can detect objects up to 113 m away (Au, 2002). This level of precision is indicative of the importance of echolocation for foraging and navigation by some species of cetaceans.

The potential impacts of noise on marine mammals have been the subject of considerable research; reviews are provided by Richardson *et al*. (1995), Nowacek *et al*. (2007), Southall *et al*. (2007), Weilgart (2007) and Wright *et al*. (2007). If the frequency of anthropogenic noise overlaps with the frequencies used by marine mammals, this may reduce the animal's ability to detect important sounds for navigation, communication and prey detection (Weilgart, 2007). This is termed acoustic masking, which may occur anywhere within an organism's auditory range (Wright *et al*., 2007; Richardson *et al*., 1995). Masking of important vocalisations will result in increasing information ambiguity and, in extreme circumstances, may result in cetaceans being unable to orientate themselves or hunt/ evade predation in the marine environment (Wright *et al*., 2007).

Exposure to high energy noise emissions (piling, drilling, seismic noise) can result in non-recoverable auditory injury (termed Permanent Threshold Shift (PTS). Behavioural reactions to acoustic exposure are generally more variable, context-dependent, and less predictable than the effects of noise exposure on hearing or physiology. This is because behavioural responses to anthropogenic sound are dependent upon operational and environmental variables, and on the physiological, sensory, and psychological characteristics of exposed animals. It is important to note that the variables may differ (greatly in some cases) among individuals, of a species and even within individuals depending on various factors (*e.g.* sex, age, previous history of exposure, season, and animal activity). NOAA (2013) outline that noise can affect cetacean behavioural patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.

Fish Species

Sound is perceived by fish through the ears and the lateral line (the acoustico-lateralis system) which is sensitive to vibration. Some species of fish such as salmon have a structure linking the gas filled swim bladder to the ear. The swim bladder is sensitive to the pressure component of a sound wave, which resonates as a signal that stimulates the ears. These species, therefore, usually have increased hearing sensitivity. Such species are considered to be more sensitive to anthropogenic underwater noise sources than species, such as lamprey, that do not possess a structure linking the swim bladder and inner ear.

It should be noted that the potential impact of noise on juvenile and adult fish in open water is considered to be minimal as they can readily move away from the noise source. Experiments on fry demonstrated balance problems resulting from exposure to an energy source, however, the effects were temporary with full recovery observed after a few minutes upon cessation of the noise (Kostyuchenko, 1971). Some studies of high energy seismic noise sources have also demonstrated fish's ability to acclimatise to noise associated with an energy source over time (*e.g.* Chapman and Hawkins, 1969).

Hearing in salmon is poor, the species responding only to low frequency tones (below 0.38 kHz). While there are no data available for hearing in lamprey, it is highly unlikely that they detect sound close to 10 kHz (Popper, 2005). The lamprey ear is relatively simple and there is nothing within the structure of the ear or associated structures to suggest any specialisations that would make them into anything but a hearing generalist, with maximum hearing to no more than several hundred Hz.

7A.5.5.4 Assessment of Potential Noise Impacts

The Irish Whale and Dolphin Group (IWDG) was contracted by Shannon LNG to monitor the use of the site by bottlenose dolphins (Berrow *et al.,* 2020). A combination of land-based Vantage Point (VP) watches and static acoustic monitoring (SAM) was used to describe the use of the site by bottlenose dolphins and any other marine mammals (seals) present, and their distribution and relative abundance at the site. The survey work built upon data obtained from 2006 and 2007 and other recent publicly available information. The report concluded that:

In conclusion, we have shown that bottlenose dolphins regularly use the waters off Ardmore Point, which is the site of the proposed Shannon LNG terminal. The results *from monitoring during 2019-2020 are broadly* consistent *with results obtained during monitoring at the same site during 2006-2007. Although dolphins were regularly recorded at the site there use seems largely transitory, passing through the site. There was no evidence dolphins are present for long periods or that it is used for foraging. However, the site is an important part of the range of the bottlenose dolphins in the Shannon estuary.*

LGL was commissioned by Shannon LNG to carry out an ecological assessment of noise generated by the construction and operational phases of the project on fish and marine mammal species (LGL, 2021) (see Appendix A7A-4). The findings of the LGL assessment are presented below.

The ecological assessment of the potential impacts of noise on marine mammals is based on estimates of how many marine mammals are likely to be present within a particular distance of activities and/or exposed to a particular level of sound. This approach is an accepted common practice, that in most cases, likely overestimates the numbers of marine mammals that would be affected in some biologically important manner, as animals tend to move away from loud sound sources before the sound level is at or above the threshold.

The assessment considered potential impacts associated with different scenarios/project activities at various positions: (1) a stationary FSRU which emits hull-radiated sound continuously, including noise from seawater cooling pumps, (2) an FSRU with an offloading LNGC tied to it and one idling tug, (3) impact pile driving, (4) vibratory pile driving with support vessels (5) socket drilling with support vessels, and (6) blasting were all modelled at the marine terminal, while (7) an approaching LNGC assisted by four transiting tugs was modelled at a location 1,150 m northwest of the terminal, along with the FSRU at the marine terminal; and (8) the FSRU together with a berthing LNGC and four sailing tugs were modeled at the marine terminal together with a general cargo ship sailing in the middle of the estuary and a ship moored at Moneypoint. Scenario 8 is referred to as the cumulative sound scenario. This multi-sequence scenario is based on the offloading scenario, with the addition of the cargo ship and moored ship. For this scenario, the following were assumed: FSRU operating continuously for 24 h, LNGC and idling tug performing offloading for 6 h, LNGC and 4 sailing/engaged tugs transiting for 15 min, cargo ship sailing for 15 min, and moored ship at Moneypoint continuously for 24 h.

Although two potential PTS exposures have been estimated for bottlenose dolphins from impact pile driving over the course of all pile driving activity, no PTS or other injuries would be expected because of the relatively short distance (94 m) to the threshold criteria and the monitoring and mitigation measures that would be implemented. Monitoring and mitigation measures would follow those in the NPWS 2014 guidance (Section 7A.7.2 for details) and would lower the likelihood of impacts from construction activities. Although PTS was modelled to be a possibility relatively far from impact pile driving (up to 3163 m) for harbour porpoise, these cetaceans rarely occur within the Shannon Estuary.

Monitoring and mitigation measures during project construction would include the use of qualified marine mammal observers to monitor during sub-tidal piling operations and the commencement of piling would be delayed if the observers sight any marine mammals within 1,000 m of the site for 30 minutes prior to the planned start of piling. Since impact piling cannot always be stopped immediately if a marine mammal approaches once piling has commenced, some potential for impacts would remain, including potential for TTS. Nonetheless, the 1,000-m mitigation zone is overly precautionary given that the MF-weighted PTS threshold was modelled to occur out to a maximum distance of 94 m.

During operations, the PTS and TTS thresholds that could be exceeded by the activities are all based on accumulated sound over a period of time (sound exposure levels). This means that individuals would have to remain within the predicted distances for the entire duration of the activity, or for at least 24 hrs if the activity lasts longer than a day, in order to experience TTS or PTS. Additionally, the operational scenarios often involved multiple sources operating in different locations. This means that the distances calculated are not continuous in all directions and any one of the sources, resulting in gaps where received sound levels would be below the threshold levels. These factors, along with the highly mobile nature of marine mammals means the it is very unlikely that any marine mammals will experience PTS or even TTS from the planned activities.

Using the available information on dolphin abundance and distribution within the Shannon Estuary, we have estimated that there are likely to be very few daily instances of bottlenose dolphins (or other marine mammals) being affected via disturbance during either construction or operational activities associated with the Shannon LNG project. For all construction activities, and most of the operational scenarios, distances to disturbance thresholds would be less than 140 m. Since the location where the in-water structures will be installed and the immediate vicinity around that are not known to be important feeding or calving areas, temporary avoidance at these distances is not likely to have significant impacts. In addition, strong impulsive sounds from impact pile driving would occur over relatively short periods of time (1 hr per day, or 4% of the time), leaving most of the time available for undisturbed movements through the area. Similarly, the two operational scenarios with disturbance threshold distances of almost 1 km, Scenarios D and E, would only occur for relatively short periods of time (less than 1 hr per day) and infrequently (up to 3 times per week). The temporal aspects (limited duration and infrequent occurrence) of these most potentially behaviourally disruptive activities mean they are unlikely to substantially disrupt important marine mammal behaviours that might occur in this region of the estuary. Since dolphins are highly mobile within the estuary and operations will occur over many years, it is likely that all individuals in the population could be exposed at some point in time to noise from the project. Nonetheless, the potential disturbance exposures likely would have no more than a minor effect, such as localized short-term avoidance of the area around the activities by individual animals and no effect on the population.

Our analysis method used MF-weighting for estimating potential disturbance exposures since it emphasizes the frequencies that are of most relevance to bottlenose dolphins. However, Kastelein et al. (2015, 2016) reported that harbour porpoise (high-frequency cetacean) hearing sensitivity was reduced when exposed to multiple impulsive pile-driving sounds with most energy at low frequencies. These findings suggest that there could be potentially greater impacts of low-frequency sounds on bottlenose dolphins than expected, but the exposure estimates for the development are almost certainly overestimates, and there is no indication that the project activities would be likely to cause significant harm to individuals or the population.

The population of bottlenose dolphins in the Shannon Estuary has remained stable for the past 20 years and has demonstrated evidence of long-term fidelity and seasonal residency despite inhabiting a busy and noisy region with various industrial activities, ferry traffic, and shipping (Ingram 2000; Ingram and Rogan 2002; Englund et al. 2007, 2008; Rogan et al. 2018). Thus, it is anticipated that the dolphins in the vicinity of the project would likely habituate to the sounds produced during project activities as they have to other similar noise and vessel traffic in the estuary. Habituation of bottlenose dolphins to noise has been shown to occur elsewhere. For example, in Aberdeen Harbour, Scotland, an area with high vessel activity, bottlenose dolphins showed a change in normal behaviour around boats, but rarely left the area; this type of response suggested habituation and tolerance, especially due to the estuary's importance for prey availability (Sini et al. 2005).

Although there is some indication that fish (especially those with swim bladders used in hearing) within hundreds of metres of impact pile driving could be at high risk of disturbance or even potentially experience injury or TTS, impact piling would occur for a relatively short duration (60 min) for each pile, once per day. Thus, impact pile driving is unlikely to hinder fish migration, and for most fish, the distances within which mortality and/or mortal injuries could occur are relatively small and should not impact the overall populations if these types of effects were to take place. Although continuous sounds during project construction and operation have little likelihood of causing injury or TTS in fish, fish that use their swim bladder for hearing could potentially be at high risk of disturbance near those sound sources. It is possible that the continuous noise emission from the FSRU during project operation could cause fish to avoid the immediate area around the FSRU, but avoidance behaviour would likely be restricted within tens of metres from the FSRU.

7A.5.5.5 Conclusion

In summary, the proposed construction and operational activities associated with Shannon LNG are similar to other activities that currently occur routinely within the estuary and are therefore unlikely to have adverse effects that could impact populations of marine mammals or fish in the long-term. The most potentially impactful activity on marine mammals and fish during construction would be impact pile driving because of the potential for PTS in marine mammals and injury or mortality in fish, but this would be of limited duration and impacts will be mitigated in multiple ways. Additionally, there is no evidence to suggest that the project site provides critical habitat for bottlenose dolphins (Berrow et al 2020) so avoidance of these activities would be unlikely to have significant impacts. During operations, underwater sounds would be created by vessel traffic and contribute to the pre-existing ambient noise within the estuary. The cumulative sound scenario and approaching/departing LNGC have the largest distances to behavioural disturbance thresholds during operations, but both scenarios would occur only briefly up to 3 times per week, and only if other vessels are located within the vicinity of the project site. Once the other power stations located in the Shannon Estuary shut down, there would be even less potential for cumulative effects from the proposed activities and existing shipping activities occurring in the estuary. In addition, harbour porpoise and grey seals rarely occur in the Shannon Estuary, and harbour seals are uncommon. Thus, any effects from project activities are expected to be **minor**, **temporary**, and localized to the area immediately around the terminal, with **no long-term** effects on marine mammal or fish populations.

7A.5.6 Impact Mechanism 4. Seabed Habitat Loss

7A.5.6.1 Relevant Receptors

- Habitats.

7A.5.6.2 Overview

Impact mechanism 4 is associated with the construction and operation phase.

There are two distinct sources of habitat loss due to the Proposed Development; one being the installation of construction piles for the jetty structure foundations and, the other being the installation of a trenched water outfall across the shoreline into the Shannon estuary.

The assessment of the potential impact of seabed habitat loss is undertaken here with respect to the Annex I habitats for which the Lower River Shannon cSAC is designated. Specifically, the assessment considers the area of Annex I habitat lost relative to the full areal extent of the Annex I habitat within the cSAC.

The construction of the jetty requires the installation of approximately 203 piles. As shown in Figure 7A-13 and Figure 7A-14 the proposed jetty overlaps the Annex I habitats 1130 Estuaries and 1170 Reefs of the Lower River Shannon cSAC. The majority of the piles supporting the jetty would be driven, with some piles drilled and socketed into the underlying rock to ensure stability of the jetty.

The proposed outfall overlaps Annex I habitats 1130 Estuaries and 1170 Reefs (see Figure 7A-13 and Figure 7A-14 respectively and Figures F7-9 and F7-10 in Volume 3). The width of the trench will be approximately 2 m while its total length through Annex I habitats is approximately 50 m. Once the outflow pipe is set position the trench will be infilled using concrete to approximately 30 mm below the surface of the level of the adjoining substrate. In areas of reef substrate, the surface concrete of the trench will be embedded with reef cobbles and stone excavated from the trench, while in areas of soft sediment the void to will left to infill naturally by sedimentation and sediment movement processes.

The Conservation Objectives[12], attributes and targets relating to the area of Annex I habitat 1130 Estuaries and 1170 Reefs within the cSAC are presented respectively in Table 7A-10 and Table 7A-11 (NPWS, 2012).

[12] NPWS (2012) Conservation Objectives Series. Lower River Shannon SAC Site Code: 002165.

Table 7A-10 Annex I Habitat 1130 Estuaries

To maintain the favourable conservation condition of Estuaries in the Lower River Shannon SAC, which is defined by the following list of attributes and targets:

Annex I habitat	Measure	Target	Notes
1130 Estuaries	Habitat area	The permanent habitat area is stable or increasing, subject to natural processes.	Habitat area was estimated as **24,273ha** using OSi data and the Transitional Water Body area as defined under the Water Framework Directive

Table 7A-11 Annex I Habitat 1170 Reefs

To maintain the favourable conservation condition of Reefs in the Lower River Shannon SAC, which is defined by the following list of attributes and targets:

Annex I habitat	Measure	Target	Notes
1170 Reefs	Habitat area	The permanent habitat area is stable or increasing, subject to natural processes.	Habitat area was estimated as **21,421ha** from the 2010 intertidal and subtidal reef survey (Aquafact 2011a, 2011b)

7A.5.6.3 Loss due to Installation of Jetty Piles

As a result of the 203 piles, approximately 163m^2 of benthic habitat within Annex I habitats will be lost pending decommissioning of the development and the removal of jetty and piles. Of the 203 piles, approximately 10 piles will be installed in the Annex I habitat Reefs [1170] while approximately 193 will be located within the Annex I habitat Estuaries [1130].

The spatial extent of Annex I habitat 1130 Estuaries and 1170 Reefs within the cSAC is estimated to be 24,273 ha and 21,421 ha respectively (NPWS, 2012) (see Table 7A-10 and Table 7A-11 respectively).

The approximate spatial extent of Annex I habitat lost pending decommissioning of the development and the removal of jetty and piles is presented in Table 7A-12. Installation of the jetty piles will result in the loss of 0.000064% and 0.000004% of the Annex I habitats 1130 Estuaries and 1170 Reefs respectively.

Table 7A-12 Loss of Annex I Habitat 1130 and 1170 due to Installation of Piles

Annex I habitat	Habitat area within cSAC[13]	Area of Annex I habitat lost pending decommissioning	% of Annex I habitat lost pending decommissioning
1130 Estuaries	24,273ha	155 m^2	6.4 x 10^{-6} %
1170 Reefs	21,421ha	8 m^2	3.7 x 10^{-5} %

7A.5.6.4 Loss due to Installation of Outfall Pipe

The installation of the outfall pipe will result in the loss of approximately 90m^2 of Annex I habitat above the low water mark and 10m^2 below the low water. Loss of Annex I habitat Estuaries [1130] habitat is estimated to be approximately 100m^2, while the loss of Reef [1170] habitat is approximately 65m^2.

[13] Estimates of habitat area taken extent from NPWS (2012) Conservation Objectives Series - Lower River Shannon SAC 002165 Version 1.0.

The approximate spatial extent of Annex I habitat lost is presented in Table 7A-13. Installation of the pipe will result in the loss of 0.000041% and 0.000030% of the Annex I habitats 1130 Estuaries and 1170 Reefs respectively.

Table 7A-13 Loss of Annex I Habitat 1130 and 1170 due to Installation of Outfall Pipe

Annex I habitat	Habitat area within cSAC[14]	Area of Annex I habitat lost pending decommissioning	% of Annex I habitat lost pending decommissioning
1130 Estuaries	24,273ha	100 m^2	4.1×10^{-5} %
1170 Reefs	21,421ha	65 m^2	3.0×10^{-5} %

7A.5.6.5 Assessment and Conclusion

The loss of Annex I habitats 1130 Estuaries and 1170 Reefs habitat due to the installation of the piles and the outflow pipe, relative to the total area of the habitats in the cSAC is negligible and will not give rise to negative impacts to the functioning of the habitats. Following decommissioning, measures will however be taken to reinstate the small areas of habitat lost.

Jetty Piles

Jetty piles will be installed in two constituent community type of the Annex I habitats (see Figure 7A-15), namely;

- Subtidal sand to mixed sediment with *Nucula nucleus* community complex; and
- Fucoid-dominated intertidal reef community complex.

At decommissioning of the Proposed Development, jetty piles installed in soft sediment areas (Subtidal sand to mixed sediment with *Nucula nucleus* community complex) will be removed. Upon removal of the pile, the void left will be left to refill naturally through sedimentation and sediment movement processes. The sediments will be naturally recolonised by the migration of flora and fauna from local sediments and the settlement of larvae.

At decommissioning, jetty piles in areas of hard substrate (fucoid-dominated intertidal reef community complex) will be cut below the level of the seabed. The voids created will be infilled concrete and embedded with reef stone native to the area. The embedded reef stone will rapidly recolonise naturally.

Outflow Pipe

As illustrated in Figure 7A-15 the outflow pipe will be entrenched through two community types;

- Subtidal sand to mixed sediment with *Nucula nucleus* community complex; and
- Fucoid-dominated intertidal reef community complex.

Parts of the trench installed in reef areas, which will have been recolonised by reef flora and fauna assemblages, will be left *in-situ*.

Parts of the trench installed in soft sediments (Subtidal sand to mixed sediment with *Nucula nucleus* community complex) will be removed. The void created will left to infill naturally by sedimentation and sediment movement processes. The sediments will be naturally recolonised by the migration of flora and fauna from local sediments and the settlement of larvae.

7A.5.6.6 Conclusion

The loss of Annex I habitats 1130 Estuaries and 1170 Reefs pending decommissioning relative to the total area of the habitats in the cSAC is negligible. The likely impact of habitat is predicted to be **negative** and **not significant**.

[14] Estimates of habitat area taken extent from NPWS (2012) Conservation Objectives Series - Lower River Shannon SAC 002165 Version 1.0.

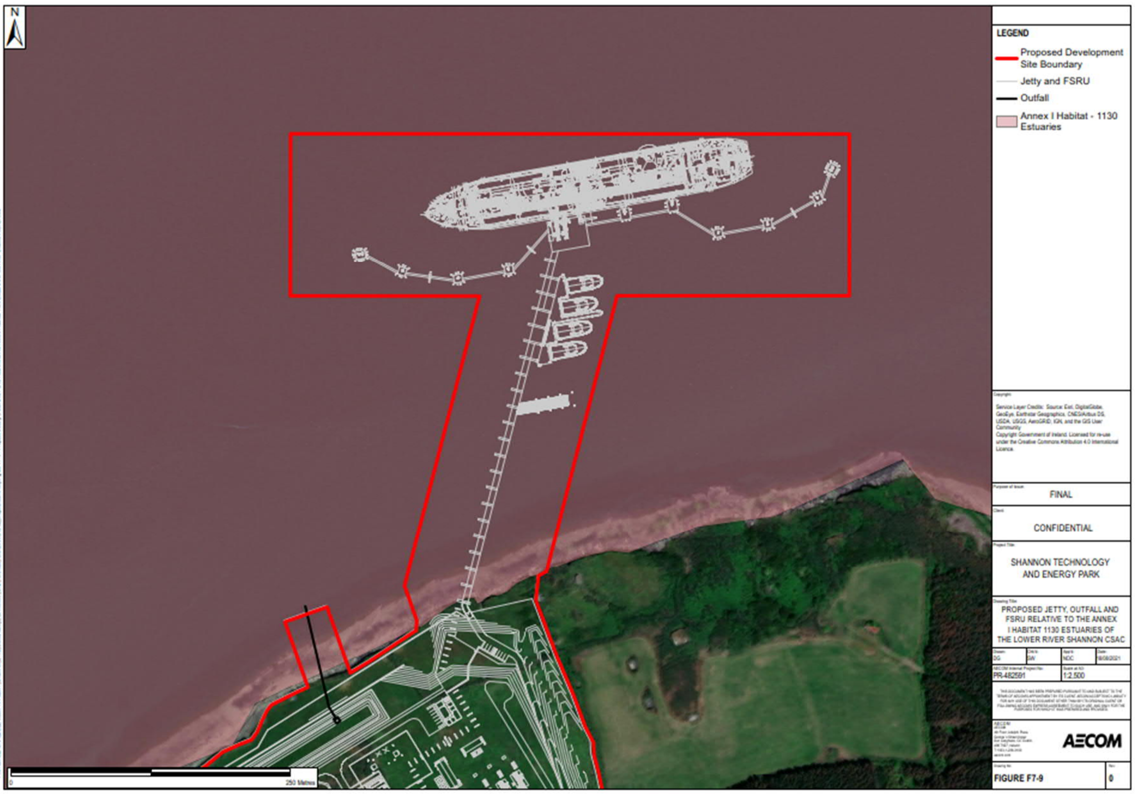

Figure 7A-13 Proposed jetty, outfall and FRSU relative to the Annex I Habitat 1130 Estuaries of the Lower River Shannon cSAC.

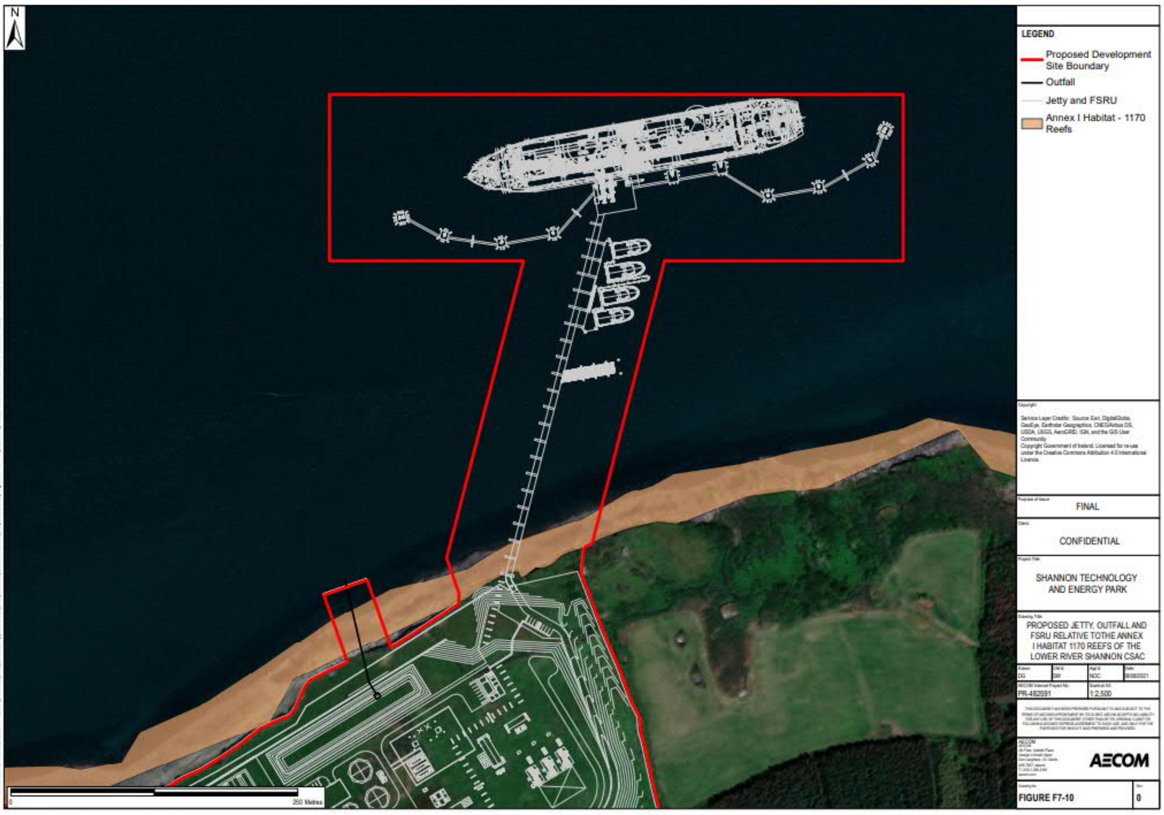

Figure 7A-14 Proposed jetty, outfall and FRSU relative to the Annex I Habitat 1170 Reefs of the Lower River Shannon cSAC

Figure 7A-15 Marine community types identified relative to marine community types within Annex I Habitats of the Lower River Shannon cSAC

7A.5.7 Impact Mechanism 5. Vessel Physical Disturbance and Collision Injury

7A.5.7.1 Relevant Receptors

- Marine Mammals.

7A.5.7.2 Assessment

Impact mechanism 5 is associated with the construction and operation phase.

According to the Shannon Foynes Port Company (SFPC), approximately 1,800 vessel movements are made within the estuary, equating to 900 different AIS (automatic identification system) tracked vessels travelling into the estuary annually. EMODnet (2021) vessel density mapping indicates that high levels of shipping activity occur throughout the year along the Shannon estuary and, in particular, in the vicinity of the Proposed Development area. In general, average monthly vessel density in 2017, 2018, 2019 and 2020 in the Shannon estuary ranged between 2 and 10 hours per km^2 and exceeded 100+ hours per km^2 in the vicinity of the Proposed Development area. The presence of the project vessels (*i.e.* construction scows and storage vessels, and the FSRU, LNGC, tugs) will not significantly increase the level of overall vessel activity in the area. In addition, during operations the vessels will be travelling at low speeds below which most lethal and serious injuries occur (Laist *et al.,* 2001). It is therefore very unlikely that marine mammals will collide with the slow moving vessel.

7A.5.7.3 Conclusion

It is predicted that there will be **no significant** impact to marine mammals from impact mechanism 5.

7A.5.8 Impact Mechanism 6. Discharge of Treated Cooled Seawater

7A.5.8.1 Relevant Receptors

- Habitats;
- Marine Mammals; and
- Fish.

7A.5.8.2 Assessment

Impact mechanism 6 is associated with the operation phase.

7A.5.8.3 Discharge of Treated Cooling Water

Overview

As outlined in Chapter 02, the LNG vaporisation process equipment to regasify the LNG to natural gas will be onboard the FSRU. The heat for LNG regasification will be via seawater, supplemented by heat from gas fired heaters when the water temperature is inadequate. The seawater intake for the LNG regasification system will be on the side of the FSRU underwater. Screens will be installed to prevent debris in the sea water from entering the FSRU. The approach velocity at the screens will not be greater than 0.3 m/s to allow mobile marine biota to swim away. The screen mesh size will be approximately 5 mm x 5 mm. However, some small debris, leaves, plankton and larvae may be drawn in through the screens. It is expected that any silt entering the seawater circulating water system will remain in suspension and carry right through the system.

The regasification water outlet is also on the side of the FSRU underwater. The maximum projected change in water temperature is 8°C below ambient seawater temperature. The FSRU regasification seawater discharge point is the largest discharge point from the FSRU.

Following the intake of seawater into the vessel, an electric current is passed through the seawater (a process known as electrolysis). Electrolysis breaks up the naturally occurring salt molecules (sodium chloride) in seawater and produces chlorine and hypochloride, which prevents the growth of marine organisms in the internal piping system and the seawater heat exchangers of the FSRU. When the seawater is discharged from the vessel back into the marine environment, some short-lived residual chlorine would be present before mixing and decay. The concentration of residual chlorine at the discharge shall be monitored and shall not exceed the permissible limit of 0.5 mg/l.

Modelling Assessment

Discharge Characteristics

The characteristics of the cooled water to be discharged from the FRSU are shown in Table 7A-14. It was decided to model the peak flow so that a 'worst case scenario' could be observed in the receiving water (*i.e.* 22,000m^3/hr is the peak loading from the FSRU and is equivalent to 6,111l/s (6.111 cumec[15]). The modelling considered the background concentration of chlorine to be zero and that the differential change in temperature is 8^{o}C below ambient with ambient modelled at 12^{o}C so that the output represents solely the effect of discharging effluent in the receiving waters.

[15] Cumec = Cubic metres per second

Table 7A-14 Characteristics of the Cold Water Discharge from Outfall Pipe

Maximum Discharge rate (m^3/hr)	Maximum Residual Total Chlorine Concentration (mg/l)	Maximum Differential Temperature (°C)
22,000	0.50	-8.0

Intake and Outfall Location of the Cooling Water

Using the maximum flow rate of 22,000m^3/hr, the modelling was undertaken to estimate the concentrations of the total residual Chloride and water temperature within the receiving waters of the Shannon Estuary from the regasification process.

The discharge was specified with a residual total chlorine concentration of 0.5mg/l and a maximum temperature decrease over the ambient temperature of 8°C. The ambient Temperature in the Shannon Estuary was set at 12° C, and the discharging water temperature was set to 4° C. The duration of the modelling simulation was sufficiently long enough to allow steady state conditions to be attained in the vicinity of the outfall and in the nearby waters. This ensured that the minimum temperature and maximum concentration values, which would be reached throughout the water body, would be observed.

Water Temperature Simulation

Modelling showed that the discharge plume sinking towards the seabed due to its higher density with minimum temperatures of the discharge water towards the bottom layers at 130 m from the site. At the site itself, due to the elevation of the discharge from the vessel, minimum temperature is encountered at mid-depth. At the medium and far fields from the discharge outfall point, the temperature change is small and is well mixed vertically and horizontally due to the high ebb and flood velocities. At the outfall the predicted minimum temperature is 10.38°C representing a maximum temperature change over the ambient of 1.62°C. The maximum temperature change (decrease) in bottom layer along the seabed is 0.76° C. At 140 m from the discharge outfall point, the minimum temperature which occurs on spring tides is 11.54° C occurring in the bottom layer and representing a maximum decrease in ambient temperature of 0.46° C.

The EPA proposal for estuarine waters states that the temperature measured downstream of a point of thermal discharge (at the edge of the mixing zone) must not exceed the unaffected temperature by more than 1.5°C. The EPA have in previous discharge licenses allowed a regulatory mixing zone length of no greater than 10% of the channel width. In the case of the Shannon Estuary at Ardmore Point the minimum estuary width is 2.3 km indicating an allowable mixing zone of 230 m. Table 7A-14 presents the maximum reduction in ambient temperature within the receiving water body. This plot shows that within 200m of the discharge the maximum reduction in ambient temperature is less than 0.5° C and that within 3 km it is less than 0.1°C. The maximum reduction in beyond this area temperature outside is > 0.05° C and < 0.1°C which is insignificant.

Given the minor insignificant relative change in water temperature, there will be no significant effects to habitats, marine mammals or fish species.

Residual Chlorine Simulation

The residual chlorine plume acts in a similar fashion as the temperature plume, sinks vertically at the discharge point and generally has maximum concentrations within a relatively short distance of the discharge point at the seabed due to the higher density of the colder discharge water over the ambient receiving waters. Within a reasonably short distance the plume due to the high ebb and flood velocities and associated turbulence becomes well mixed vertically and horizontally.

Within 1.5 km both east and west of the discharge point the predicted maximum residual chlorine concentration is less than 0.01 mg/l. Maximum Concentration above 0.1mg/l are shown to occur only within 20 m of the discharge point and for a short period of time.

Given the minor insignificant relative change in chlorine level, it is predicted that there will be **no significant** impacts to habitats, marine mammals or fish species.

7A.5.8.4 Conclusion

Given the above it is concluded that will be **no significant** impact from impact mechanism 6.

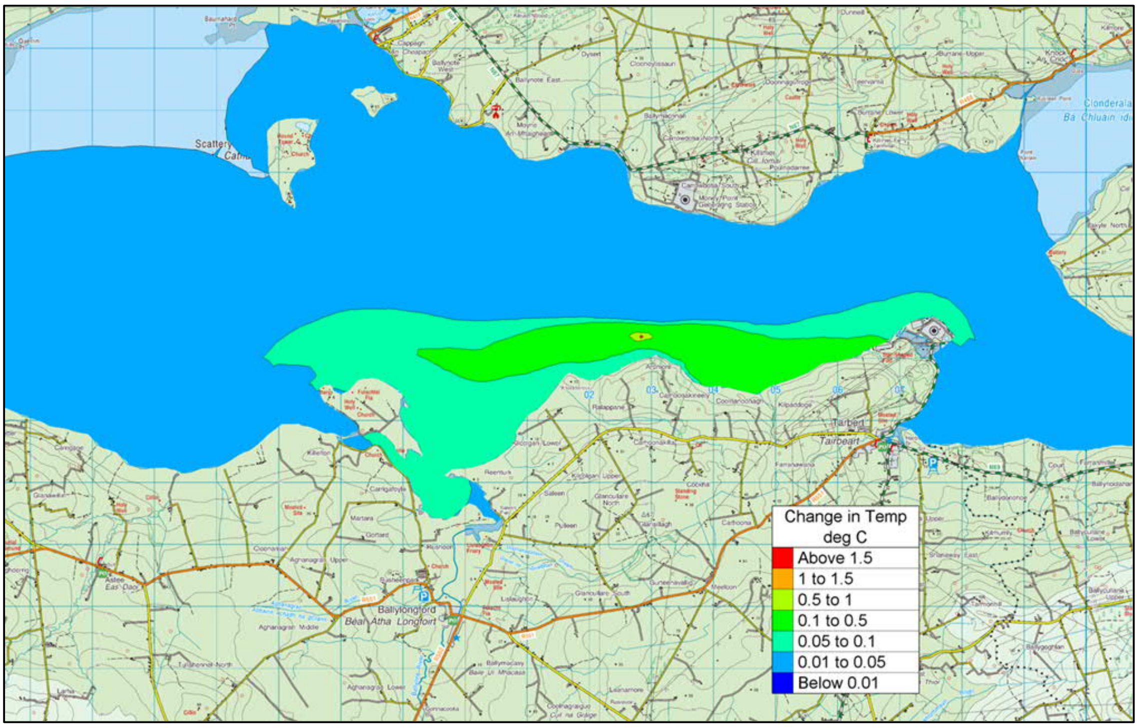

Figure 7A-16 Maximum Temperature Reduction Envelope Within Receiving Shannon Estuary Water body over a 15 day Simulation

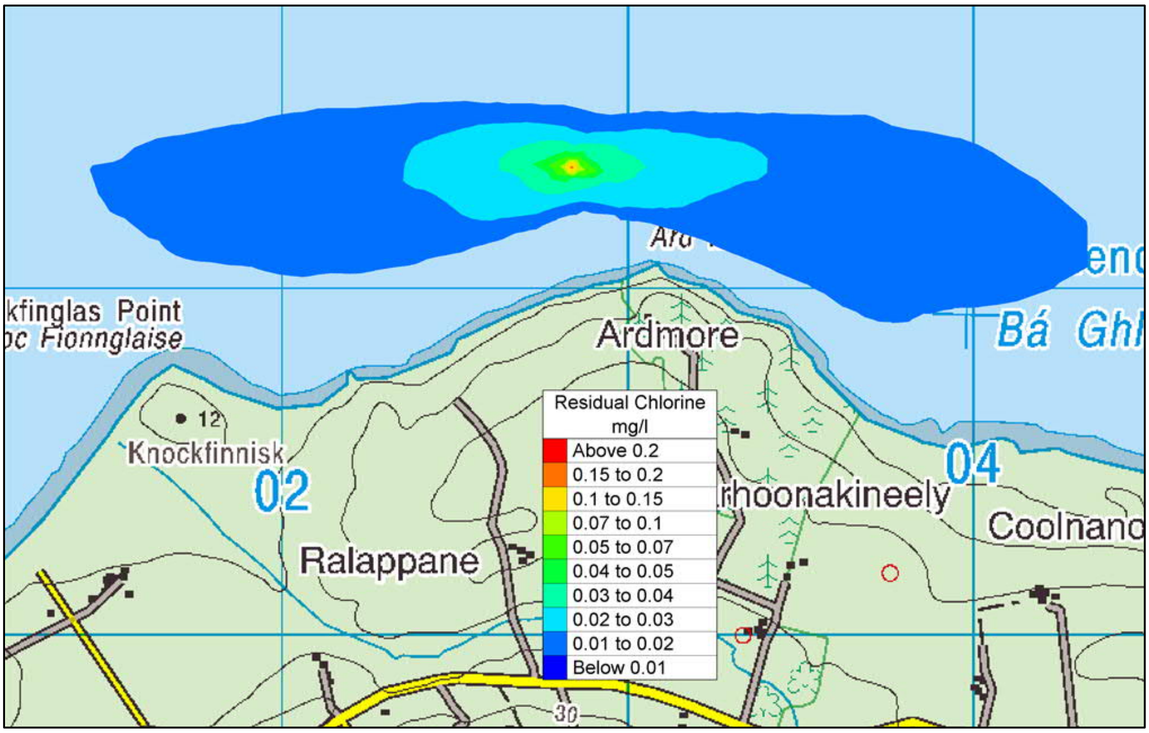

Figure 7A-17 Maximum Residual Chlorine Envelope within Receiving Shannon Estuary Water body over a 15 day Simulation (All Vertical Layers)

7A.5.9 Impact Mechanism 7. Entrainment and Impingement of Fauna by the FSRU Seawater System

7A.5.9.1 Relevant Receptors

- Fish and crustaceans; and
- Juvenile and adult fish.

7A.5.9.2 Assessment

Impact mechanism 7 is associated with the operation phase.

Fish and Crustaceans

An assessment of the impact of the LNG cooling water system, including the use of sodium hypochloride to control biofouling by epiflora and epifauna on macrocrustaceans and fish in the Shannon Estuary was carried out by reviewing relevant scientific literature on the topic. The review included*, inter alia,* Langford (1983), (1990), Rajagopal, Jenner and Venugopalan (2012), Barnthouse (2013) and Turnpenny and Horsfield (2014).

Entrainment and Impingement

Entrainment is the unwanted passage of organisms through a water intake, which is generally caused by an absence or inadequate screen surrounding the water intake while impingement is the physical contact of an organism with such a barrier structure (screen) due to intake velocities which are too high to allow the organism to escape.

With regard to flows in the Shannon Estuary, if all inflowing rivers are included along with the flows in the river, the total flow rate is 300 m^3 sec. The area of the estuarine section of the Shannon is *ca* 500 km^2 and a using a mean depth of *ca* 20, the volume of the estuary is 20 x 10^6 m^3.

The tidal prism at the mouth of the Shannon Estuary is the mean volume (500 km^3) x mean tidal height (4.5m) = 22.5 x $10^9 m^3$. The predicted volume of sea water abstracted at the LNG plant over a 12 h tidal cycle is 240,000m^3 or 0.24 x10^6 m^3.

Based on these estimates, the abstraction of 0.00024 x 10^6 m^3 of cooling water over a 12-hour period represents *ca* 0.01% of the average tidal prism volume of the Shannon Estuary which is a very small number. The potential impact of sea water abstraction therefore on crustacean and fish populations in the estuary is considered to be very low and any consequent impact on predators that feed on crustaceans and/ or fish will be imperceptible.

Seawater intakes will be located in the hull of the FSRU, approximately 2 metres below water level. A mesh size of 5 mm is proposed for the intake pipe and a velocity of 0.3 m sec (which is an order of magnitude lower than the maximum tidal velocity of the Shannon) is proposed for the intake. These physical characteristics have been designed to minimise possible intake of marine organisms including adult macrocrustaceans and fish larvae and juveniles. Some planktonic and larval forms of invertebrates and fish will however be entrained and impinged on the mesh.

Estuaries by their very nature are very variable ecosystems with considerable variations in such things as flow rates, scour, salinity and tidal fluctuations, rain fall and wind-induced variations in flows and directions, seasonal temperature variations, suspended solids loadings and oxygen levels. The Shannon Estuary has all these attributes in profusion.

With regard to macrocrustaceans that occur in the Shannon Estuary, benthic survey work carried out by AQUAFACT for the LNG project recorded the following species: *Eupagurus bernhardus* and *Leiocarcinus depurator*. Other taxa that are likely to be present include *Palaemon serratus, Homarus gammarus, Maja* sp (*sensu lato*), *Carcinus maenas* and *Cancer pagurus.* Given the physical oceanographic characteristics and the spatial extent of the Shannon compared to the size and physical characteristics of the intake pipe, the potential impact of sea water abstraction on crustacean and fish populations in the estuary is considered to be very low and any consequent impact on predators that feed on crustaceans and/ or fish will be imperceptible.

In terms of fish species, the Shannon Estuary, anadromous species include species Atlantic salmon (*Salmo salar*), Thwaite shad *(Alosa fallax*), Sea lamprey (*Petromyzon marinus*), River lamprey (*Lampetra fluviatilis*) while catadromous species include the European eel (*Anguilla anguilla*). However, as these species do not spawn in the Shannon Estuary, their larvae will not be affected by neither impingement nor entrainment.

The following is a list of fish species recorded in the Shannon Estuary by Inland Fisheries Ireland (2008): *Chelon labrosus* Thick Lipped Grey Mullet, *Platichthys flesus* Flounder, *Dicentrarchus labrax* Sea Bass, *Sprattus sprattus* Sprat, *Pomatoschistus microps* Common Goby, *Pomatoschistus minutus* Sand Goby, *Gobiusculus flavescens* 2 Spotted Goby, *Pleuronectes platessa* Plaice, *Entelurus aequoreus* Snake Pipefish, *Anguilla anguilla* Eel, *Pholis gunnellus* Butterfish, *Gobius niger* Black Goby, *Atherina presbyter* Sand Smelt, *Ciliata mustela* 5-Bearded Rockling, *Limanda limanda* Dab, *Taurulus bubalis* Long-Spined Sea-Scorpion, *Gasterosteus aculeatus* 3-Spined Stickleback, *Gadus morhua* Cod, *Pollachius pollachius* Pollock, *Myoxocephalus scorpius* Short-Spined Sea, *Labrus bergylta* Ballan Wrasse, *Syngnathus rostellatus* Nilsson's Pipefish, *Spinachia spinachia* 15-Spined Stickleback, *Syngnathus acus* Greater Pipefish, *Solea solea* Common Sole, *Symphodus melops* Corkwing Wrasse, *Callionymus lyra* Dragonet, *Scyliorhinus canicula* Lesser Spotted Dog fish, *Agonus cataphractus* Pogge, *Labrus mixtus* Cuckoo Wrasse, *Conger conger* Conger Eel, *Merlangus merlangus* Whiting, *Perca fluviatilis* Perch, *Trisopterus minutus* Poor Cod and *Osmerus eperlanus* Smelt.

Leuciscus leuciscus, Dace, is also known to be present in the Ratty River which is a tributary of the Shannon and other species that are likely to occur there are *Raja* sp., Ray, *Trigla* sp (*sensu lato*), Gurnard, *Ammodytes* sp. (*sensu lato*) Sand eel, *Blennius gattorugine* Tompot Blenny and *Pollachius viren*s Coalfish.

Given the physical oceanographic characteristics and the spatial extent of the Shannon compared to the size and physical characteristics of the intake pipe, the potential impact of sea water abstraction on the above list fish populations in the estuary is considered to be very low and any consequent impact on predators that feed on them will be imperceptible.

Barnthouse's (2013) important review of literature from many parts of the world on the impacts of cooling water systems at thermal electricity generating stations on the entrainment and impingement on fish at power plants included peer-reviewed publications, 'blue-ribbon' commission reports on aquatic resource degradation that evaluate causes of observed degradation of aquatic ecosystems and the USA's EPA's assessments of causes of degradation in coastal environments. His conclusion was that any impacts caused by impingement and entrainment were small compared to other impacts on fish populations caused by overfishing, habitat destruction, pollution and invasive species. The available scientific evidence did not support a conclusion that reducing entrainment and impingement mortality via regulation of cooling water intakes would result in significant improvements of fish populations.

He cited many studies which showed no environmental impact, in fisheries terms, of thermal electricity generating station cooling water system operation including Turnpenny (1988), Turnpenny and Taylor (2000) and Greenwood (2008) who used equivalent adult models to quantify impacts of impingement at plants in the U.K. and all of these studies found that impingement of mainly juvenile fish at power plants was equivalent to only a few percent of commercial harvest tonnages of adult fish.

Control of Biofouling

With regard to the control of biofouling, as stated in the *Integrated Pollution Prevention and Control (IPPC) Reference Document on the application of Best Available Techniques to Industrial Cooling Systems, December 2001*, open, once-through cooling systems are typically treated with oxidizing biocides to control fouling by epiflora and epifauna. The amount applied can be expressed in the yearly used oxidative additive expressed as chlorine-equivalent per Megawatt thermal (MWth) in connection with the level of fouling in or close to the heat exchanger. Operational measures for reducing harmful effects of cooling water discharge are the closing of the purge during shock treatment and the treatment of the blowdown before discharge into the receiving surface water.

According to the Reference Document, Free Oxidant (FO)/ Total Residual Oxidants (TRO) is defined as the applied measure of free oxidants in the discharge of cooling water systems, also referred to as TRO or Total Chlorine (TC) or Free Chlorine (FC). The document further defines TRO as the operational equivalent to total residual chlorine and total available chlorine. Free Residual Oxidant (FRO) is not defined.

The document cites a programme in The Netherlands for the optimised use of hypochlorite in cooling water. A concentration of 0.1 to 0.2 mg FO/l in the discharge was used as a target concentration for continuous dosed (once-through) cooling systems. For intermittent or shock chlorination regimes the FO or FRO concentration was always below 0.2 mg/l as a daily (24h) average value but during shock injection, the FO or FRO concentrations could be close or equal to 0.5 mg/l (hourly average).

The IPPC summarises the primary Best Available Technology (BAT) approach for the reduction of emissions to water by design and maintenance techniques in terms of emissions of free (residual) oxidant in once-through cooling system as follows:

- FO or FRO ≤ 0.5 mg/l at the outlet for intermittent and shock chlorination of sea water as an hourly average value within one day used for process control requirements; and
- FO or FRO ≤ 0.2 mg/l at the outlet for continuous chlorination of sea water as a daily (24h) average value.

Tarbert Power Plant Integrated Pollution Prevention Control Licence (P0607-02)

The ELV for chlorine in cooling water discharges to the Shannon Estuary, as specified in the SSE Generation Ltd.'s Integrated Pollution Prevention Control Licence (P0607-02) for Tarbert power plant, which was issued on 27th September 2012 to ensure that the emissions from the facility had due regard to the *European Communities Environmental Objectives (Surface Waters)* Regulations*, 2009,* is 0.5 mg/l. Hourly/ daily limit values are not specified.

SSE Generation Ltd is required to analyse weekly water samples for chlorine. According to its Annual Environmental Reports, chlorine is measured by colorimetric spectroscopy using the Hach 8167 method for Total Chlorine. Results are typically <1.2 x ELV (0.5 mg/l Chlorine). It is noted that dosing of the cooling system at Tarbert power plant with biocides is limited due to a lack of evidence of mussel growth within the system.

Great Island SSE Power Plant Integrated Pollution Prevention Control Licence (P0606-03)

The ELV for chlorine in cooling water discharges to Waterford Estuary, as specified in the SSE Generation Ltd.'s Integrated Pollution Prevention Control Licence (P0606-03) for the Great Island power plant, which was issued on 16th March 2011, by the EPA, is 0.3 mg/l.

Given the above, it is considered that an application for an ELV of 0.3 mg/l Total Chlorine is considered appropriate for cooling water discharges for the Shannon LNG project. It should be noted however, that the actual ELV applied will be determined by the Environmental Protection Agency under the IPPC regime.

As noted above, the Shannon Estuary is a highly variable ecosystem with considerable ranges in physical oceanographic characteristics as flow rates, scour, tidal fluctuations, wind-induced variations in flows and directions and turbulence that give rise to high levels of dilution and dispersion. Any sodium hypochlorite that is released to the estuary will be very quickly diluted and dispersed away from the end of the pipe.

Juvenile and Adult Fish

Seawater intakes will be located in the hull of the FSRU, approximately 2 m below water level. Screens will be covering the intakes to prevent fish, crustaceans and debris from entering the seawater system within the FSRU. The design of the water intakes will be such that the approach velocity of the seawater entering the screens will not be greater than 0.3 m/s to allow mobile marine biota to swim away. The screen mesh size will be approximately 5 mm x 5 mm.

Conservation Feature Fish Species of the Lower Shannon cSAC

Atlantic Salmon *Salmo salar*

Salmon spend their juvenile phase in rivers before migrating to sea to grow and mature. The life cycle of salmon begins where salmon eggs are laid in spawning grounds located upstream. After 2 to 6 months the eggs hatch into tiny larvae called sac fry or alevin.

The alevin has a sac containing the remainder of the yolk, and they stay hidden in the gravel for a few days while they feed on the yolk. When the sac or yolk has almost gone the larvae leave the protection of the gravel and start feeding on plankton. At this point the salmon are called fry. At the end of the summer the fry develop into juvenile fish called parr that feed on small invertebrates and are camouflaged with a pattern of spots and vertical bars. Once the parr have grown to between 10 and 25 cm in body length, they undergo a physiological pre-adaptation to life in seawater. At this point the salmon are called smolt. As salmon larvae will not be present in the project area there is no potential for impact from entrainment and impingement by the cooling system.

Sea Lamprey *Petromyzon marinus* and River Lamprey *Lampetra fluviatilis*

Lamprey spawning habitat requires a gravel bottom with swift-running water and nearby sheltered areas with muddy bottoms for the larvae (Wheeler, 1969). Sea lamprey congregate at spawning gravels to spawn in May and June, and river lamprey spawning in March and April (Kelly and King, 2001).

Hatching occurs two weeks after egg deposition and within a further one to three weeks the ammocoete larvae emerge from the spawning substrate and burrow into muddy beds in sheltered areas. Ammocoetes (larvae) are relatively immobile and remain in the muddy beds in freshwater stretches of rivers for between 3 – 8 years (Kelly and King, 2001; Dawson et al., 2015). As larvae will not be present in the project area there is no potential for impact from entrainment and impingement by the cooling system.

Brook Lamprey *Lampetra planeri*

The Brook Lamprey (Lampetra planeri) are a freshwater species occurring in streams and occasionally in lakes in northwest Europe, particularly in basins associated with the North and Baltic seas. Spawning occurs in the rivers in March and April.

Once hatched, Brook Lamprey larvae leave the nest at 3-5 mm in length and drift downstream, settling in depositing substrates in in freshwater stretches of river margins and back-waters. The larval period lasts for approximately 6 years. Following metamorphosis, Brook Lamprey turn more silvery along the sides and the belly and the back remains a dark grey-brown colour. At this stage of the life cycle the brook lamprey has reached a length of 12-15 cm. The adult brook lamprey moves out from the silt beds as spawning time approaches and start to migrate upstream in search of a suitable habitat for spawning. They continue to burrow as adults or hide under stones during the day. As larvae will not be present in the project area there is no potential for impact from entrainment and impingement by the cooling system.

7A.5.9.3 Conclusion

Potential impacts are assessed as **negative** and **not significant**.

7A.5.10 Impact Mechanism 8. Discharge of Wastewater and Power Plant Process Heated Water Effluent

7A.5.10.1 Relevant Receptors

- Habitats;
- Marine Mammals; and
- Fish.

7A.5.10.2 Assessment

Impact mechanism 8 is associated with the operation phase.

Overview

The proposed treated sanitary effluent discharge from the development was modelled discharging from the proposed nearshore outfall pipe located on the sea bed.

The outfall pipe is also the discharge point for effluent from the Power Plant.

The parameters of interest modelled are temperature, BOD, Ammonia, Total Phosphorous and *E.coli.*

Modelling Assessment

Power Plant Process Heated Water Effluent

The Power Plant will generate several process water effluent streams. Some of the effluent streams will be collected and removed offsite and the remaining effluent streams will be pumped or fall by gravity to the effluent sump. Process water effluent leaving the effluent sump, will be continuously monitored for pH before discharging to the estuary via the storm water outfall pipe.

The automatic control system associated with the effluent sump will sound an alarm if the pH goes outside a pre-set range – typically 6 to 9. This will alert the operator to take corrective action to remedy the problem. If the pH continues to go outside the pre-set range, this will automatically close the discharge valve and open the associated re-circulation valve and will then start the re-circulation process during which period the sump will be dosed with either acid or caustic soda to return the pH to between 7 and 8. At this stage the automatic discharge valve will re-open and the re-circulation valve will close. A regular visual check on oils and greases will also be made in this sump to ensure that the discharge will be free of these contaminants before discharge. The process effluent in the sump will be monitored for compliance with the IE licence limits and then discharged, via the storm water outfall pipe, to the Shannon Estuary. Table 7A-15 below summarises the Power Plant Process Effluent Sump Discharge.

Table 7A-15 Power Plant Process Effluent Sump Discharge

Parameter	Typical Range of Emissions (min. to max.)
Volume range	0 to 1,128m^3/day
pH	6 – 9
Temperature range	25^{0}C to 40°C
BOD	20 mg/l
Suspended Solids	30 mg/l
Total Dissolved Solids	5000 mg/l
Mineral Oil	20 mg/l
Total Ammonia (as N)	5 mg/l
Total Phosphorous (as P)	5 mg/l

Treated Sanitary Effluent Discharge

Sanitary effluent will be generated by the LNG Terminal and by the Power Plant. All sanitary effluent will be pumped or fall by gravity to a common wastewater treatment plant (WWTP) onsite. The effluent waste stream will be monitored for compliance with the licence limits and then discharged, via the storm water outfall pipe, to the Estuary.

A biological Wastewater Treatment System is proposed. It will be sized for a headcount of 67. Table 7A-16 summarises the effluent stream generated from the WWTP and provides estimated quantities.

Effluent leaving the WWTP will be continuously monitored for pH before discharging to the estuary. The automatic control system associated with the WWTP will sound an alarm if pH falls outside of expected range. This will alert the operator to take corrective action to remedy the problem. If the problem continues to go outside the pre-set range, this will automatically close the discharge valve and effluent will be diverted to a holding tank.

Table 7A-16 Characteristics of WWTP Discharges

Parameter	Emission Limit Value
Volume	35m^3/day
pH	6 – 10
BOD	25 mg/l
Suspended Solids	35 mg/l
Ammonia (as N)	5 mg/l
Total Phosphorous (as P)	2 mg/l

Modelled Discharges

The modelled effluent was a combination of the treated sanitary effluent of 35m^3/day and the process effluent at a mean daily discharge of 778m^3/day and an instantaneous maximum hydraulic load of 1,128 m^3/day. This was modelled as a thermal discharge at 40^{o}C with the receiving waterbody ambient temperature of 12^{o}C (effluent at 20^{o}C above ambient). The various treated effluent concentrations are outlined in Table 7A-15 and Table 7A-16.

The Heated discharge from the processed waters was modelled at 28^{o}C above ambient with the ambient at 12^{o}C. The maximum and mean temperature envelope are presented in Figure 7A-18 and Figure 7A-19 over a full 15 day spring-neap-spring tidal period. These plots show very local rise in temperature at the outfall site having a maximum increase of 0.9135^{o}C and mean increase at outfall site of 0.069^{o}C. The maximum temperature increase reduces within 100 m of the discharge point to 0.171^{o}C which is an insignificant impact. The heated plume rises and mixes in the water column due to a lower density than the receiving waters. At the outfall site the maximum temperature occurs at the sea bed but within a short distance the plume is well mixed vertically.

E.coli was modelled from the sanitary discharge only using a conservative die-off rate of T_{90} = 36hours (winter conditions) at a secondary treated effluent concentration of 10^6 No./ 100ml and a discharge rate of 0.41l/s. The maximum and mean concentration envelopes for *E.coli* are presented in Figure 7A-20 and Figure 7A-21 over a complete spring-neap-spring tidal period. The highest concentration occurs in the receiving waters at the outfall site which is predicted to reach 1,458 No/100ml *E.coli* and within 100 m (mixing zone) this has reduced to 279 No./ 100ml. The tidal mean concentration over 15 days of tides is 102 No./100ml at the outfall site and significantly lower elsewhere. The predicted concentration plume shows no impact on Ballylongford and Glencloosagh Bays where shellfish activities are located.

BOD concentration was modelled at 9l/s at concentration of 20 mg/l from the process effluent and at 0.41 l/s at 25 mg/l from the sanitary effluent discharge. The maximum and mean concentration envelopes for BOD are presented in Figure 7A-22 and Figure 7A-23 over a complete spring-neap-spring tidal period.

The highest concentration occurs in the receiving waters at the outfall site at a concentration of 0.692 mg/l BOD. The maximum BOD concentration within 100 m of the outfall site is 0.132 mg/l. The average BOD concentration in the receiving water at the outfall site is 0.048 mg/l.

The total ammonia discharge from the treated process water and treated sanitary water produces a maximum ammoniacal nitrogen concentration within the receiving waterbody of 0.1513 mg/l N and a mean concentration at the outfall site of 0.012 mg/l N, refer to Figure 7A-24 and Figure 7A-25. The maximum Ammoniacal nitrogen concentration within 100 m of the outfall site is predicted to be 0.033 mg/l N.

The dispersion simulations show that the total Phosphorous Concentration from the treated process water and treated sanitary water produce a maximum concentration within the receiving waterbody of 0.167 mg/l P occurring at the outfall site and a mean concentration at the outfall site of 0.0117 mg/l P, refer to Figures Figure 7A-20 and Figure 7A-21. The maximum Total phosphorous concentration at 100 m from the outfall site is predicted to be 0.032 mg/l P.

7A.5.10.3 Conclusion

All of the above modelled water quality parameters are shown to easily satisfy the permissible limits set out in the surface water regulations and will not impact the water quality status of the receiving Shannon Estuary waters. Consequently, it can be concluded there will be **no significant** environmental impact from impact mechanism 8.

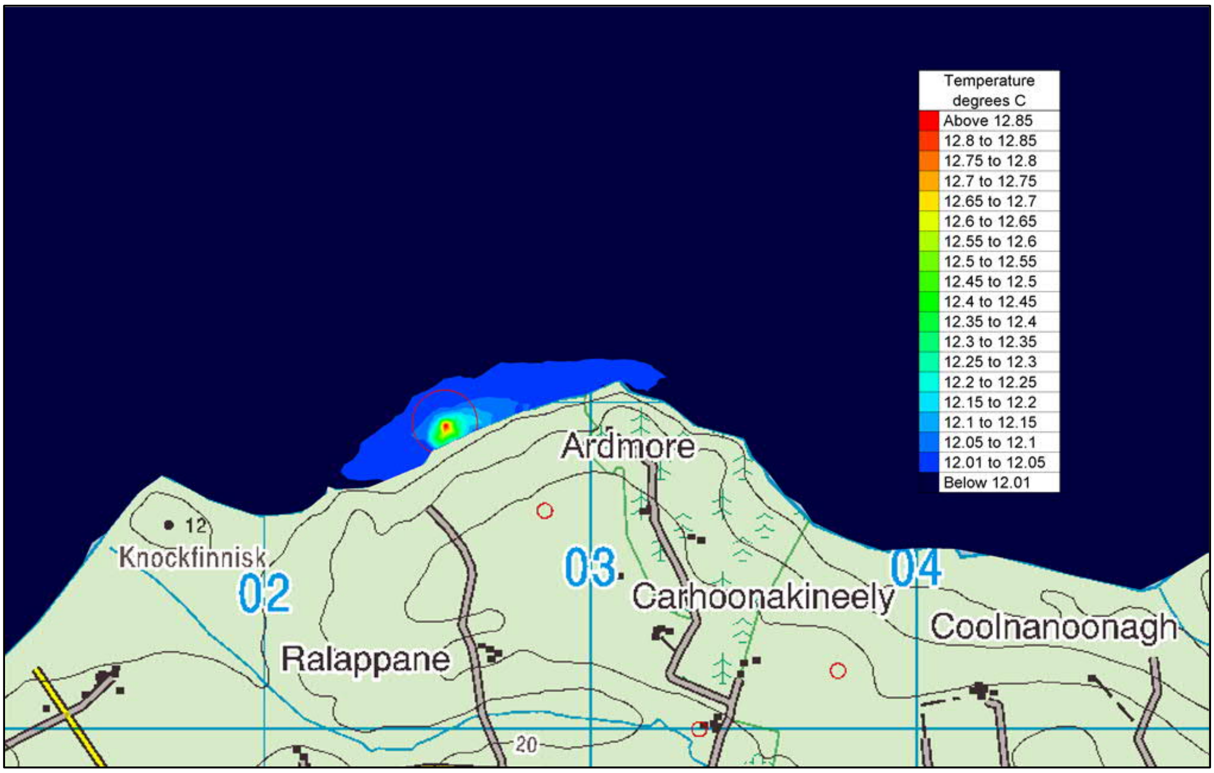

Figure 7A-18 Predicted Maximum Temperature Envelope over 15 Days for Spring-neap-spring Tide Simulation Modelling Effluent at 40ºC and Ambient Temperature at 12ºC

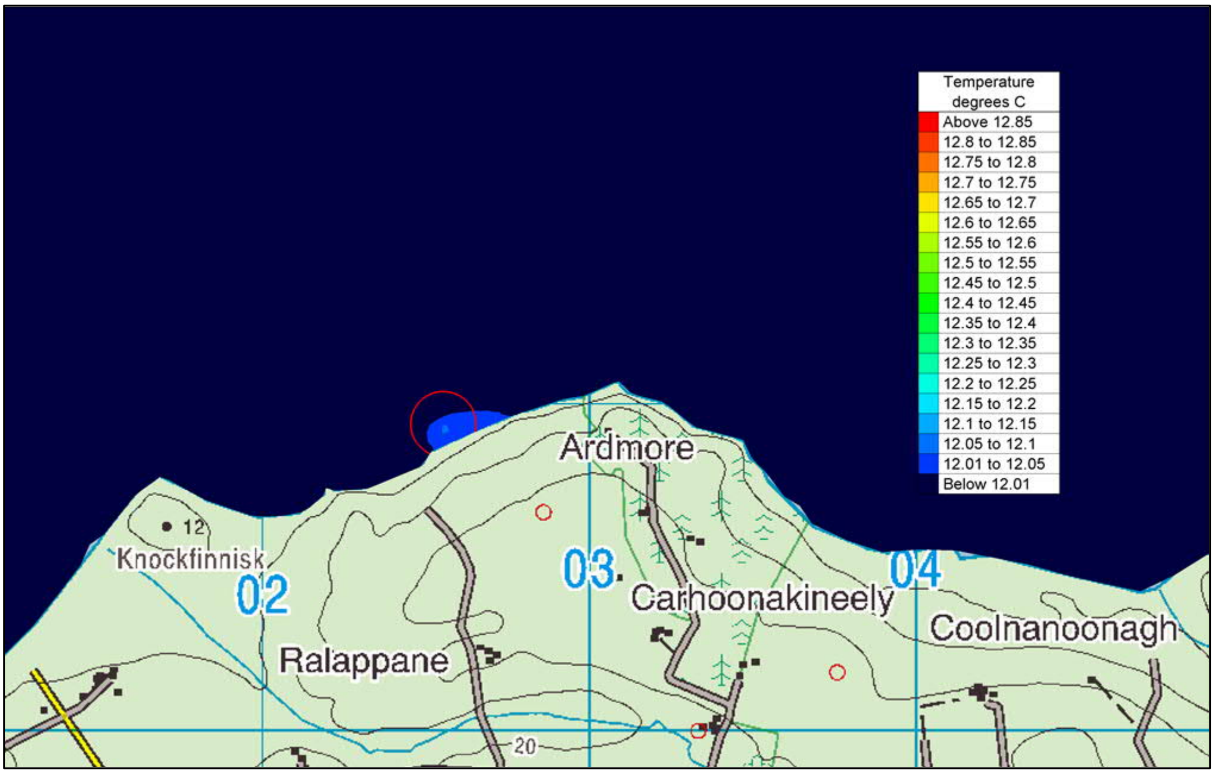

Figure 7A-19 Predicted Mean Temperature Envelope over 15 days for Spring-neap-spring Tide Simulation Modelling Effluent at 40 ºC and Ambient Temperature at 12 ºC

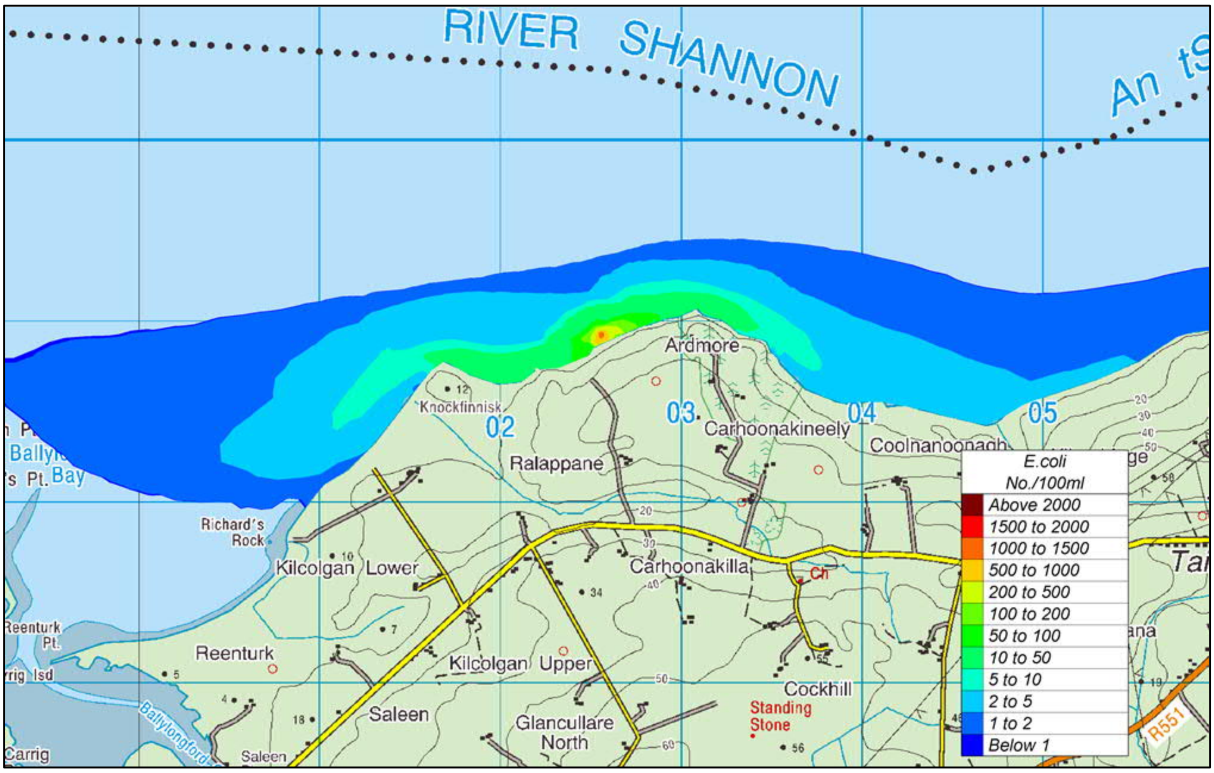

Figure 7A-20 Predicted Maximum *E.coli* concentration (No./ 100ml) Envelope over 15 Days for Spring-neap-spring Tide Simulation

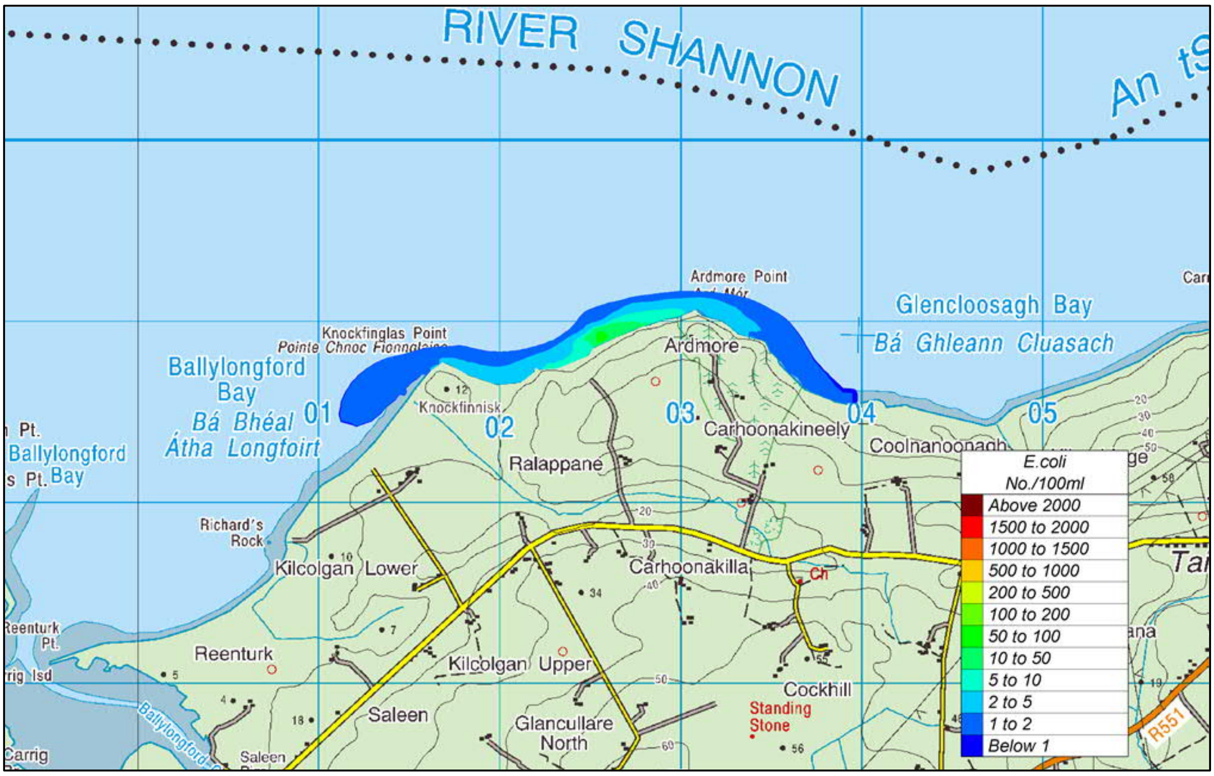

Figure 7A-21 Predicted Average *E.coli* Concentration (No./ 100ml) Envelope over 15 days for Spring-neap-spring Tide Simulation

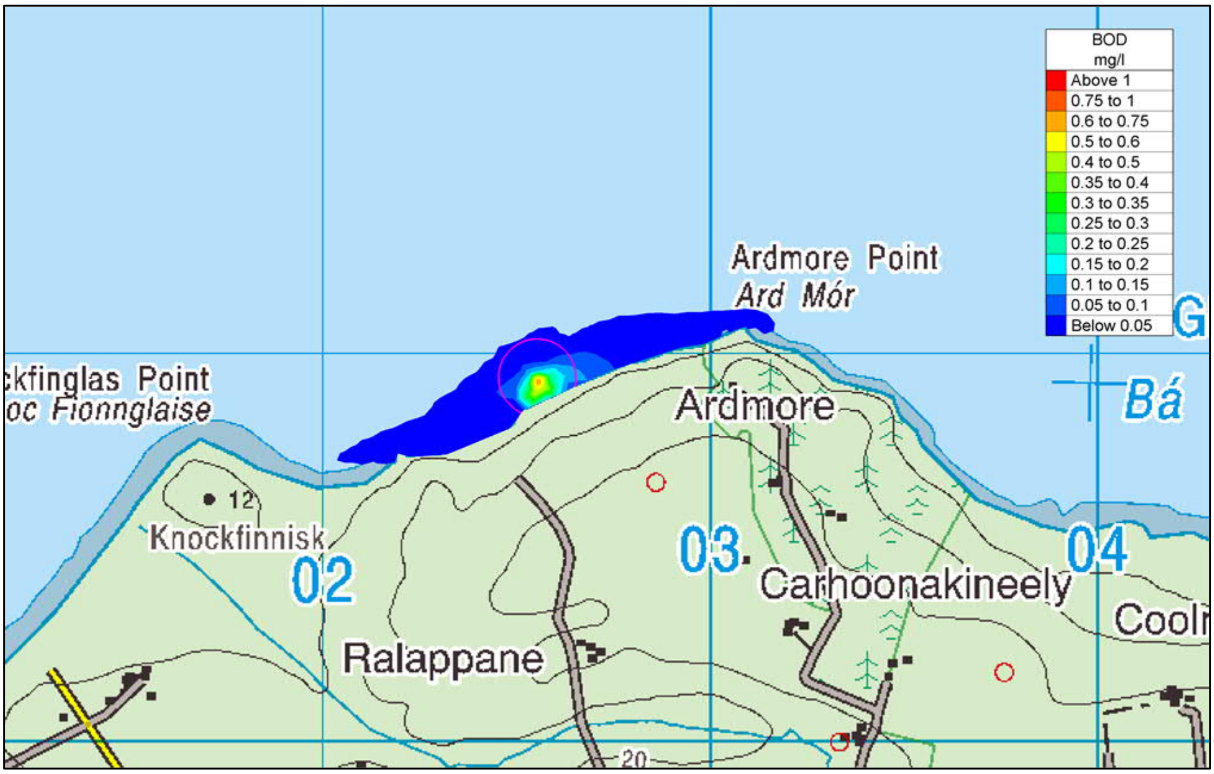

Figure 7A-22 Predicted Maximum BOD concentration (mg/l) Envelope over 15 days for Spring-neap-spring Tide Simulation

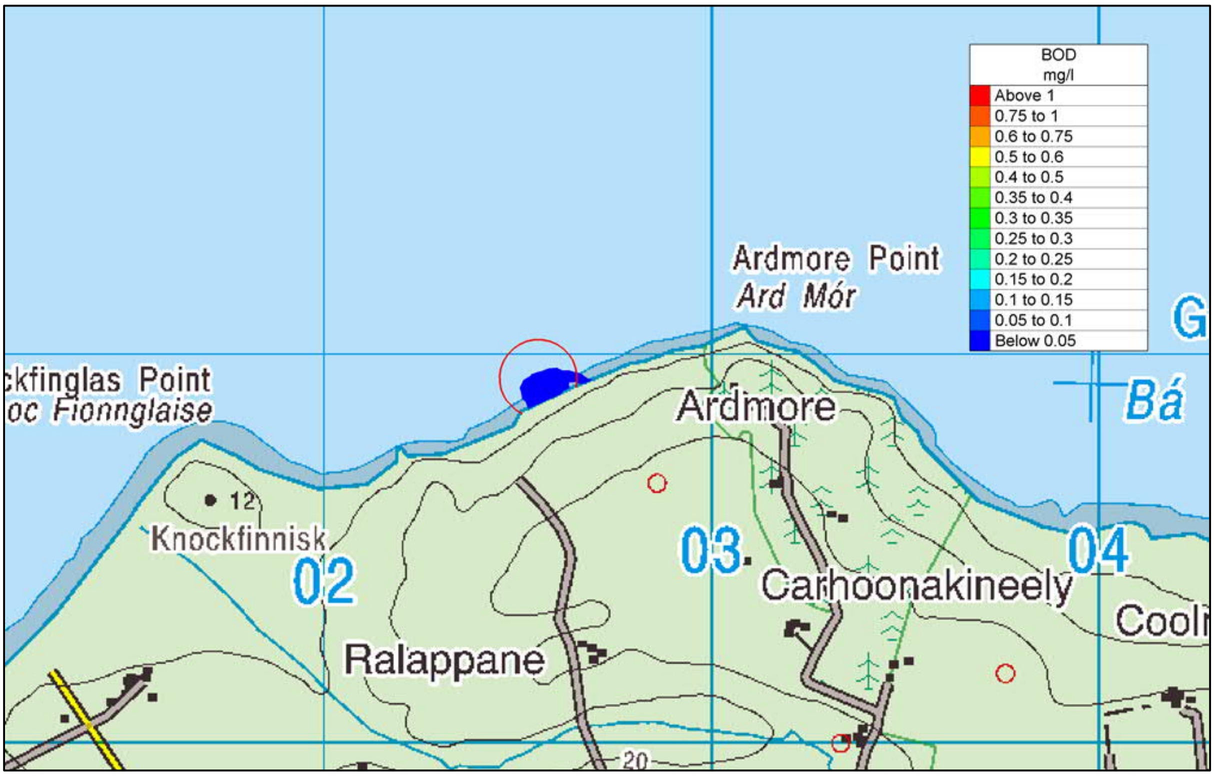

Figure 7A-23 Predicted Mean BOD Concentration (mg/l) Envelope over 15 days for Spring-neap-spring Tide Simulation

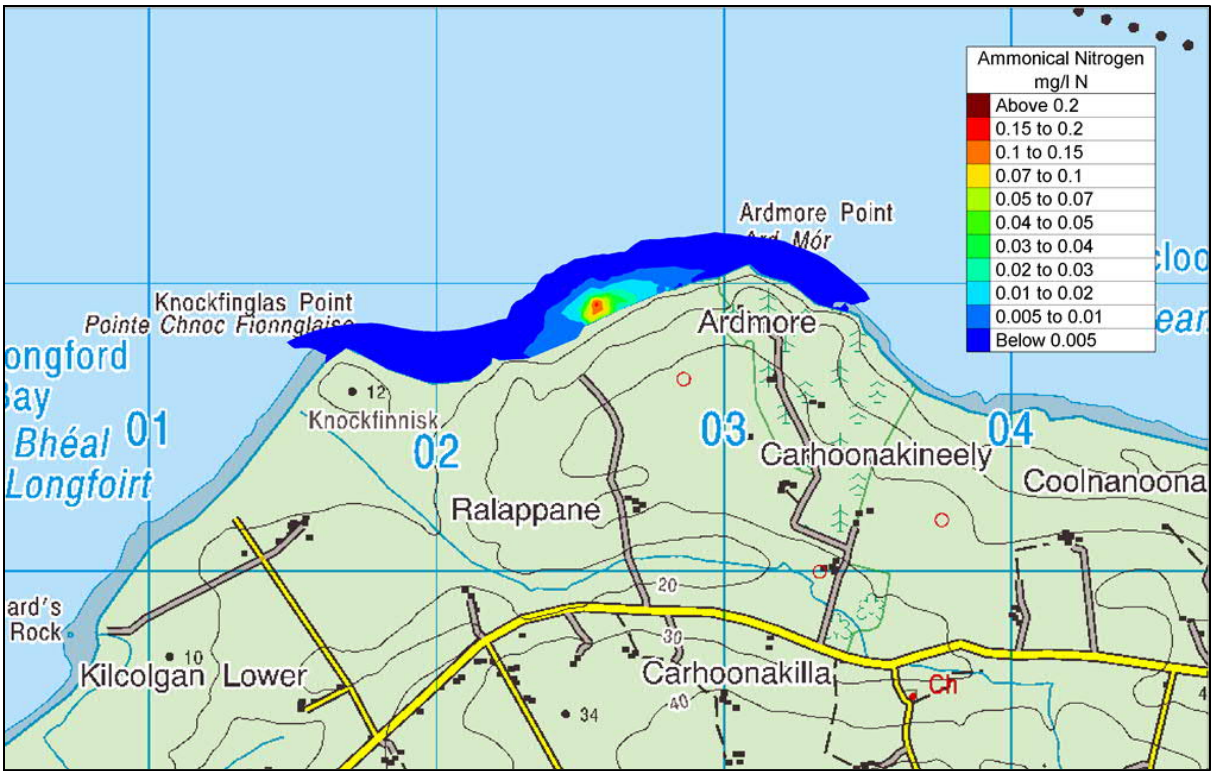

Figure 7A-24 Predicted Maximum Ammoniacal Nitrogen Concentration (mg/l N) Envelope over 15 days for Spring-neap-spring Tide Simulation

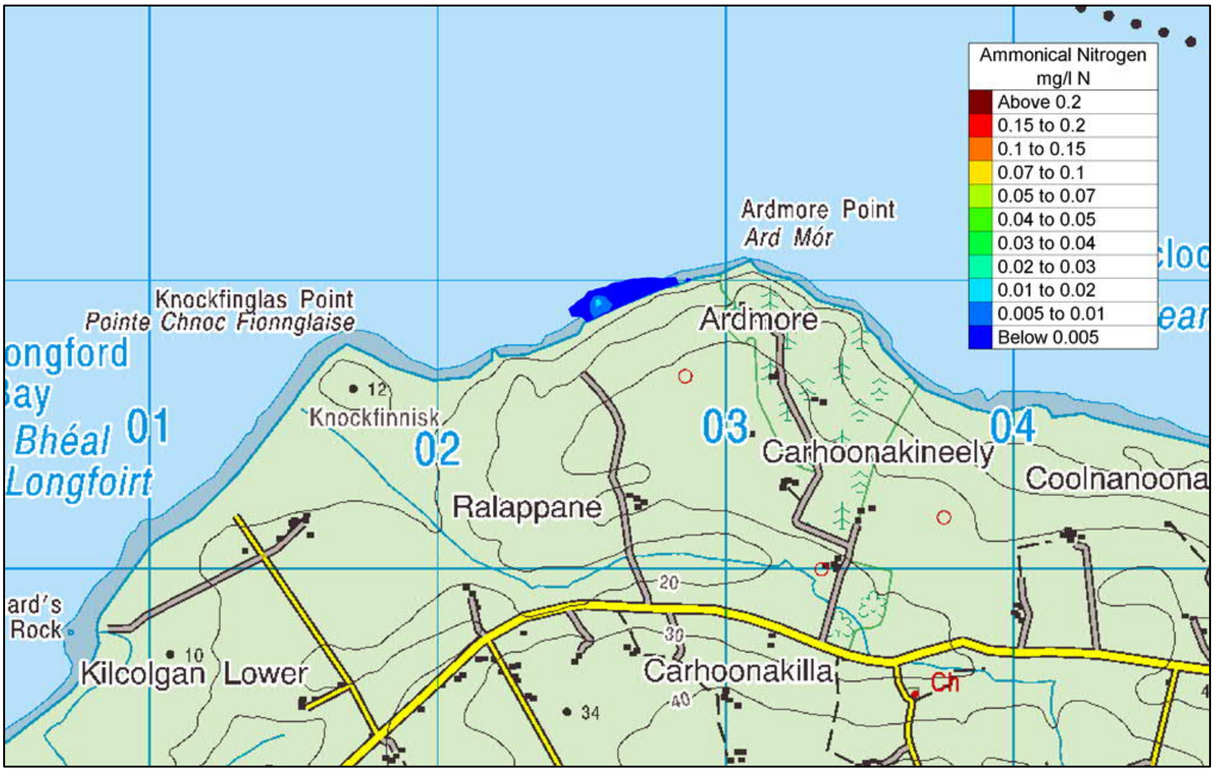

Figure 7A-25 Predicted Mean Ammoniacal Nitrogen Concentration (mg/l N) Envelope over 15 days for Spring-neap-spring Tide Simulation

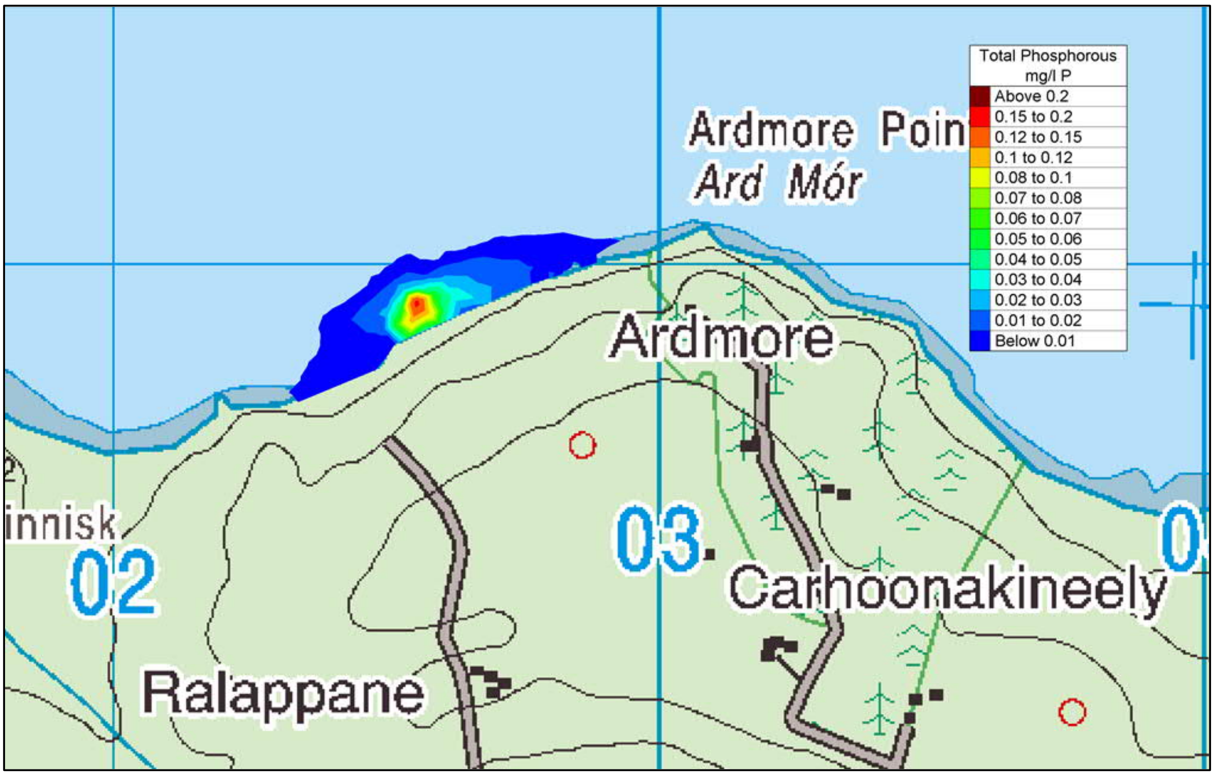

Figure 7A-26 Predicted Maximum Total Phosphorous Concentration (mg/l P) Envelope over 15 days for Spring-neap-spring Tide Simulation

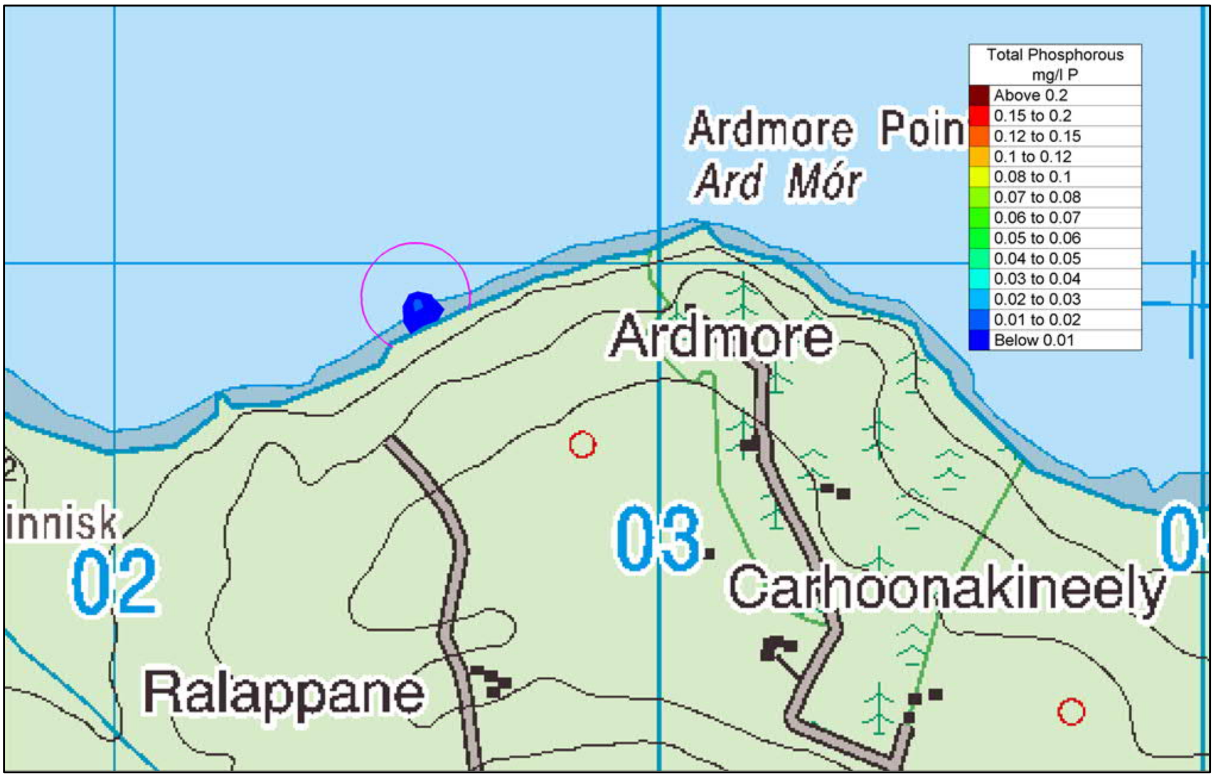

Figure 7A-27 Predicted Mean Total Phosphorous Concentration (mg/l P) Envelope over 15 days for Spring-neap-spring Tide Simulation

7A.5.11 Impact Mechanism 9. Introduction of Invasive Species

7A.5.11.1 Relevant Receptors

- Habitats;
- Marine Mammals; and
- Fish.

7A.5.11.2 Assessment

Impact mechanism 9 is associated with the operation phase.

Invasive non-native plant and animal species are a significant threat to biodiversity worldwide. 'Non-native species' are the equivalent of 'alien species' as used by the Convention of Biological Diversity16. It refers to a species, subspecies or lower taxon, introduced by human action outside its natural past or present distribution; includes any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce. An invasive non-native species is any non-native animal or plant that has the ability to spread causing damage to the environment. Alien species that become invasive are considered to be main direct drivers of biodiversity loss across the globe. Invasive species are non-native species that can cause harm to the natural ecology of an area, often by out-competing native species.

Ballast water which is used by commercial vessels to control trim, draft and stability is widely recognised as one of the key dispersal mechanisms for marine invasive species. These species can affect the ecological balance of their new regions by outcompeting native species or otherwise impacting native ecosystems. Established protocols to manage the use of ballast water and the risk of introduction and spread of marine invasive species is provided in Section 7A.7.4 below.

7A.5.11.3 Conclusion

Without the implementation of mitigation potential impacts are predicted to **negative**, **significant** and **long-term**.

Strict adherence to protocols will ensure there is no significant risk of environmental impact from the introduction and spread of marine invasive species is managed.

[16] Convention on Biological Diversity. Invasive Alien Species. https://www.cbd.int/invasive/. Accessed 10/01/2017.

7A.5.12 Impact Mechanism 10. Accidental Large Scale Oil or LNG Spill

7A.5.12.1 Assessment

Impact mechanism 10 is associated with the operation phase.

The likelihood of large-scale oil and LNG spills due to accidents and vessel collision during operations at the Proposed Development is regarded as remote, while the risk of accidental small spillages of pollutants (including fuels, hydrocarbons, oils etc.) is considered to be low.

Specifically, the assessment of likelihood of release events from the Proposed Development are set out in the following

- Marine Navigation Risk Assessment, which was prepared by the Shannon Foynes Port Company (see Appendix A2-2 of EIAR Vol. 4).
- Quantitative Risk Assessment (QRA) and associated Major Accidents to the Environment (MATTE) submitted to the HSA as part of the planning application (see Appendix A2-5, Vol. 4).
- EIAR for the Proposed Development submitted ABP as part of the planning application
- OCEMP (see provided in Appendix A2-4, Vol. 4).

Additionally, the operation of the Proposed Development will be controlled and regulated by the following bodies:

- Environmental Protection Agency;
- Commission for Regulation of Utilities;
- Health and Safety Authority;
- KCC; and
- The Shannon Foynes Port Company.

However, in consultation with Shannon Foynes Port Company and the Shannon Estuary Anti-Pollution Team (SEAPT), Shannon LNG has prepared an Oil and Hazardous and Noxious Substances (HNS) Spill Plan Development Framework (see Appendix A2-6 of EIAR Vol. 4). This document describes the graduated and tiered response process to fulfil these obligations and to provide a robust and coordinated response to release incidents in the unlikely event they should occur. The developed plans will follow international best practice guidelines of the International Maritime Organization (IMO), The Society of International Gas Tanker and Terminal Operators (SIGTTO), and International Petroleum Industry Environmental Conservation Association (IPIECA) while taking into account relevant Irish legislative and regulatory approval requirements. In particular the plans will follow the requirements made within the National Maritime Contingency Plan Oil and HNS Spills 2019 (NCP) and the National Framework for the Management of Major Emergencies. The plans will be developed to cover both In-Land (onshore) and Marine based releases and shall cover the Construction and Operational Phases of the Proposed Project. Key objectives and the format of the Oil and HNS Spill Plan Oil and how the plan relates to the National Contingency Plan (NCP) are described in Section 7A.6.

The development has (provisional to project go-ahead) been accepted as member of the Shannon Estuary Anti-Pollution Team (SEAPT). Membership of SEAPT will enable the development to interface directly with the approved Shannon Estuary Oil/HNS Plan and access additional response equipment to augment that held within the terminal (see Section 7A.7.5 for further details).

LNG is stored on the FSRU and LNGC site as a liquefied gas and when released to its surroundings it vaporises rapidly to form natural gas, leaving no residue. LNG (methane and other light hydrocarbons) is classed under the COMAH Regulations as ‘Liquefied Flammable Gasses’. As LNG and natural gas are not toxic to the environment, hazards are associated with exposure to low temperatures from an LNG release (cryogenic burns), or fires if a release of LNG or natural gas is ignited. Environmental receptors at risk are flora and fauna.

The MATTE assessment determined that thermal radiation from jet fires and flash fires will not affect the NHA and onshore cSAC to the west of the Site. LNG Pool fires on the sea surface could lead to thermal radiation effects at the NHA and onshore SAC to the west of the Site. The frequency of these events have been calculated within the Safeti QRA Model and are at most 3.7 x 10^{-6} per year (once in 270,270 years) at the closest point of the onshore SAC. This frequency is considered to be very low. It should be noted that the 5 kw/m^2 thermal radiation intensity is below that which would lead to a fire and therefore recovery from this type of event would be less than three years. Modelling indicates that the jet and pool fire contours of 5kW/m^2 reach areas of the estuary that forms part of the SAC and SPA close to the jetty/terminal. While harm to birds present on the estuary surface close to the Proposed Development may be possible in the event of a fire, bird surveys have identified that there are no significant populations of bird species in the vicinity of the Proposed Development site. Based on the definition of a MATTE jet fires and LNG pool fires are not considered credible MATTE events. All of the MATTE events identified are considered to be low frequency and consequently low risk.

Based on the assessments described above, the likelihood of major accident is predicted to be remote and therefore does not pose a significant risk to habitats or species within or in the vicinity of the Proposed Development site.

7A.5.12.2 Conclusion

Based on the assessments described above, the risk of major accident is predicted to be remote and therefore are not an issue to habitats or species within or in the vicinity of the Proposed Development site.

The potential impact of small-scale accidental spillages is predicted to be **negative**, **significant** and **medium-term.**

With the implementation of mitigation impact of small-scale accidental spillages is predicted to be **not significant.** It should be noted that releases of pollution will be contained and cleaned up immediately. Remediation measures will be carried out in the unlikely event of pollution of the marine environment.

7A.5.13 Climate Change and Biodiversity

The EU Commission guidance document on integrating climate change and biodiversity into environmental impact assessment (EU Commission, 2013) aims to improve the way in which climate change and biodiversity are integrated into Environmental Impact Assessment. Key principles specified by the document when considering impacts include the following:

- Consider climate change at the outset;
- Analyse the evolving environmental baseline trends;
- Take an integrated approach;
- Seek to avoid biodiversity and climate change effects from the start;
- For biodiversity, EIA should focus on ensuring ‘no net-loss’;
- Assess alternatives that make a difference in terms of climate change and biodiversity;
- Use ecosystem-based approaches and green infrastructure as part of the project design and/ or mitigation measures; and
- Assess climate change and biodiversity synergies and cumulative effects which can be significant.

The potential effects from the Proposed Development on climate have been specifically addressed by Chapter 15 – Climate. No significant interactions between the effects on biodiversity resulting from this development and climate change have been identified.

7A.5.14 Decommissioning

As described in Chapter 02 – Project Description, the Proposed Development is expected to have a design life of 50 years, but this could be extended by maintenance, equipment replacement and upgrades or by the transition of the site to use hydrogen capability (which would be subject to a future planning application).

During decommissioning, measures would be undertaken by the Applicant to ensure that there would be no significant, negative environmental effects during the decommissioning phase. The decommissioning plan would incorporate measures to satisfy all regulatory requirements and to achieve targeted environmental goals. The decommissioning measures would have to be implemented to the satisfaction of the relevant consenting authorities.The impact of decommissioning will be **temporary** and **not significant** following the implementation of standard mitigation measures.

7A.6 Cumulative Impacts

The cumulative impacts of the Proposed Development and nearby consented projects in the vicinity of the Proposed Development are discussed below. A planning search of granted and pending planning applications made within the vicinity of the Proposed Development site is presented in Chapter 04 – Energy and Planning Policy.

7A.6.1 Summary of Schemes Considered in Cumulative Impact Assessment

7A.6.1.1 LNG Pipeline, Data Centre Campus and Power Transmission

LNG Pipeline

Permission was granted in 2009 for a pipeline to connect the Proposed Development to the existing national gas network near Foynes, Co. Limerick. The application was accompanied by an EIAR. No significant residual effects were identified to the marine environment in the EIAR for the LNG pipeline.

Following the implementation of good practice standard construction environmental measures and the CEMP for the Proposed Development as detailed, **no significant** cumulative effects on marine biodiversity will result.

Data Centre Campus

A Data Centre Campus is to be constructed to the west of the Proposed Development. This will be subject to its own EIAR and planning application.

220 kV and Medium Voltage (10/ 20 kV) Power Transmission Systems

An application to connect to the national electrical transmission network via a 220 kV high voltage connection was submitted to EirGrid in September 2020. An offer has yet to be received. It is expected that the high voltage connection will run 5 km east under the L1010 road to the ESBN/ EirGrid Kilpaddoge 220 kV substation.

The LNG Terminal may need to be operational before the Power Plant and/ or 220 kV high voltage grid connection are completed or operational. Therefore, the LNG Terminal design will also require an onsite substation and a separate medium voltage (10/ 20 kV) connection, from the existing Electricity Supply Board Networks (ESBN)/ EirGrid Kilpaddoge substation. This will be used as a back-up electricity system when the Power Plant is undergoing maintenance.

The medium voltage (10/ 20 kV) and 220 kV power connections will be constructed in parallel with the Proposed Development but will be subject to separate planning design and planning applications.

Construction Impact

If works associated with these three schemes (described above) in close proximity to the Proposed Development are concurrent with works at the Proposed Development, there is potential for cumulative impacts and effects on marine biodiversity features. Should this situation arise, construction activities will be planned and phased, in consultation with the construction management team for the STEP.

The implementation of best practice standard construction environmental measures and the OCEMP for the Proposed Development as detailed, no significant cumulative effects on biodiversity will result.

Discharges from both this project and the Proposed Development are governed by strict limits to ensure compliance with quality standards. **No long-term cumulative impact** on water quality will occur.

Operational Impacts

No cumulative operational impact will occur.

7A.6.1.2 Cross Shannon 400 kV Cable Project

If the sediment plumes associated with the Cross Shannon 400 kV Cable Project overlap plumes generated due to the installation of piles, there is potential that combined sediment deposition depths could exceed the threshold for impact to habitats and associated faunal communities.

As discussed in section 3.4.3, OSPAR Commission (OSPAR 2008, 2009) outline that benthic fauna can survive rapid sediment deposition up to depths of 100mm, while negative impacts to marine life are only expected when sediment deposition depths exceed 150mm.

While the sediment plumes generated due to the installation of piles (see Figure 7A-33) overlap the sediment plumes generated by the Cross Shannon 400 kV Cable Project (see Figure 7A-34), the combined sediment deposition depths do not exceed the threshold identified in OSPAR (2008, 2009) for impacts to habitats and associated faunal communities; consequently it is predicted that significant negative in-combination effect will not occur.

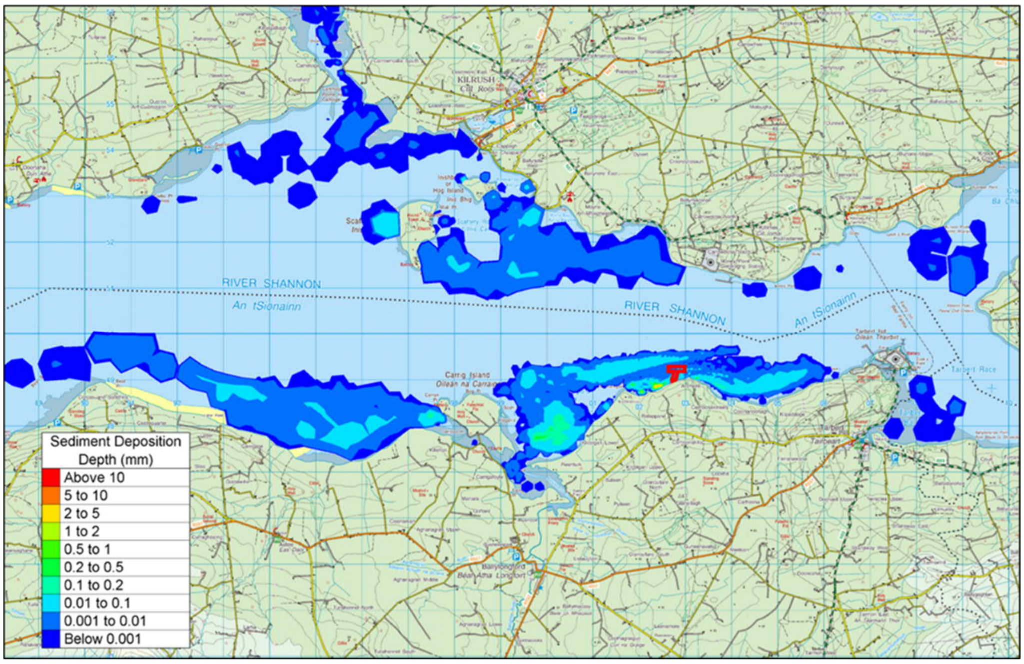

Figure 7A-28 Marine Community Types Identified within Annex I Habitats in Relation to the Modelled Sediment Plume Associated with Sediment Generated by Piling

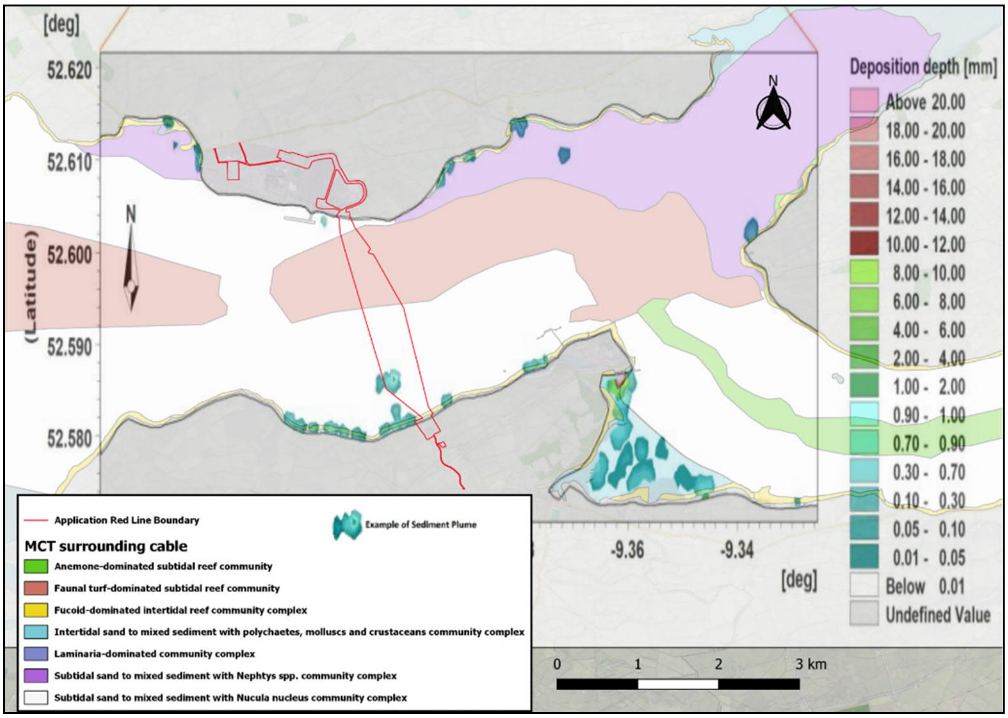

Figure 7A-29 Marine Community Types Identified within Annex I Habitats in Relation to the Modelled Sediment Plume for Trenching Activities Proposed for the Cross Shannon 400 kV Cable Project (Mott McDonald, 2019)

7A.7 Mitigation and Monitoring Measures

7A.7.1 Construction Mitigation Measures and Best Practice

This will take into account measures presented in the OCEMP regarding construction activities including any that are required to ensure no significant release of pollutants, sediment laden water, runoff chemicals or other waste material pollution into the nearby habitats, watercourses and waterbodies.

Measures will include standard construction best practice used to manage the risk of potential for loss of hydrocarbons such as diesel and hydraulic fluids. Careful supervision of construction operations and general construction practice will reduce the risk from impacts so that the likelihood of impacts is best described as low.

At a minimum the oil spill response equipment will include the following: absorbent mats, waste- bags, oil splash goggles, gloves and vinyl or rubber shoe covers to protect the user from the harmful effects of the spilled material.

Imported backfill material will be washed (cleaned) to remove fines and checked for invasive species before use.

Imported material to be used backfill will be stored on the site; measures to avoid the release of sediment will be implemented (including silt fences).

Clean (washed) rock material will be used as rock protection to minimise the risk of introducing fine materials.

The implementation of general construction practice will ensure that the likelihood of pollution in a well-equipped, maintained and managed construction site is low.

7A.7.2 Underwater Noise Mitigation

To mitigate potential impact to marine mammal species Shannon LNG will implement relevant impact mitigation and monitoring measures in relation to marine mammals as outlined in DAHG Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters (DAHG, 2014).

7A.7.2.1 NPWS 2014 Required Mitigation

- **Pre-start Observation:** Marine mammal observation period of 30 minutes minimum prior to start (or re-start after a break of 30 minutes) of any impact piling and any drilling;
- **Start delay due to observation:** A gap of at least 30 minutes required between last observation of a marine mammal and start of operations;
- **Observation zone:** The observation zone is 1000 m for impact piling and 500 m for drilling (thus impact piling likely to require > 1 marine mammal observer);
- **Commence in daylight only:** Impact piling and drilling can only start in daylight conditions when visual monitoring can take place (*i.e.* when wind/ wave conditions mean observation is possible: NPWS guidance recommends 'sea conditions for effective visual monitoring by MMOs are WMO Sea State 4 (≈Beaufort Force 4 conditions) or less';
- **Soft-start:** For any source, including equipment testing, exceeding 170 dB re: 1μPa @1 m an appropriate ramp-up procedure (*i.e.* 'soft-start') must be used. This should be a minimum of 20 minutes and no longer than 40 minutes;
- **Continuity:** Once piling or drilling has started it can continue into darkness and does not need to stop even if marine mammals are seen in the observation zone (in fact, an MMO is not required once the sound generating activity starts though continued observation can be beneficial for unexpected breaks or down-time as the 30 minute observation period can start immediately;
- **Marine mammal observer:** MMOs must be dedicated to and engaged solely in monitoring an operator's implementation of the NPWS technical guidance. A sufficient number of MMO personnel must be assigned to ensure that the role is performed effectively. Avoidance of observer fatigue is essential; and
- **MMO training:** Use trained and experienced marine mammal observers – the guidance states this should be a visual observer who has undergone formal marine mammal observation and distance estimation training (JNCC MMO training course or equivalent) and also has a minimum of 6 weeks full-time marine mammal survey experience at sea over a 3-year period in European waters.

7A.7.2.2 Additional Mitigation

- **Piling activities:** No simultaneous impact piling;
- **Continuity between activities:** Pile installation will require a combination of techniques including impact piling, vibratory piling and drilling requiring breaks in activity as equipment is changed. Where an activity progresses to a lower sound level activity – i.e. from impact piling to vibratory piling or drilling, and the break between activities is less than 30 minutes a new period of observation is not required, and activities can be considered to be continuous;
- **Additional seasonal observation for bottlenose dolphin:** For any impact piling taking place during August, an additional MMO will be present at Moneypoint to undertake additional observations for mother-young dolphin pairings. There is known presence of neonatal bottlenose dolphin in the estuary between July and September, peaking in August, and though numbers are low there is potential for presence in the region of the Proposed Development. There will be full communication between the Moneypoint MMO and the construction team to ensure no impact piling commences until animals have moved away from a 1000 m radius observation zone (ensuring the full width of the estuary is observed in August);
- **Mitigation measures during blasting:** Whilst all blasting is land based there will be propagation of sound into the underwater environment. Thus, the standard mitigation measures for blasting will be adopted as a precautionary measure – qualified MMO, a 1000 m observation zone and an

observation period of 30 minutes. As only single blasts will take place in each event (not a series), a soft-start is not included; and

- **Monitoring:** The marine mammal monitoring programme, currently being undertaken by the Irish Whale and Dolphin Group (in the vicinity of the project using CPODs) will be continued into the construction phase for the validation of predictions (based on observations from other studies – see impact assessment) that any animals displaced from an area return after the construction activity stops.

7A.7.3 Invasive Species Surveys

A post consent verification invasive species survey will be undertaken within the Proposed Development boundary by a competent ecologist to determine if invasive species listed under Part 1 of the Third Schedule of S.I No. 477 of 2011 have established in the area in the period between pre-planning and post consent. In the event that invasive species are identified within the works area a site-specific Invasive Species Management Plan will be developed and implemented by a competent specialist on behalf of the Contractor. In addition, in order to comply with Regulations 49 and 50 of the European Communities (Birds and Natural Habitat) Regulations (2011) the appointed Contractor will ensure biosecurity measures are implemented throughout the construction phase to ensure the introduction and translocation of invasive species is prevented. The appointed Environmental (Ecological) Clerk of Works (ECoW) will carry out a toolbox talk which will identify invasive species and will also implement biosecurity measures such as the visual inspection of vehicles for evidence of attached plant or animal material prior to entering and leaving the works area.

To ensure the spread of invasive species is avoided a ‘Check, Clean, Dry’ protocol will be undertaken by the appointed ECoW with all equipment, machinery and vehicles entering and leaving the Proposed Development boundary.

7A.7.4 Ballast Management

Ballast water for the FSRU and LNGC would be managed in accordance with the vessels Ballast Water Management Plan in accordance with Flag State requirements, Shannon Foynes Port Company operating procedures and the provisions of section 34 of the Sea Pollution (Miscellaneous Provisions) Act 2006 referencing the International Convention for the Control and Management of Ships' Ballast Water and Sediments, which entered into force in September 2017.

The FSRU would initially arrive at the Terminal full of LNG and therefore would not be carrying ballast. Ballasting of vessels within the River Shannon is a routine practice and the FSRU would take on ballast water from the river once in operation. There is, therefore, no risk of extra marine invasive species being introduced to the River Shannon from FSRU ballast water. LNGCs also would arrive full of LNG and with no ballast water. The LNGC’s would take in ballast water in accordance with routine practice.

7A.7.5 Pollution Mitigation and Response Protocols

HNS Spill Plan

The primary objectives of Oil and Hazardous and Noxious Substances (HNS) Contingency Plans under the framework are:

- To assess the pollution risk from operations and ensure sufficient preventative and response measures are in place to ensure the risk of a pollution incident ‘as low as reasonably practicable’ (ALARP);
- To ensure the safety of employees, contractors, response personnel and the community/ members of the public throughout the response to a pollution incident:
- To detail the internal and external notification processes and set-in motion practices for an integrated efficient pollution response;
- To ensure the timely mobilisation of resources, both personnel and equipment, to combat a pollution incident within the geographical scope of this plan;

- To have in place actions and procedures to ensure the response to a pollution incident is both timely and effective in mitigating any adverse impact on vulnerable socio-economic and environmental receptors; and
- To be compliant with regulatory and best practice guidance on pollution preparedness and response.

In accordance with the requirements of the National Contingency Plan (NCP) Standard Operation Procedure 05, the Plan is developed around the five operational phases of the core document:

- Phase 1 – Discovery and Notification, Evaluation, Identification and Activation;
- Phase 2 – Development of an Action Plan;
- Phase 3 – Action Plan Implementation;
- Phase 4 – Response Termination and Demobilisation;
- Phase 5 – Post Operations, Documentation of Costs/ Litigation; and

The Oil and HNS Spill Plan is presented in Appendix A2-6, Vol. 4).

The Shannon Estuary Anti-Pollution Team

The Shannon Estuary Anti-Pollution Team (SEAPT) is a Mutual Aid Group and the primary response organisations for oil and HNS spills within the Shannon Estuary. The SEAPT consists of the Shannon Foynes Port Company, Kerry, Limerick and Clare Local Authorities and commercial and industrial entities operating within the Shannon Estuary. SEAPT was initiated to form a unified coordinated response to pollution incidents on the Shannon Estuary. SEAPT is a members' organisation. Members contribute annually to maintain equipment, carry out exercises and training and purchase new and replacement equipment. SEAPT holds a significant stockpile of equipment. This equipment is available to respond to any pollution incident or threat thereof. The Proposed Development would also be able to avail of spill dispersion modelling capability held by SEAPT. SEAPT are also the custodians of the Shannon Estuary Oil/ HNS Contingency Plan developed in accordance with the NCP and approved by the Irish Coast Guard. Shannon LNG Limited has consulted extensively with SEAPT and the intention is to join the SEAPT organisation on successfully receiving development consents and prior to commencement of the construction phase. The development has (provisional to project go-ahead) been accepted as a member of the SEAPT. Membership of SEAPT will enable the development to interface directly with the approved Shannon Estuary Oil/ HNS Plan and access additional response equipment to augment that held within the Terminal. Through the membership process, the development will additionally be contributing to the on-going development and strengthening of the SEAPT organisation.

Incident Response

The development will manage the response to any Tier 1 (Local – within the capability of the operator onsite) and Tier 2 (Regional – beyond the in-house capability of the operator) incident for any pollution on the water within their area of jurisdiction with the full cooperation and integration of the response with the Shannon Foynes Port, the SEAPT mutual aid group which includes the three local authorities of Kerry, Clare and Limerick and other agencies as appropriate. However, the developed plans will identify realistic Tier 1 and Tier 2 scenarios and the resources required to effectively respond to and mitigate these. The plans will further describe any escalation to Tier 3 (requiring national resources) and as discussed above, interface with the National Marine Oil/ HNS Spill Contingency Plan. A training and exercising program forms part of the plans. The completed plans will be submitted to the Irish Coast Guard and EPA for appropriate approvals.

7A.8 Do Nothing Scenario

A significant proportion of marine habitats and associated flora and fauna have been modified from their natural state by human activity. In the absence of Proposed Development, it is expected that the marine environment would largely remain under the same management regimes. No significant changes are likely to occur, in the 'do nothing' scenario.

7A.9 Residual Impacts

Table 7A-17 below provides a summary of table of residual risk of impact to marine ecology associated with each impact mechanism.

Impact Mechanism 1 Release of Pollutants During Construction

The release of pollutants during construction has the potential to impact water quality, habitats, fish and marine mammals. In sufficient quantities pollutant released during the construction phase have the potentially to impact water quality, contaminate the seabed sediments, and directly impact flora and fauna. Standard construction best practice mitigation measures to prevent release of sediments, chemical and pollutants during construction will ensure there is no significant risk of impact to receptors.

Impact Mechanism 2 Release of Spoil during Piling

Given the scale of piling operations significant releases of spoil will not occur and there is no significant risk of impact to environment impact. Mitigation and monitoring measures are not required.

Impact Mechanism 3 Underwater Noise

The relevant receptors are marine mammals and fish.

To mitigate potential impact to marine mammal species during the construction phase Shannon LNG will implement relevant impact mitigation and monitoring measures in relation to marine mammals as outlined in DAHG Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters (DAHG, 2014). The mitigation is summarised in Section 7A.7.2.1 above. To further ensure no potential impact to marine mammal Shannon LNG will also implement the additional mitigation outlined in Section 7A.7.2.2 above.

Given the scale of construction piling operations the area within fish mortalities and/ or mortal injuries could occur is relatively small. Consequently, the overall fish population could not be impacted. Mitigation and monitoring measures are not required.

Impact Mechanism 4 Seabed Habitat Loss

The installation of construction piles for the jetty structures foundations and, the installation of a trenched water outfall across the shoreline into the Shannon estuary will result in negligible loss of habitats relative to the total area of the habitats and will not result in significant effects. The minor, almost imperceptible, effects are reversible with recovery following decommissioning of the project.

Impact Mechanism 5 Vessel Physical Disturbance and Collision Injury

The receptors relevant are marine mammals. The presence of the slow moving project vessels will not significantly increase the level of vessel activity and disturbance in the area or increase the risk of collisions. It is concluded that will be no significant impact to marine mammals. Mitigation and monitoring measures are not required.

Impact Mechanism 6 Discharge of Treated Cooled Seawater

Given the minor insignificant relative local change in chlorine level and water temperature, there will be no significant environmental effects to habitats, marine mammals or fish species. Mitigation and monitoring measures are not required.

Impact Mechanism 7 Entrainment and Impingement of Fauna by the FSRU Seawater System

The seawater system has been designed to minimise possible intake of marine organisms including adult macrocrustaceans and fish larvae and juveniles. While some planktonic and larval forms of will be entrained and impinged, there will be no significant impacts. Mitigation and monitoring measures are not required.

Impact Mechanism 8 Discharge of Wastewater and Power Plant Process Heated Water Effluent

Water quality parameters satisfy the permissible limits set out in the surface water regulations and will not impact the water quality status of the receiving Shannon Estuary waters. Consequently, it can be concluded there will be no significant environmental impact.

Impact Mechanism 9 Introduction of Invasive Species

Established protocols to manage the use of ballast water and the risk of introduction and spread of marine invasive species are detailed in Section 7A.7.4.

Impact Mechanism 10 Accidental Large Scale Oil or LNG Spill

Mitigation measures specifically designed to minimise the risk of spills and the introduction of contaminants to the Shannon Estuary will ensure the environmental risk is managed. Mitigation measures are detailed in detailed in Section 7A.7.5.

Potential Impact to Aquaculture Activities

Aquaculture activity in the SAC and SPA relates to the production of shellfish (oysters and mussels). The main aquaculture activity involves the cultivation of Pacific oysters (*Crassostrea gigas*) on trestles in intertidal areas. The mussel culture includes subtidal suspended (longlines) and bottom culture. The majority of the sites are contained in inner Poulnasherry Bay where aquaculture activity has been carried out for many years. There are aquaculture applications in outer Poulnasherry Bay and there are existing and proposed aquaculture activities in the Carrigaholt, Rinevella, Ballylongford/Bunaclugga and Aughinish/ Foynes areas of the Shannon Estuary. In addition, there are three areas within the Shannon Estuary covered by Fishery Orders. While these Orders do not come under the remit of the Department of Agriculture, Food and Marine, they are included as part of the in-combination assessment.

Impact mechanisms associated with the Proposed Development that have potential to directly impact water quality and indirect impact to aquaculture activities is Impact Mechanism 8. Wastewater discharge and Power Plant Process Heated Water Effluent. Hydrodynamic and dispersion modelling study concluded that change to water quality parameters are within permissible limits set out in the surface water regulations and will not impact the water quality status of aquaculture areas. Consequently, it can be concluded there will be no significant impact.

7A.10 Summary

Impacts on the marine ecological environment as a result of the Proposed Development are summarised as follows:

The marine elements of the Proposed Development overlap with the Lower River Shannon cSAC and the River Shannon and River Fergus Estuaries SPA. The OCEMP implemented will contain the construction best practice standards and measures regarding pollution prevention. Following implementation of mitigation measures there will be no adverse impacts on designated sites overlapping with the elements of the project.

During the construction phase Shannon LNG will implement relevant impact mitigation and monitoring measures in relation to marine mammals to ensure no potential impact to marine mammal.

The loss of habitat due to the installation of construction piles and, the trenched water outfall is negligible, and will not result in significant effects. The minor, almost imperceptible, effects are reversible with recovery following decommissioning of the project.

The release of spoil during piling operations will not result in significant environment impact.

The presence of the project vessels will not significantly increase the level of vessel activity and disturbance in the area or increase the risk of collisions with marine mammals.

The release of treated cooled seawater will not result in significant environmental impacts

There will be an insignificant loss of fauna due to entrainment and impingement on seawater system FSRU seawater system.

Wastewater and Power Plant process heated water effluent will not impact the water quality status of the receiving Shannon Estuary waters.

Implementation of established ballast water management protocols and measures will manage the risk of the introduction and spread of marine invasive.

Environmental risk of spills and the release of contaminants will be managed by implementation established protocol and mitigation.

Table 7A-17 Summary

Proposed Development Stage	Aspect/ Impact Assessed	Receptor (greatest importance)	Impact Quality	Impact Significance (Prior to Mitigation)	Impact Duration and Frequency	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Significance rating (Following Mitigation)	EIAR Chapter Reference
Construction Phase	Impact Mechanism 1 Release of pollutants during construction	Marine habitats of the Lower River Shannon cSAC)	Negative	Significant	Short-term	Standard construction best practice mitigation measures to prevent release of sediments, chemical and pollutants during construction (see Section 7A.7.1 and the OCEMP included in Appendix A2-4, Vol. 4).	Not significant	Section 7A.5.3
Construction Phase	Impact Mechanism 1 Release of pollutants during construction	Marine Mammals (including Bottlenose dolphin species of the Lower River Shannon cSAC)	Negative	Significant	Short-term	Standard construction best practice mitigation measures to prevent release of sediments, chemical and pollutants during construction (see Section 7A.7.1 and the OCEMP included in Appendix A2-4, Vol. 4).	Not significant	Section 7A.5.3
Construction Phase	Impact Mechanism 1 Release of pollutants during construction	Fish populations of estuary including fish of the Lower River Shannon cSAC)	Negative	Significant	Short-term	Standard construction best practice mitigation measures to prevent release of sediments, chemical and pollutants during construction (see Section 7A.7.1 and the OCEMP included in Appendix A2-4, Vol. 4).	Not significant	Section 7A.5.3
Construction Phase	Impact Mechanism 2 Release of spoil during piling	Marine Mammals (including Bottlenose dolphin species of the Lower River Shannon cSAC)	Negative	Not Significant	Short-term	None	-	Section 7A.5.4
Construction Phase	Impact Mechanism 2 Release of spoil during piling	Marine Mammals (including Bottlenose dolphin species of the Lower River Shannon cSAC)	Negative	Not Significant	Short-term	None	-	Section 7A.5.4
Construction Phase	Impact Mechanism 2 Release of spoil during piling	Fish populations of estuary including fish of the Lower River Shannon cSAC)	Negative	Not Significant	Short-term	None	-	Section 7A.5.4

Construction Phase **and** Operation Phase	Impact Mechanism 3 Underwater noise	Fish of the Lower River Shannon cSAC)	Negative	Not Significant	Short-term	None	-	Section 7A.5.5
Construction Phase	Impact Mechanism 3 Underwater noise	Marine Mammals (including Bottlenose dolphin species of the Lower River Shannon cSAC)	Negative	Significant	Medium-term	Chapter 07A summarises standard mitigation required to minimise the risk potential impact to marine mammal species as outlined in DAHG, 2014: • Marine mammal observation period of 30 minutes minimum prior to start (or re-start after a break of 30 minutes) of any impact piling and any drilling; • A gap of at least 30 minutes required between last observation of a marine mammal and start of operations; • The observation zone is 1000 m for impact piling and 500 m for drilling (thus impact piling likely to require > 1 marine mammal observer); • Impact piling and drilling can only start in daylight conditions when visual monitoring can take place (i.e. when wind/ wave conditions mean observation is possible: NPWS guidance recommends ‘sea conditions for effective visual monitoring by MMOs are WMO Sea State 4 (≈Beaufort Force 4 conditions) or less’; • For any source, including equipment testing, exceeding 170 dB re: 1µPa @1 m an appropriate ramp-up procedure (i.e. ‘soft-start’) must be used. This should be a minimum of 20 minutes and no longer than 40 minutes; • Once piling or drilling has started it can continue into darkness and does not need to stop even if marine mammals are seen in the observation zone (in fact, an MMO is not required once the sound generating activity starts though continued observation can be beneficial for unexpected breaks or down-	Not significant	Section 7A.5.5

time as the 30 minute observation period can start immediately;

- MMOs must be dedicated to and engaged solely in monitoring an operator's implementation of the NPWS technical guidance. A sufficient number of MMO personnel must be assigned to ensure that the role is performed effectively. Avoidance of observer fatigue is essential; and
- Use trained and experienced marine mammal observers – the guidance states this should be a visual observer who has undergone formal marine mammal observation and distance estimation training (JNCC MMO training course or equivalent) and also has a minimum of 6 weeks full-time marine mammal survey experience at sea over a 3-year period in European waters.

Additional mitigation measures to be implemented include:

- No simultaneous impact piling (i.e. two rigs operating at the same time);
- Pile installation will require a combination of techniques including impact piling, vibratory piling and drilling requiring breaks in activity as equipment is changed. Where an activity progresses to a lower sound level activity – i.e. from impact piling to vibratory piling or drilling, and the break between activities is less than 30 minutes a new period of observation is not required, and activities can be considered to be continuous;
- For any impact piling taking place during August, an additional MMO will be present at Moneypoint to undertake additional observations for mother-young dolphin pairings. There is known presence of neonatal bottlenose dolphin in the estuary between July and September, peaking in August, and though numbers are low there is potential for presence in the region of the Proposed Development. There will be full

						communication between the Moneypoint MMO and the construction team to ensure no impact piling commences until animals have moved away from a 1000 m radius observation zone (ensuring the full width of the estuary is observed in August); • Whilst all blasting is land based there will be propagation of sound into the underwater environment. Thus, the standard mitigation measures for blasting will be adopted as a precautionary measure – qualified MMO, a 1000 m observation zone and an observation period of 30 minutes. As only single blasts will take place in each event (not a series), a soft-start is not included; and • The marine mammal monitoring programme, currently being undertaken by the Irish Whale and Dolphin Group (in the vicinity of the project using CPODs) will be continued into the construction phase for the validation of predictions (based on observations from other studies – see impact assessment) that any animals displaced from an area return after the construction activity stops.		
Construction Phase **and** Operation Phase	Impact Mechanism 4 Seabed habitat loss	Annex I habitats 1130 Estuaries and 1170 Reefs of the Lower River Shannon cSAC	Negative	Not Significant	Reversible Effects	Negligible loss of habitat pending decommissioning of the development and natural recolonisation of reinstatement of the affected habitat areas.	Not significant	Section 7A.5.6
Construction Phase **and** Operation Phase	Impact Mechanism 5 Vessel physical disturbance and collision injury	Marine Mammals (including Bottlenose dolphin species of the Lower River Shannon cSAC)	-	Not Significant	-	None	-	Section 7A.5.7
Operation Phase	Impact Mechanism 6	Habitats of the Lower River Shannon cSAC)	-	Not Significant	-	None	-	Section 7A.5.8

	Discharge of treated cooled seawater							
Operation Phase	Impact Mechanism 6 Discharge of treated cooled seawater	Marine Mammals (including Bottlenose dolphin species of the Lower River Shannon cSAC)	-	Not Significant	-	None	-	Section 7A.5.8
Operation Phase	Impact Mechanism 6 Discharge of treated cooled seawater	Fish populations of estuary including fish of the Lower River Shannon cSAC)		Not Significant	-	None	-	Section 7A.5.8
Operation Phase	Impact Mechanism 7 Entrainment and impingement of fauna by the FSRU seawater system	Fish and crustacean species of the estuary (including fish species of the Lower River Shannon cSAC)	Negative	Not Significant	-	None	-	Section 7A.5.9
Operation Phase	Impact Mechanism 8 Discharge of Wastewater and Power Plant Process Heated Water Effluent	Habitats (including marine habitats of the Lower River Shannon cSAC)	Negative	Not Significant	Long-term	None	-	Section 7A.5.10
Operation Phase	Impact Mechanism 8 Discharge of Wastewater and Power Plant Process Heated Water Effluent	Marine Mammals (including Bottlenose dolphin species of the Lower River Shannon cSAC)	Negative	Not Significant	Long-term	None	-	Section 7A.5.10
Operation Phase	Impact Mechanism 8 Discharge of Wastewater and Power Plant	Fish populations of estuary including fish of the Lower River Shannon cSAC)	Negative	Not Significant	Long-term	None	-	Section 7A.5.10

	Process Heated Water Effluent						
Operation Phase	Impact Mechanism 9 Introduction of invasive species	Negative	Significant	Long-term	Before and after use, all relevant equipment will be thoroughly cleaned using Virkon Aquatic to guard against the spread of fish viruses, bacteria, fungi, and moulds. All water used in the cleansing, testing or disinfection of structures or machinery shall be rendered safe prior to discharge, particularly any chlorinated water. A post consent verification invasive species survey will be undertaken within the Proposed Development boundary by a competent ecologist. the appointed Contractor will ensure biosecurity measures are implemented throughout the construction phase to ensure the introduction and translocation of invasive species is prevented. The appointed ECoW will carry out a toolbox talk which will identify invasive species and will also implement biosecurity measures such as the visual inspection of vehicles for evidence of attached plant or animal material prior to entering and leaving the works area. To ensure the spread of invasive species is avoided a 'Check, Clean, Dry' protocol will be undertaken by the appointed ECoW with all equipment, machinery and vehicles entering and leaving the Proposed Development boundary.	Not significant	Section 7A.5.11
Operation Phase	Impact Mechanism 10 Accidental large scale oil or LNG spill	Negative	Significant	Medium-term	Established protocols to manage the risk of accidental spill and potential environmental impact.	Not significant	Section 7A.5.12

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CHAPTER 07B
Terrestrial Ecology

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park
Environmental Impact Assessment Report

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7.B Terrestrial Ecology

7B.1 Introduction

DixonBrosnan Environmental Consultants were commissioned to assess the potential impacts of a proposed Liquefied Natural Gas (LNG) Terminal and a Power Plant on terrestrial and freshwater aquatic ecology. DixonBrosnan previously assessed the potential impacts of the proposed Shannon LNG Terminal (LNG Terminal) on terrestrial and aquatic ecology. As part of that process, the entire site, including the area now intended for the Proposed Development, was surveyed in 2006/ 2007 and 2011/ 2012.

This chapter describes and evaluates the habitats within the Proposed Development site along with their representative flora and fauna in order to describe and assess the impacts that will result from the proposed LNG Terminal and Power Plant. The chapter follows the structure and protocols detailed in the Environmental Protection Agency's Draft Guidelines on the information to be contained in *Environmental Impact Assessment Reports* (EPA, 2017).

A detailed description of the project is provided in Chapter 02 – Project Description and construction activities are described in detail in appendices to Chapter 02 i.e., Appendix A2-4 Outline Construction Environmental Management Plan (OCEMP), Appendix A2-7 Construction Equipment Onsite. Chapter 05 – Land and Soils and Chapter 06 – Water address the changes in hydrology and hydrogeology which can have an impact on ecology. Chapter 07A addresses the potential impacts on the marine and estuarine ecology. Noise impacts are addressed in Chapter 08 – Airborne Noise and Groundborne Vibration. Underwater noise modelling (by Vysus Group) (VG)) is presented in Appendix A7A-3, Vol. 4.

7B.2 Competent Expert

Carl Dixon MSc (Ecology) is a senior ecologist who has over 20 years' experience in ecological and water quality assessments. He also has experience in mammal surveys, bat surveys, invasive species surveys and ecological supervision of large-scale projects. Projects in recent years include the Waste to Energy Facility Ringaskiddy, Shannon LNG Project, supervision of the Fermoy Flood Relief Scheme, Skibbereen Flood Relief Scheme, Upgrade of Mallow WWTP Scheme, Douglas Flood Relief Scheme, Great Island Gas Pipeline and Arklow Bank Wind Park Phase 2.

7B.3 Methodology

7B.3.1 Overview

This assessment is based on surveys of the Proposed Development site (Refer to Figure F2-1, Vol. 3). The Proposed Development includes a Liquefied Natural Gas (LNG) Terminal and a Power Plant. A review of desktop data was also carried out to identify potential ecological issues (Sections 7B.3.3 and 7B.3.4). In addition to surveys conducted in 2006/ 2007 and 2011/ 2012, additional ecological surveys were carried out between 2019 and 2021 to inform this Environmental Impact Assessment Report (EIAR) Dates of ecological surveys are included in Table 7B-1.

7B.3.2 Relevant Legislation

Flora and fauna in Ireland are protected at a national level by the Wildlife Act 1976, as amended, and the European Communities (Birds and Natural Habitats) Regulations 2011. They are also protected at a European level by the EU Habitats Directive (92/ 43/ EEC) and the EU Birds Directive 2009/ 147/ EC.

Under this legislation, sites of nature conservation importance are designated in order to legally protect faunal and floral species and important/ vulnerable habitats. The relevant categories of designation are as follows:

- Special Areas of Conservation (SACs) are designated under the European Communities (Birds and Natural Habitats) Regulations 2011 to comply with the EU Habitats Directive (92/ 43/ EEC);
- Special Protection Areas (SPAs) are designated under the EU Birds Directive (79/ 409/ EEC) amended in 2009 as Directive 2009/ 147/ EC; and

- Natural Heritage Areas (NHAs) and proposed Natural Heritage Areas (pNHAs) are listed under the Wildlife (Amendment) Act, 2000, as amended. A NHA is designated for its wildlife value and receives statutory protection. A list of pNHAs was published on a non-statutory basis in 1995, but these have not since been statutorily designated. Consultation with the NPWS is still required if any development is likely to impact on a pNHA.

7B.3.2.1 Relevant European Legislation

- Council Directive 92/ 43/ EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (The Habitats Directive);
- Directive 2009/ 147/ EC of the European Parliament and of the Council on the conservation of wild birds (The Birds Directive);
- Directive 2000/ 60/ EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy (The Water Framework Directive); and
- Directive 2006/ 44/ EC of the European Parliament and of the Council of 6 September 2006 on the quality of fresh waters needing protection or improvement in order to support fish life (The Fish Directive (consolidated)).

7B.3.2.2 Relevant Irish Legislation

- Wildlife Act 1976 as amended by Wildlife Act 1976 (Protection of Wild Animals) Regulations 1980, Wildlife (Amendment) Act 2000, Wildlife (Amendment) Act 2010, Wildlife (Amendment) Act 2012, European Communities (Wildlife Act, 1976) (Amendment) Regulations 2017 (The Wildlife Act);
- European Communities (Conservation of Wild Birds) Regulations 1985 (S.I. No. 291/ 1985) as amended by S.I. No. 31/ 1995 (The Wild Birds Regulations);
- European Communities (Natural Habitats) Regulations 1997 (S.I. No. 94/ 1997 as amended by S.I. No. 233/ 1998 and S.I. No 378/ 2005) (The Habitats Regulations);
- Fisheries (Consolidation) Act, 1959 (as amended) (The Fisheries Act);
- European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/ 2011) (The Habitats Reguations); and
- The Flora (Protection) Order 2015 (S.I. No. 356/ 2015).

7B.3.3 Sources of Information

A desktop study was carried out to collate the available information on the local ecological environment. The purpose of the desktop study was to identify features of ecological value occurring within the Proposed Development site and those occurring in proximity to it. A desktop review also allows the key ecological issues to be identified early in the assessment process and facilitates the planning of surveys. Sources of information utilised for this report include the following:

- National Parks and Wildlife Service (NPWS), 2021;
- Environmental Protection Agency (EPA), 2021;
- National Biodiversity Data Centre (NDBC), 2021;
- Bat Conservation Ireland, 2021;
- Birdwatch Ireland, 2021;
- British Trust for Ornithology (BTO), 2021;
- National Biodiversity Action Plan 2017-2021 (NPWS 2017);
- Kerry Co. Council (KCC, 2019) *Council Climate Change Adaptation Strategy 2019-2024;*
- KCC (2008) *Biodiversity Action Plans 2008-2012;* and
- KCC (2015) *County Development Plan 2015 – 2021*.

7B.3.4 Guidance

This chapter of the EIAR follows the *Environmental Protection Agency's Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports* (EPA, 2017). It also takes account of the *Draft Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment* (Department of Environment, Community and Local Government, August 2018), *Chartered Institute of Ecology and Environmental Management Guidelines on Ecological Impact Assessment in the UK and Ireland, 2nd edition* (CIEEM 2016) and *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, Version 1.1* (CIEEM, 2019). Reference was also made to the following key documents where relevant:

- *Environmental Impact Assessment of Projects Guidance on the preparation of the Environmental Impact Assessment Report (Directive 2011/ 92/ EU as amended by 2014/ 52/ EU)* (European Union, 2017);
- *Guidance on integrating climate changes and biodiversity into environmental impact assessment* (EU Commission 2013);
- *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (National Roads Authority 2009) (*for habitat assessment)*;
- *Best Practice Guidance for Habitat Survey and Mapping* (Heritage Council, 2011);
- *A Guide to Habitats in Ireland* (Fossitt, 2000);
- *Guidelines for the treatment of Badgers prior to the construction of National Road Schemes. National Roads Authority, Dublin* (National Roads Authority (NRA) 2005a);
- *Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes* (NRA 2005b);
- *Guidelines for the treatment of bats during the construction of national road schemes (National Roads Authority* (NRA 2005c);
- *Guidelines for the protection and preservation of trees, hedgerows and scrub prior to, during and post construction of national road schemes*. (NRA 2006);
- *Guidelines for the treatment of Otters prior to the construction of National Road Schemes (National Roads Authority* (NRA 2008);
- *Bird Census Techniques* Bibby, C.J., Burgess, N.D., Hill, D.A. & Mustoe, S.H. (2000); and
- *Bird Monitoring Methods - a Manual of Techniques for Key UK Species*. Gilbert, G., Gibbons, D.W. & Evans, J. (1998).

7B.3.5 Field Surveys

This assessment is based on surveys at the Proposed Development site (Figure F2-1 of Volume 3). The Proposed Development comprises of two main components i.e., a Power Plant (described in Section 2.4.1) and a LNG Terminal (described in Section 2.4.2 of Chapter 02 – Project Description).

Ecological survey work was previously carried out at the Proposed Development site in 2006/ 2007 and 2011/ 2012. These surveys informed the Environmental Impact Assessments (EIA) for the previous planning applications. Therefore, a large volume of background information about the site is available. Additional ecological surveys were carried out between 2019 and 2021 to inform this Environmental Impact Assessment Report (EIAR).

7B.3.5.1 Habitat Surveys

Habitats were mapped according to the classification scheme outlined in the Heritage Council publication *A Guide to Habitats in Ireland* (Fossitt, 2000) and following the guidelines contained in *Best Practice Guidance for Habitat Survey and Mapping* (Heritage Council, 2011). Habitats were cross referenced with Habitats Directive Annex I habitats. Dates of the main habitat surveys are included in Table 7B-1. During these surveys the site was also surveyed for invasive species and rare floral species (Wyse *et al*., 2016; Stace 2019). It is noted that a considerable number of site visits were carried during the overall assessment process including winter bird surveys, breeding bird surveys, aquatic surveys and mammal surveys (Refer

Table 7B-1). Observations in relation to habitats made during these site visits are included in the habitat descriptions where relevant.

Table 7B-1 Survey Types and Survey Dates for 2019 to 2021 Surveys

Survey Type	Survey Dates
Habitat Survey	22nd July 2019, 27th July 2019, 10th April 2020, 30th May 2020, 1st July 2021
Badger Survey	General surveys: 22nd July 2019, 27th July 2019, 10th April 2020, 30th May 2020 and 22nd April 2021 Bait marking surveys: 8th January 2019, 24th January 2019, 26th January 2019, 30th January 2019, 3rd February 2019, 4th February 2019, 5th February 2019, 6th February 2019, 9th February 2019, 11th February 2019,13th March 2019, 16th March 2019, 20th March 2019, 23rd March 2019, 31st March 2019 and 10th April 2019. Trail camera: 24th January to 10th April 2019 and 28th January to 30th March 2021
Bat Survey	9th September 2020, 26th May 2021, 27th May 2021, 14th June 2021, 30th June 2021, 13th July 2021, 14th July 2021, 20th July 2021
Otter Survey	General surveys: 22nd July 2019, 27th July 2019, 10th April 2020, 30th May 2020, 22nd April 2021, 1st July 2021 Trail Camera Surveys: 24th January to 10th April 2019 and 28th January to 30th March 2021
Breeding Bird Survey	31st March 2019, 22nd July 2019, 27th July 2019, 10th April 2020, and 30th May 2020
Estuarine Bird Survey	Winter surveys: 18th October 2018, 22nd November 2018, 29th November 2018, 12th December 2018, 18th December 2018, 21st January 2019, 24th January 2019, 18th February 2019, 20th February 2019, 15th March 2019, 21st March 2019, 21st October 2019, 25th October 2019, 15th November 2019, 19th November 2019, 3rd December 2019, 9th December 2019, 22nd January 2019, 30th January 2020, 23rd February 2020, 24th February 2020, 31st March 2020. Summer surveys: 28th May 2021, 30th June 2021, 19th July 2021, 20th July 2021
Aquatic Survey	22nd April 2021

7B.3.5.2 Badger

Badger *Meles meles* bait marking and activity surveys were carried out at the Proposed Development site between January 2019 and April 2019 (Refer to

Table 7B-1). Bait marking surveys were based on Scottish Natural Heritage methods (SNH 2003) and following guidelines from the National Roads Authority (NRA 2006a). Potential habitat such as grassland and scrub to a minimum of 150m from the site boundary were systematically checked for signs of Badger activity or habitation. These signs include the presence of main, annex, subsidiary, and outlier setts, foraging evidence (e.g. snuffle holes), latrines, access runs and trails, hairs caught on wires and bushes, tracks, and prints. Trail camera surveys were also carried out in the periods from 24th January to 10th April 2019 and 28th January to 30th March 2021. Further details on Badger survey methods are included in Appendix A7B-1 of Volume 4.

7B.3.5.3 Bats

Bat activity surveys were conducted within the Proposed Development site under suitable weather conditions on several dates outlined in

Table 7B-1. Dusk activity surveys commenced at 15 minutes before sunset and ended a minimum of two hours after sunset (Collins 2016). The primary purpose of bat surveys was to assess usage of structures and habitats, located within or in close proximity, to the site boundary. Activity surveys were also carried out to identify foraging and/ or commuting routes across the site (i.e. hedgerows/ treelines, coastal habitats, Ralappane Stream etc.) within the Proposed Development site boundary. All buildings located within the planning boundary were surveyed during daytime, as well as two other buildings to the west of the Proposed Development site. Further details on bat survey methods are included in Appendix A7B-1 of Volume 4.

7B.3.5.4 Otter

Watercourses, drainage channels and coastal habitats were assessed on a number of dates between 2019 and 2021 for signs of Otter *Lutra lutra* (Refer to Table 7B-1 for dates). Observations relating to Otter that were made during other surveys, such as estuarine and breeding bird surveys, were also recorded where relevant. Otter survey methodology followed guidance outlined in NRA (2008) and included searches for breeding or resting sites within 150m of the Proposed Development site boundary. Trail cameras were utilised along the stream and along the coast to assess usage patterns. Other evidence of Otter, including spraints, footprints, or feeding remains, was also recorded where present. Further details on Otter survey methods are included in Appendix A7B-1 of Volume 4.

7B.3.5.5 Breeding Birds

The breeding bird survey was based on the BTO Common Bird Census (CBC) methodology and Breeding Bird Survey (BBS) (Gilbert *et al.* 1998 and Bibby *et al*. 2000) which aims to capture a snapshot of breeding bird activity within the survey area. The survey area focused on terrestrial habitats within the planning boundary. Breeding bird surveys were carried out over five days at outlined in

Table **7B-1**.

The Proposed Development site was walked so that all habitats within 50 m of all potential nesting features were surveyed. The ornithological surveyor slowly walked through the site, stopping at regular intervals to scan with binoculars and to listen for bird calls or song. Birds were identified by sight and song. All species seen or heard in the survey area and immediate environs were recorded including those in flight. Visits were made during favourable weather conditions.

All species encountered during the survey were mapped and coded using standard BTO species codes and activity recorded using the BTO codes for breeding evidence. In an effort to minimise potential disturbance, no attempts were made to locate nests as observed behaviours are generally sufficient to determine probable or confirmed breeding. The conservation status of birds was also recorded. Bird species listed in Annex I of the Birds Directive are considered a conservation priority. Certain bird species are listed by BirdWatch Ireland as Birds of Conservation Concern in Ireland (BOCCI). These are bird species suffering declines in population size. BirdWatch Ireland and the Royal Society for the Protection of Birds have identified and classified these species by the rate of decline into Red and Amber lists (Gilbert *et al*. 2021). Red List bird species are of high conservation concern and the Amber List species are of medium conservation concern. Green listed species are regularly occurring bird species whose conservation status is currently considered favourable.

Further details on breeding bird survey methods are included in Appendix A7B-2 of Volume 4.

7B.3.5.6 Estuarine Birds

Winter bird surveys were carried out from four vantage points overlooking the Shannon Estuary to the west and east of the Proposed Development site in 2018/ 2019 and 2019/ 2020. Additional surveys were carried out in the summer of 2021 with two additional vantage points added to the east of the Proposed Development site. The vantage point locations for the winter bird counts are shown in Figure 7B-11.

The survey methodology was based on that used by the British Trust for Ornithology (BTO), Wetland Bird Survey (WeBS) and also that for the Irish Wetland Bird Survey (I-WeBS), as outlined in Gilbert *et al.* (1998) and the low tide waterbird surveys (Lewis and Tierney 2014). The winter bird survey was undertaken using 8.5×45 binoculars and a Swarovski ATX30-70x95 spotting scope. Sixty-minute counts were undertaken at each survey location at either high tide, mid tide and low tide.

Dates of winter bird surveys are included in

Table **7B-1** and further details on survey methods are included in Appendix A7B-3 of Volume 4.

7B.3.5.7 Aquatic Surveys

Aquatic Services Unit (ASU) carried out a fisheries assessment of the Ralappane Stream on 4th October 2006. Quantitative electro-fishing was undertaken at 3 x 30 m stretches of the stream within the Proposed Development site. Stop nets were placed upstream and downstream to isolate each stretch as it was being fished; in each case, three times using the depletion fishing method.

Aquatic Services Unit also carried out a macro-invertebrate survey and a fisheries assessment of the stream on 4th October 2006. The stream was sampled using kick-sampling methodology. Two 1-minute kick samples (combined as one composite) were taken at each site. Each sample was collected in areas of moderate to shallow, swift current in coarse substrate usually comprising small to large stones and cobbles.

A macro-invertebrate survey of the Ralappane Stream was carried out by DixonBrosnan on 22nd April 2021. The macro-invertebrate samples from the stream were assessed in terms of water quality using the biotic index system used by the Environmental Protection Agency (EPA) in its on-going monitoring of biological quality in Irish rivers. The index assigns a score to a given site depending on the relative proportion of pollution sensitive and pollution tolerant organisms present.

Further details of the macro-invertebrate survey are included in Appendix A7B-4 of Volume 4.

7B.3.6 Consultation

Consultations were carried out with statutory and non-statutory bodies. Letters were received from IFI (13th April 2021) and NPWS DAU (26th April 2021). Of particular relevance to terrestrial biodiversity were consultations held with IFI and NPWS; the comments raised are presented below.

The following extracts from the NPWS letter are relevant to the current chapter i.e. Terrestrial Biodiversity. Biodiversity is also addressed in Chapter 07A – Marine Biodiversity and to the Natura Impact Statement (NIS) which accompanies this planning application. Full details of the NPWS letter are included in Chapter 07A Table 7A-3.

7B.3.6.1 LNG FRSU Terminal

- *Any increase in the risk of oil spills from increased ship traffic need to be fully assessed;*
- *Effect of the lighted jetty on bird mortality during poor weather condition, based on evidence from monitoring of jetties elsewhere;*
- *Effect of pile-driving on estuarine birds: The seasonal timing and type of pile driving needs to be clearly described, and its impact of estuarine birds assessed. Unless adequate data is already available, a two-year survey of bird use of the estuary within 2 km of the proposed jetty and FSRU infrastructure is recommended, with a year being the minimum requirement;* and
- *Modelling of pool fires and accidents: The impact of shipping accidents and pool fires on estuarine and sea-birds needs to be assessed. Although there is a good safety record for LNG ship transport, nevertheless it is recommended that such risks are formally modelled (e.g. Woodward & Pitbaldo (2010) . The feasibility of bird surveys at and on each side of the sip lane within the SPA need to be established and if feasible such data is recommended to be collected.*

7B.3.6.2 Power Plant at Ralappane

- *If any indirect effects are likely, a re-assessment of the small lagoon near the land bank site, for typical lagoonal species, is recommended; in particular the protected species Lamprothamnium papillosum;* and
- *A re-assessment of the use of the terrestrial and shore development area by Otter needs to be carried out.*

7B.3.6.3 Powerlines Exporting Electricity

- *It is understood that an underground cable is the preferred means of exporting electricity. However, if powerlines remain an option then the impact on birds dispersing between different parts of the SPA need to be assessed, with particular reference to mortality and/ or electrocution.*

7B.3.6.4 White-tailed Sea Eagles

- *There is a current release site for white-tailed sea eagles, under Phase II of the White-tailed Sea Eagles Reintroduction Project, within 7 km of the Proposed Development, and the potential impact on recently-released young eagles needs to be assessed. This species is particularly susceptible to powerline collision and electrocution.*

7B.3.6.5 Protected Mammals

- *A re-assessment of the use of the terrestrial and shore development area by the strictly protected species, Otter needs to be carried out*; and
- *Use of the terrestrial development site by dispersing and migrating bats also needs re assessment.*

7B.3.7 Limitations and Assumptions

Extensive survey work was carried out over several years at the Proposed Development site using a range of standard methodologies. However, there were difficulties in mapping areas of Badger territory and other species in third party lands outside the control of the Applicant. It can be difficult to determine territory size in Badger populations particularly where they may include multiple landholdings. Therefore, in this case a conservative approach was adopted in determining impact on Badger social groups.

7B.4 Baseline Environment

7B.4.1 Description of Existing Site

The Proposed Development will be located on the Shannon Estuary, 4.5 km from Tarbert and 3.5 km Ballylongford in Co. Kerry. The site for the Proposed Development is 52 ha (including the marine area). The Shannon Landbank on which the Proposed Development site is located has a total area of 243 ha.

The Proposed Development site consists primarily of improved agriculturally grassland, which runs along the southern shore of the Shannon estuary. The Proposed Development site boundary is shown in Figure 7B-3. The shoreline in this general area is relatively sheltered and composed of shingle or low earthen cliffs. The land within the site is primarily used for grazing or hay/ silage. The type of grassland varies considerably with topography and includes areas of wet grassland particularly in the northwest section of the Proposed Development site. The lower section of the Ralappane Stream forms the western boundary of the Proposed Development site. To the west of the Proposed Development site boundary, this stream forms a tidal creek and dense reed beds adjoin parts of its lower reaches near its discharge to into the Shannon Estuary. Lands in the eastern part of the site include large, well-drained fields and here the area is more intensively farmed.

7B.4.2 Designated Sites

7B.4.2.1 European Sites

Special Areas of Conservation (SACs) and candidate SACs (cSACs) are protected under the Habitats Directive and the European Communities (Birds and Natural Habitats) Regulations 2011, as amended. Special Protection Areas (SPAs) are protected under the Birds Directive 2009/ 147/ EC and European Communities (Birds and Natural Habitats) Regulations 2011, as amended. Collectively, these sites are referred to as Natura 2000 or European sites.

Table 7B-2 Natura 2000 sites within 15 km radius of Proposed Development Site

Site	Code	Distance from Proposed Development site Boundary (at closest point)
Special Area of Conservation (SAC) and candidate SAC (cSAC)		
Lower River Shannon cSAC	002165	0 km
Moanveanlagh Bog SAC	002351	12.4 km south
Tullaher Lough and Bog SAC	002343	14.0 km northwest
Special Protection Area (SPA)		

River Shannon and River Fergus Estuaries SPA	004077	0 km
Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA	004161	10.0 km south
Natural Heritage Areas (NHAs) and Proposed Natural Heritage Areas (pNHAs)		
Ballylongford Bay pNHA	001332	Approximately 80 m west
Tarbert Bay pNHA	001386	2.1 km southeast
Bunnaruddee Bog NHA	001352	5.9 km south

The Proposed Development site boundary partially overlaps the Lower River Shannon candidate Special Area of Conservation (cSAC) (Site code 002165) (NPWS 2012a) and the River Shannon and River Fergus Estuaries Special Protection Area (SPA) (Site code 004077) (NPWS 2012b). Marine habitats which overlap with the Lower River Shannon cSAC are discussed in Chapter 07A – Marine Biodiversity and in the NIS.

Three other Natura 2000 sites are located within a 15 km radius of the Proposed Development i.e., Moanveanlagh Bog SAC (002351) (12.4 km south) and Tullaher Lough and Bog SAC (Site code: 002343) (14.0 km northwest) and the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA (Site code: 004161) (10.0 km south). The location of SACs and SPAs within a 15 km radius are listed in Table 7B-2 and illustrated in Figure 7B-1 and Figure 7B-2..

The Lower River Shannon cSAC (Site code: 002165) overlaps with the Proposed Development site (Figure 7B-3). This very large site stretches along the Shannon valley from Killaloe in Co. Clare to Loop Head/ Kerry Head, a distance of approximately 120 km. The site thus encompasses the Shannon, Feale, Mulkear and Fergus estuaries, the freshwater lower reaches of the River Shannon (between Killaloe and Limerick), the freshwater stretches of much of the Feale and Mulkear catchments and the marine area between Loop Head and Kerry Head. The site is designated for a wide range of Annex I marine, coastal, freshwater aquatic and terrestrial habitats, while Annex II species for which the site is designated include marine mammals, diadromous fish species and freshwater aquatic species.

Moanveanlagh Bog SAC (Site code: 002351), located 12.4 km south of the Proposed Development is situated in Co. Kerry approximately 6 km east of Listowel, mainly within the townlands of Carhooeara and Bunagarha. The site comprises a raised bog that includes both areas of high bog and cutover bog. The site is a designated for Annex I habitats [7110] Raised Bog (Active)*, Degraded raised bogs still capable of natural regeneration [7120] and Depressions on peat substrates of the Rhynchosporion [7150].

Tullaher Lough and Bog SAC (Site code: 002343), which is located 14.0 km northwest of the Site, is a diverse site comprising of raised bog (including areas of high bog and cutover bog), wet grassland, improved grassland, scrub woodland, alkaline fen and lake. It is bounded to the east by the Doonbeg to Moyasta road, to the west by a local road, to the north by bog tracks and to the south by a conifer plantation. The site is a designated for Annex I habitats [7110] Raised Bog (Active)*, Degraded raised bogs still capable of natural regeneration [7120], Transition mires and quaking bogs [7140] and Depressions on peat substrates of the Rhynchosporion [7150].

River Shannon and River Fergus Estuaries SPA (Site code: 004077), which overlaps with part of the Proposed Development site (Figure 7B-3) includes the estuaries of the River Shannon and River Fergus form the largest estuarine complex in Ireland. The site comprises the entire estuarine habitat from Limerick City westwards as far as Doonaha in Co. Clare and Dooneen Point in Co. Kerry. The site has vast expanses of intertidal flats which contain a diverse macroinvertebrate community which provides a rich food resource for the wintering birds. Salt marsh vegetation frequently fringes the mudflats and this provides important high tide roost areas for the wintering birds. Elsewhere in the site the shoreline comprises stony or shingle beaches. The site is designated for the following species: 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 *Anas marila*, Ringed Plover *Charadrius hiaticula*, Golden Plover *Pluvialis apricaria*, Grey Plover *Pluvialis squatarola*, Lapwing *Vanellus vanellus*, Knot *Calidrus canutus*, Dunlin *Calidris alpina*, Black-tailed Godwit *Limosa limosa*, Bar-tailed Godwit *Limosa laponica*, Curlew *Numenius arquata*, Redshank *Tringa totanus*, Greenshank *Tringa nebularia* and Black-headed Gull *Larus ridibundus*. The site is also designated for wetlands.

Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA (Site code: 004161), which is located 10 km south of the Proposed Development site, is a very large site centred on the borders between the counties of Cork, Kerry and Limerick. The site is skirted by the towns of Newcastle West, Ballydesmond, Castleisland, Tralee and Abbeyfeale. The SPA is designated for Hen Harrier *Circus cyaneus*.

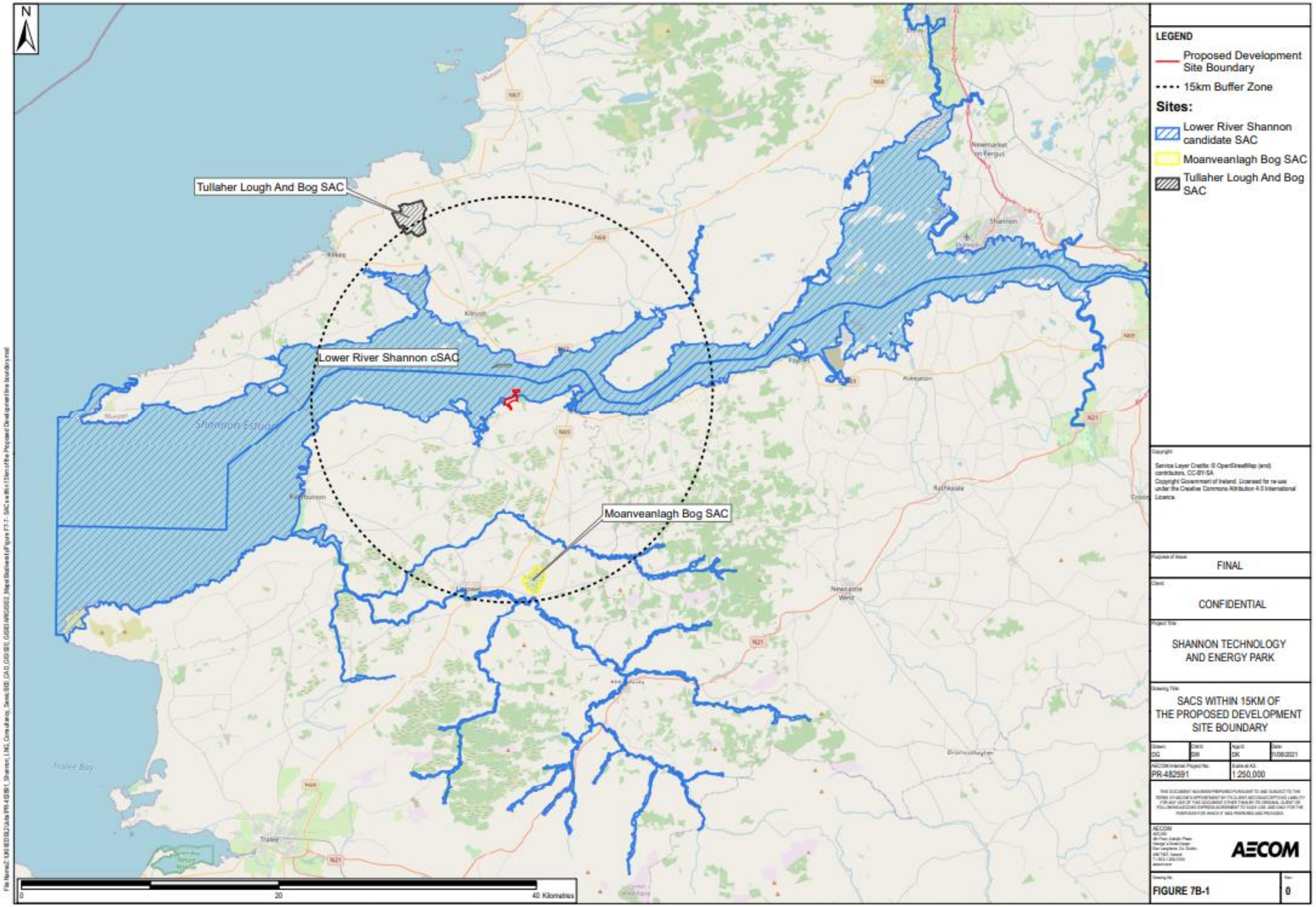

Figure 7B-1 Special Areas of Conservation within 15 km radius of the Site

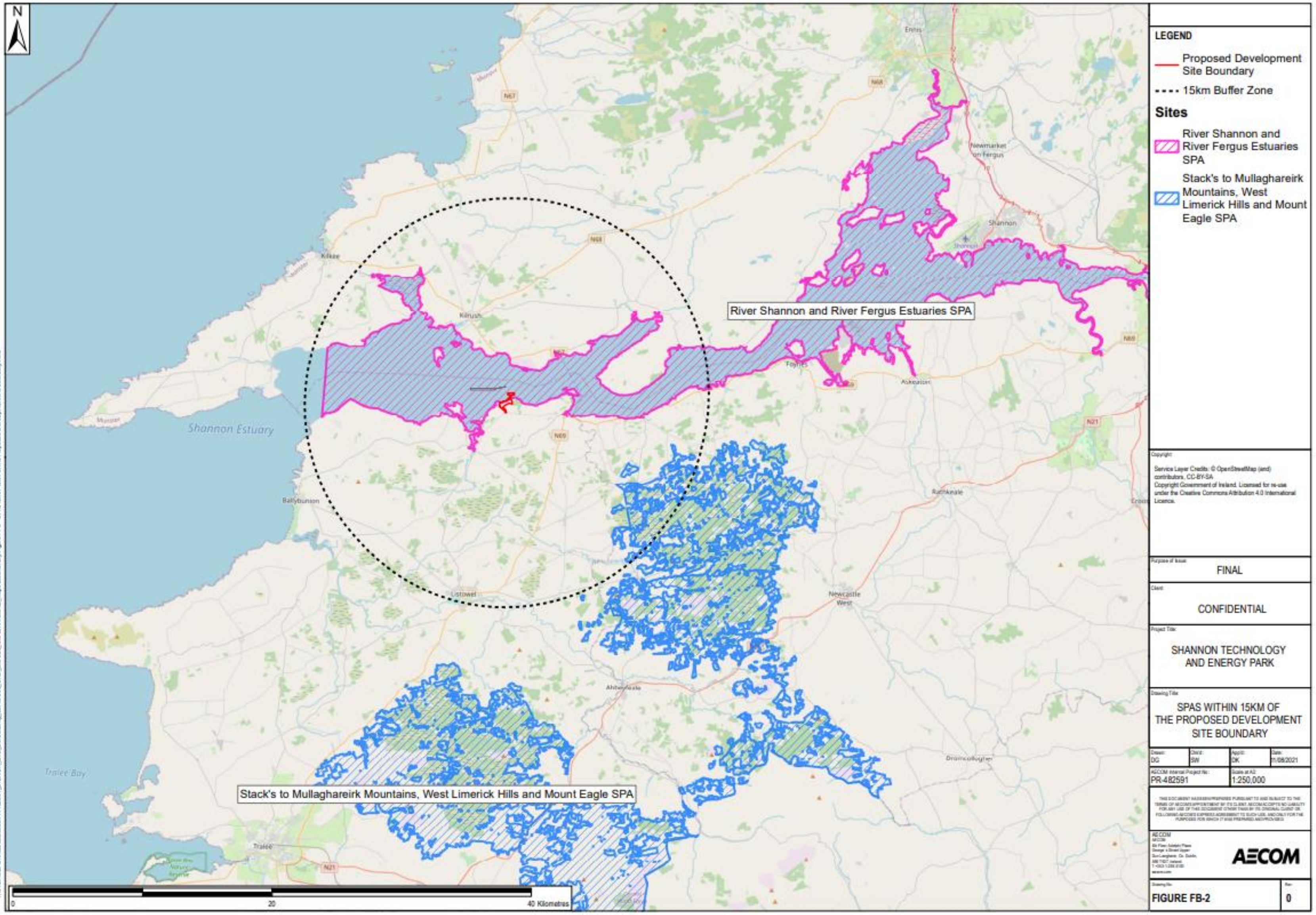

Figure 7B-2 Special Protection Areas (SPAs) within 15 km radius of the Site

Figure 7B-3 Proposed Development Site and Overlapping Natura 2000 Sites

Potential impacts on designated Natura 2000 sites (SAC/ cSAC/ SPA) are specifically addressed in *Shannon Technology and Energy Park Screening Statement for Appropriate Assessment and Natura Impact Statement Volume 1 – Main Report* which has been submitted as part of this application. This report concluded the following:

Following a comprehensive evaluation of the potential direct, indirect and cumulative impacts on the conservation features in light of their Conservation Objectives, it has been concluded that with the construction and operation of the Proposed Development will have no adverse effect on the River Shannon and River Fergus Estuaries SPA.

Following a comprehensive evaluation of the potential direct, indirect and cumulative impacts on the conservation features in light of their Conservation Objectives, it has been concluded that with the construction and operation of the Proposed Development will have no adverse effect on the Lower River Shannon cSAC.

7B.4.2.2 National Sites

Natural Heritage Areas (NHA) and proposed Natural Heritage Areas (pNHA) are national designations under the Wildlife Act 1976, as amended. A NHA is designated for its wildlife value and receives statutory protection. A list of proposed NHAs (pNHAs) was published on a non-statutory basis in 1995, but these have not since been statutorily proposed or designated.

NHAs and pNHAs located in the vicinity of the Proposed Development site are listed in Table 7B-2 and illustrated in Figure 7B-4 and Figure 7B-5. Habitats (marine and/ or terrestrial) within the site do not overlap with any NHA/ pNHA.

Ballylongford Bay pNHA (site code 1332) is located west of Knockfinglas Point. It includes the wetland area along the Ralappane Stream to the west of the Proposed Development site and the adjacent heathland and the salt marsh further west of the site. This pNHA is an inlet on the southern side of the Shannon Estuary and runs northwards from the town of Ballylongford in Co. Kerry. The scientific interest of the bay lies in the large concentrations of waterfowl that feed on the mudflats. The Ballylongford Bay pNHA makes up a valuable part of the Shannon Estuary.

Tarbert Bay pNHA (site code 001386) is also located within the Shannon Estuary. Tarbert Bay is a sandy intertidal bay fringed by saline vegetation, which is best developed at Tarbert Village. Some deciduous woodland is included in the pNHA and this comes down to the estuary edge in places. The site is important for a wintering waterfowl and is part of the large Shannon- Fergus estuarine complex.

The importance of the Shannon estuary is underlined by its designation as a Special Protection Area and both Ballylongford Bay pNHA and Tarbert Bay pNHA overlap with the Lower River Shannon cSAC and the River Shannon and River Fergus Estuaries SPA.

The Proposed Development site is potentially hydrologically connected to both these pNHAs via the Shannon Estuary. Further details on indirect impacts to the Ballylongford Bay pNHA are included in Chapter 06 – Water. Given the distance from the Tarbert Bay pNHA (2.1 km) and the dilution available within the Shannon Estuary no significant impact on this pNHA are predicted to occur. No significant connection with any other NHA/ pNHA has been identified.

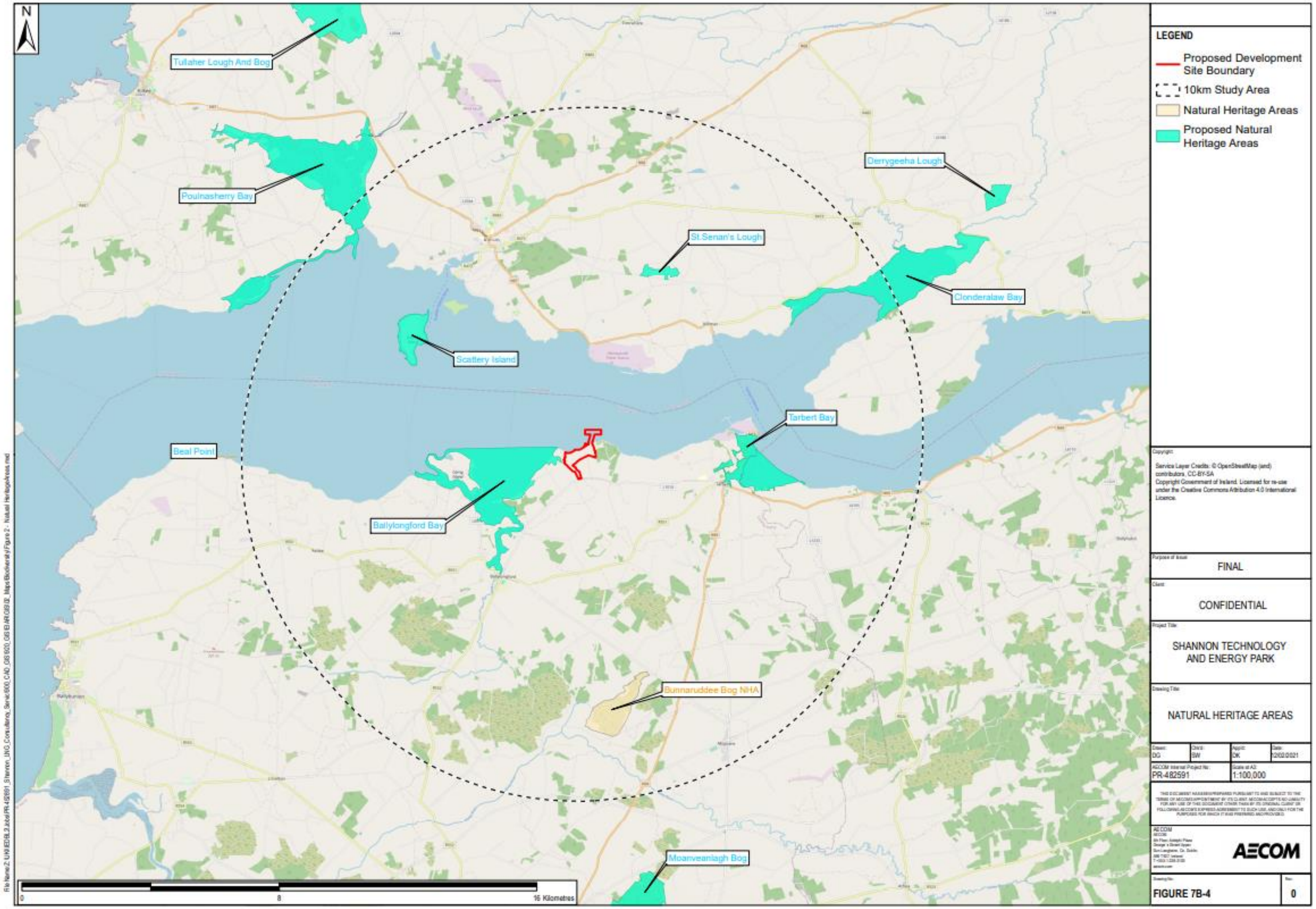

Figure 7B-4 Natural Heritage Areas (NHAs) and Proposed Natural Heritage Areas (pNHAs) in vicinity of Proposed Development

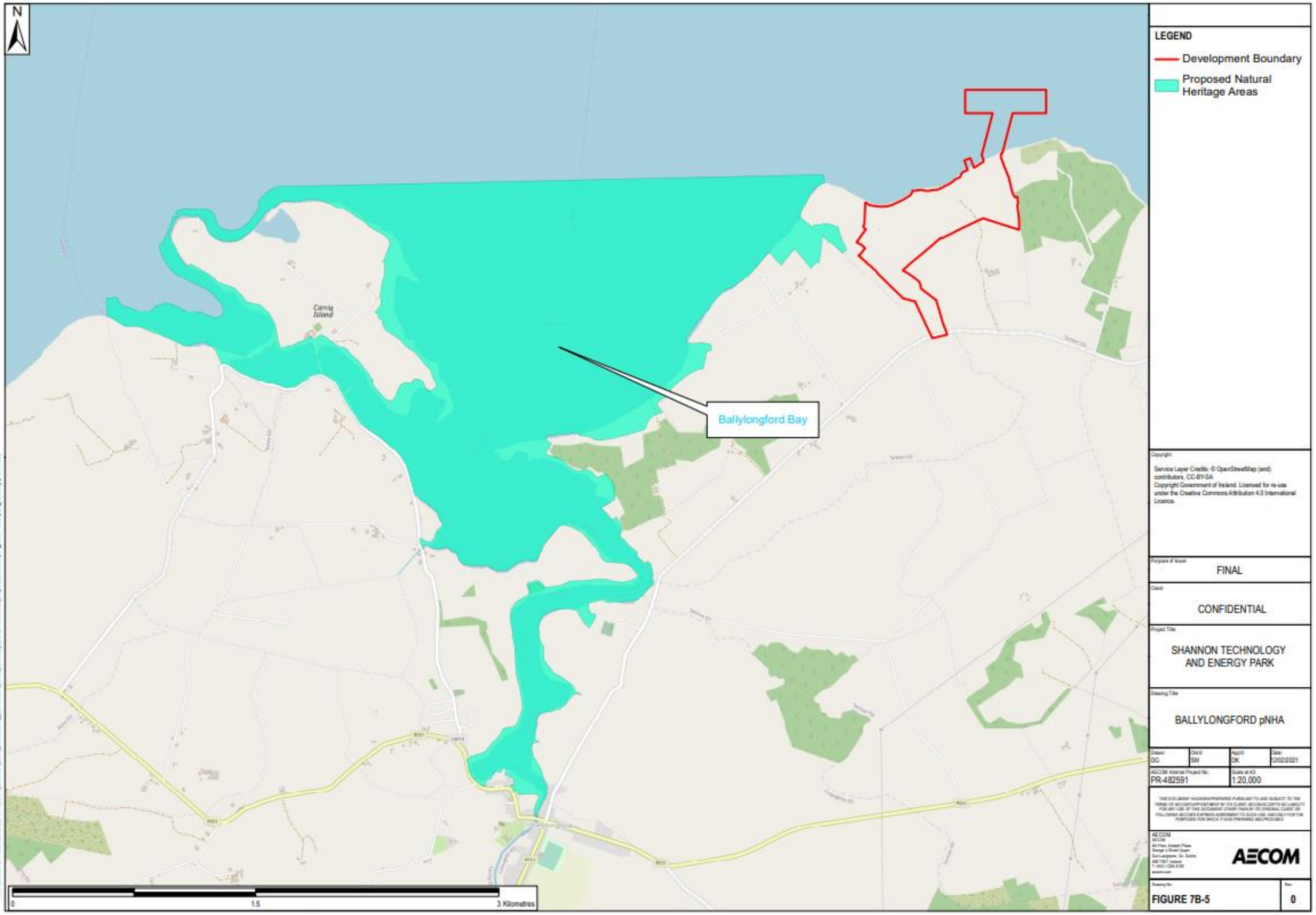

Figure 7B-5 Ballylongford Bay pNHA Relative to Proposed Development Site

7B.4.3 Habitats

Habitat mapping was carried out in line with the methodology outlined in the Heritage Council Publication, *Best Practice Guidance for Habitat Survey and Mapping* (Heritage Council, 2011). The terrestrial and aquatic habitats within the Proposed Development site boundary were classified using the classification scheme outlined in the Heritage Council publication *A Guide to Habitats in Ireland* (Fossitt, 2000) and cross referenced with Annex I Habitats where required. The survey results are representative of the habitats within the application site and include the dominant and characteristic species of flora.

No rare plant species were recorded within the Proposed Development site boundary during the site survey and given the common nature of the habitats within the Proposed Development area, are unlikely to occur. A full list of plant species recorded during site surveys is included in Appendix A7B-5 of Volume 4. Site photographs are included in Appendix A7B-6 of Volume 4.

A current overview of habitats recorded within the Proposed Development site boundary is outlined in the habitat maps included in Figure 7B-6.

Habitats recorded within the Proposed Development site boundary and their ecological value are detailed in Table 7B-3. The ecological value of habitats has been defined using the classification scheme outlined in the Guidelines for Assessment of Ecological Impacts of National Road Schemes (NRA 2009) which is included in Appendix A7B-7 of Volume 4 of this EIAR. It should be noted that the value of a habitat is site specific and will be partially related to the amount of that habitat in the surrounding landscape.

- Habitats that are considered to be good examples of Annex I and Priority habitats are classed as being of International or National Importance;
- Semi-natural habitats with high biodiversity in a county context and that are vulnerable, are considered to be of County Importance;
- Habitats that are semi-natural, or locally important for wildlife, are considered to be of Local Importance (higher value); and
- Sites containing small areas of semi-natural habitat or which maintain connectivity between habitats are considered to be of Local importance (lower value).

Figure 7B-6 Terrestrial and Freshwater Habitats within the Proposed Development Site Boundary

Table 7B-3 Terrestrial and Freshwater Habitats Recorded within Proposed Development Site Boundary

Habitat	Comment	Ecological Value (NRA Guidelines)*
Wet grassland GS4/ Improved agricultural grassland GA1	Several fields within Proposed Development site boundary Refer to Section 7B.4.3.1 for detail.	Local importance (Lower value)
Improved Agricultural grassland GA1	Several fields within Proposed Development site boundary Refer to section 7B.4.3.2 for detail	Local importance (Lower value)
Hedgerows WL1/ Treelines WL2	Located within Proposed Development site boundary. Refer to section 7B.4.3.3 for detail	Local importance (Higher value)
Sedimentary Sea Cliffs CS3	Located along the northern site boundary, a small area of this habitat overlaps with the proposed jetty location. This habitat overlaps the Lower River Shannon cSAC boundary, therefore it has been categorised as of international importance, however it is noted that this is not a qualifying habitat for the cSAC. Refer to section 7B.4.3.4 for details.	International importance
Eroding River FW1	The Ralappane Stream passes through the southern boundary of the site before running outside the western planning boundary to its confluence with the Shannon Estuary. Refer to section 7B.4.3.5 for details	Local importance (Higher value)
Drainage ditches FW4	Drainage ditches flow along hedgerows at a number of locations within the site. Refer to section 7B.4.3.6 for details	Local importance (Lower value)
Scrub WS1	Patchy distribution within the Proposed Development site boundary. Not shown of Figure 7B-6. Refer to 7B.4.3.7 for detail.	Local importance (Higher value)

* Refer to Appendix A7B-7 of Volume 4 of this EIAR. *Guidelines for Assessment of Ecological Impacts of National Road Schemes*

7B.4.3.1 Wet Grassland GS4/ Improved Agricultural Grassland GA1

This habitat consists of areas of pasture dominated by Yorkshire-Fog *Holcus lanatus*, Creeping Bent *Agrostis stolonifera*, Soft Rush *Juncus effusus* and Yellow Flag *Iris pseudacorus*. It generally occurs where ground is waterlogged either due to topography or due to low intensity agricultural management i.e., blocked drains. Within the Proposed Development site, wet grassland grades into improved agricultural grassland where reseeding has occurred, and rye grass becomes abundant in the sward. Species noted include Perennial Ryegrass *Lolium perenne*, Meadow Foxtail *Alopecurus pratensis*, Timothy *Phleum pratense* and Sweet Vernal-Grass *Anthoxanthum odoratum*. Associated herbaceous species include Creeping Buttercup *Ranunculus repens*, Cuckoo Flower *Cardamine pratensis*, Silverweed *Potentilla anserina*, Chickweed *Stellaria media*, Ribwort Plantain *Plantago lanceolata*, Curled Dock *Rumex crispus*, Angelica *Angelica sylvestris* and Horsetail *Equisetum* spp..

7B.4.3.2 Improved Agricultural Grassland GA1

The drier portions of the site are dominated by improved agricultural grassland which is a very common habitat type in the Irish countryside. Larger fields are located to the east of the Proposed Development site and these areas are more intensively managed with lower species diversity. Rye-grasses dominate the sward and other common grasses include meadow-grasses, Timothy, Sweet Vernal-grass and Yorkshire-fog.

7B.4.3.3 Hedgerows WL1/ Treelines WL2

The Proposed Development site is dominated by a managed agricultural landscape of fields bounded by defined hedgerows and treelines, which support a variety of species. Included within this category are sections of earth banks (BL2) and stonewalls (BL1) which also occur on field boundaries in conjunction with hedges and tree lines. Where hedges are sheltered they are generally denser; hedges exposed to wind are less dense with Hawthorn *Crateagus monogyna* often dominant. Other tree species noted include Elm *Ulmus glabra*, Blackthorn *Prunus spinosa*, Holly *Ilex aquifolium*, Willow *Salix* spp and Alder *Alnus glutinosa*. Climbing plants include Ivy *Hedera helix*, Honeysuckle *Lonicera periclymenum* and Dog- Rose *Rosa canina*. Grass and herbaceous understory species include Yarrow *Achillea millefolium*, Lords-and- Ladies *Arum maculatum*, Common Knapweed *Centauria nigra*, Cleavers *Galium aparine*, Herb-Robert Geranium roberianum, Hogweed *Heracleum mantegazzianum*, Bluebell *Hyacinthoides non-scripta*, False Oat- Grass *Arrhenatherum elatius*, Cock's-Foot grass *Dactylus glomerata*, Red Fescue *Festuca rubra*, False Brome *Brachypodium sylvaticum*, Meadow Foxtail, Yorkshire-Fog, Timothy and Sweet Vernal-Grass. Hedges provide nesting and foraging habitat and function as wildlife corridors.

7B.4.3.4 Sedimentary Sea Cliffs CS3

Sedimentary sea cliffs (CS3) occurs along sections of the boundary between the Shannon Estuary and the Proposed Development site. These cliffs run approximately from the Ralappane Stream in the west to the eastern boundary. However, only a small section of this habitat occurs within the Proposed Development site boundary. This category includes steep to almost vertical coastal cliffs that are formed primarily of unconsolidated material. The cliffs within the Proposed Development site is composed of glacial till and is subject to erosion making it unstable and difficult for plants to colonise.

The cliffs within the Proposed Development site boundary are relatively low and largely unvegetated. The top of the cliff is dominated by common scrub species such as Bramble and improved agricultural grassland. Although this habitat type is loosely linked with the Annex I habitat ‘vegetated sea cliffs of the Atlantic and Baltic coasts 1230’ which is a qualifying habitat for the Lower River Shannon cSAC, the cliffs within the Proposed Development site are not an example of this Annex I habitat and are not considered of high ecological value.

7B.4.3.5 Eroding River FW1

The Ralappane Stream runs through the southern area of the Proposed Development site before flowing northwards to its confluence with the Shannon Estuary. With the exception of a small section near the southern boundary of the Proposed Development site, this stream is located outside the Proposed Development site boundary. The section of the Ralappane Stream within the Proposed Development site is representative of the habitat type Eroding river FW1. The stream supports a macroflora dominated by Lesser Water-Parsnip *Berula erecta*, Fool’s Watercress *Apium nodiflorum* and Common Starwort *Stellaria graminea*. Hemlock Water Dropwort *Oenanthe crocata* also occurs. There is some tidal influence in the lower reaches of the river, outsite the Proposed Development site boundary, and here the river is classified as Tidal River CW2. The lower section of this watercourse, which is outside the Proposed Development site boundary is included in the Ballylongford pNHA and the Lower Shannon cSAC.

7B.4.3.6 Drainage Ditch FW4

Several drainage ditches cross the southern portion of the Proposed Development site, generally flowing in a west or northwest direction. The drainage ditches along the access road all ultimately drain to a single watercourse, namely the Ralappane Stream. It is noted that, with the exception of D3 (Refer to Section 6.5.8.2 in Chapter 06 – Water), all drainage ditches are dry during the summer months. Therefore, they do not support fish and do not provide significant foraging habitat for Otter. Surrounding vegetation consists of typical riparian and field flora including Rushes *Juncus* spp., Willow, Alexanders *Smyrnium olusatrum*, Stinging Nettles *Urtica dioica,* Water Crowsfoot *Ranunculus aquatilis*, Pondweeds *Potamogeton* spp and Water Starwort *Callitriche* spp.

7B.4.3.7 Scrub WS1

Scrub habitat has a patchy distribution within the Proposed Development site boundary. Scrub has begun to encroach around the margins of grassland habitats from adjoining hedgerow habitat. The main species recorded in these areas are Hawthorn, Bramble *Rubus fruticosa* and Gorse *Ulex europaeus*. Along the Ralappane Stream scrub species include Goat Willow *Salix caprea*.

7B.4.3.8 Habitats Outside the Proposed Development Site

The Lower River Shannon cSAC and Ballylongford Bay pNHA are located to the north and west of the Proposed Development site, as well as overlapping within marine habitats (refer to Figure 7B-3 and Figure 7B-5). These sites support a variety of important habitats and species, both terrestrial and aquatic. A number of terrestrial qualifying habitats for the Lower River Shannon cSAC are located to the west of the Proposed

Development site i.e. Atlantic Salt Meadows (1330), Mediterranean Salt Meadows (1410), Perennial Vegetation on Stony Banks (1220), Estuaries (1130) and Coastal Lagoons (1150). Estuarine and coastal qualifying habitats are discussed further in Chapter 07A – Marine Biodiversity.

A number of notable terrestrial and freshwater habits are located outside the planning boundary. These include:

- Lagoon and saline lakes CW1. A brackish lagoon (CW1) occurs to the west of the Proposed Development site. This habitat comprises a small lake of impounded brackish water that is separated from the sea by banks of shingle. Tidal influence is much reduced by this physical barrier which fluctuates on a daily and seasonal basis, depending on tides and inputs of freshwater. Surveys carried out by Minerex in 2007 confirmed that this habitat is not hydrologically connected to the Proposed Development site (*Hydrological and hydrogeological impact assessment of the Proposed Shannon LNG Terminal at Ballylongford, Co. Kerry* (Minerex 2007)).
- Reed and large sedge swamps FS1. A large area of reedbed dominated by Common Reed *Phragmites australis* occurs to the west of the Ralappane Stream. This reed bed is species poor and dominated by Common Reed. This area, which is outside the Proposed Development site boundary, is included within the Ballylongford pNHA and Lower River Shannon cSAC. Surveys carried out by Minerex in 2007 confirmed that this habitat is not hydrologically connected to the Proposed Development site (*Hydrological and hydrogeological impact assessment of the Proposed Shannon LNG Terminal at Ballylongford, Co. Kerry* (Minerex 2007)).
- Lower salt marsh CM1. Along the lower reaches of Ralappane Stream a typical saltmarsh zonation occurs. It is subject to periodic tidal influence and comprises only small areas of pioneer and low-mid marsh. This area, which is outside the boundary of the Proposed Development site, is included within the Ballylongford pNHA. Lower salt marsh is allied to four types of salt marsh habitat listed in Annex I of the Habitats Directive (habitat codes 1310, 1320, 1330 and 1420) however correspondence is not exact. This habitat has deteriorated in quality in recent years. Surveys carried out by Minerex in 2007 confirmed that this habitat is not hydrologically connected to the Proposed Development site (*Hydrological and hydrogeological impact assessment of the Proposed Shannon LNG Terminal at Ballylongford, Co. Kerry* (Minerex 2007)).
- Conifer plantation WD4. A mature Sitka Spruce *Picea sitchensis* coniferous forestry plantation is located to the east of the Proposed Development site.

These habitats are located outside the Proposed Development site boundary and there will be no direct or indirect impacts on these habitats as a result of the Proposed Development.

7B.4.4 Mammals

The following mammals were recorded during the 2019-2021 sites surveys; Badger, Otter, Mink *Mustela lutreola,* Fox *Vulpes vulpes*, Irish Hare *Lepus timidus,* Common Pipistrelle *Pipistrellus pipistrellus,* Soprano Pipistrelle *Pipistrellus pygmaeus* and Leisler's Bat *Nyctalus leisleri.* During the 2006/ 2007 and 2011/ 2012 surveys Irish Hare, Fox, Otter, Badger and Common Pipistrelle were recorded. Full details of mammal surveys are included in Appendix A7B-1 of Volume 4.

7B.4.4.1 Badgers

Badger bait marking surveys were carried out at the Proposed Development site in 2007, 2011 and 2019. Bait marking surveys can be extremely useful for establishing the limits of Badger social group territories (SNH 2003). Bait-marking techniques rely upon the fact that Badgers mark the boundaries of their territories with dung pits (or aggregations of these, known as 'latrines'). These are regularly maintained by a large proportion of the Badger social group, although most of the marking activity is thought to be undertaken by the adult males. Full details of bait marking survey methods and results are included in Appendix A7B-1 of Volume 4.

Extensive surveying was carried out by DixonBrosnan for Badgers in 2007 following the discovery of three separate Badger setts; two within the overall Proposed Development site and one immediately outside the eastern boundary. The location of these setts is shown in Appendix A7B-1 of Volume 4. A site visit on 28 November 2011 ascertained that these three setts remained in place and activity levels remain similar to those recorded in 2007. The two setts (Sett 1 and Sett 3) are respectively located east and south-west of the overall Proposed Development site boundary. Sett 2, which was located within the site boundary was a much smaller sett, which had developed on a disused track. Signs of activity were recorded at this sett in 2011. It was concluded in 2011 that a possible sett nominated as Sett 2a in 2007 was not used by Badger. It was noted that the results of the survey may have been distorted by site clearance works (during the 2011 surveys) and in particular by unseasonably dry weather which may have impacted on feeding patterns and use of latrines.

An assessment of the 2007 bait marking survey was carried out prior to the implementation of the 2019 survey. Results from the 2007 survey were tentative and were considered uncertain due to agricultural works during the survey period and particularly dry weather. No such issues were recorded during the 2019 bait marking survey and results from this more recent survey are considered more reliable. The primary purpose of the bait marking survey in 2019 was to more accurately determine the status of Sett 1 and Sett 2 which are located within the Proposed Development site boundary.

The results of the bait marking survey which was carried out in 2019 are considered conclusive and provide a relatively clear picture of Badger usage patterns. A number of latrines were located which contained coloured pellets which illustrates the distribution of Badger social groups. Bait marking was carried out as outlined in Table 7B-4.

Table 7B-4 Bait Marking Survey 2019

Sett	Description of sett	Colour of pellets
Sett 1	Outlier sett located inside the Proposed Development site boundary	Blue pellets
Sett 2	Subsidiary sett located within the Proposed Development site boundary	Yellow pellets
Sett 3	Very large main sett located outside the Proposed Development site boundary	Red pellets
Sett 4	Main sett located outside the Proposed Development site boundary	White pellets

Based on the results of the 2019 bait marking survey, it was concluded that Sett 3 and Sett 2 belong to the same social group and that Sett 2 is a subsidiary sett (Sett 3 is the main sett). As expected, uptake of bait was high at Sett 3 as this is a large main sett. Uptake of bait was much lower at Sett 2, which was expected as this is a smaller subsidiary sett. The presence of yellow and red pellets in latrines indicates that these setts are linked as the main and subsidiary sett of the same social group. An overview of Badger sett distribution from the 2019 survey is provided in Figure 7B-7.

At Sett 1 which is located just inside the Proposed Development site boundary, bait update was much larger in 2007 but showed relatively low levels of activity in 2019. Following identification of a large sett (Sett 4) outside the Proposed Development site boundary, white and blue pellets were identified in Sett 4 latrines indicating that Sett 1 and Sett 4 are linked, with Sett 4, the main sett (outside the site boundary) and Sett 1 (within the eastern boundary) an outlier sett with very limited usage.

Figure 7B-7 Badger Latrine with Recorded Pellets and Sett Locations

Following the 2019 surveys it was concluded that two main Badger setts occur near the Proposed Development site, namely Sett 3 and Sett 4. However, neither sett will be directly impacted by the Proposed Development. Bait marking surveys indicate that Sett 2 is a subsidiary sett and the main sett for this social group is Sett 3, which will be unaffected by the Proposed Development. Sett 1 which has contracted since initial surveys in 2007, now consists of one unused sett entrance and on outlier sett just within the site boundary. It is noted that neither of the main setts (Sett 3 and Sett 4) will be impacted by the Proposed Development and exclusion of the Badgers from outlier and subsidiary setts (Sett 1 and Sett 2) is a viable option in relation to the Proposed Development.

Overall, the Proposed Development site is of Local importance (Higher value) for Badger.

7B.4.4.2 Bats

Night-time bat emergence surveys and transect surveys as well as daytime building surveys and were carried out within the Proposed Development site boundary in April 2007, September 2020, May 2021, June 2021 and July 2021. Full details of survey methods and results are included in Appendix A7B-1 of Volume 4.

The hedgerows and treelines, grassland areas, shoreline and river corridor around the Proposed Development site may be used by bats for feeding, however no trees were recorded which could potentially support bat roosts were noted in the 2007 site surveys. Within the Proposed Development site boundary, a disused farmstead (Location B in Figure 7B-8) was surveyed in 2007 via a standard bat detector survey. A small number of Common Pipistrelle (<20) were recorded at this location. This indicated that these disused farmstead buildings supported a small summer bat roost. A small derelict building was located closer to the shoreline west of the Proposed Development site boundary (Location D Figure 7B-8). However, this building lacked the crevices and spaces which would make it suitable as roosting sites for bats and the presence of bat roosts at this location is considered highly improbable.

Bats spend much of the winter in torpor at hibernation sites although they will rouse on warmer nights to drink, forage and expel waste products. Bats can change hibercula depending on weather conditions. In general winter roosting sites have a constant temperature and high humidity (Collins, 2016) and are often in basements or underground cellars. The buildings within the Proposed Development site and in immediate proximity to it, are in an advanced state of disrepair and drafty in winter with extreme fluctuations in temperature. There are no cellars or underground structures associated with these buildings. Therefore, no potential winter roosting habitat for bats will be affected.

All buildings and structures were resurveyed in 2020 and 2021 (Table 7B-1). No buildings with significant potential to support bats were recorded within the Proposed Development site boundary during the 2020 or 2021 bat surveys. A disused farmhouse within the Proposed Development site boundary (Location B in Figure 7B-8) has a heavy growth of ivy and is drafty due to an absence of windows or doors. Three Common Pipistrelle, one Soprano Pipistrelle and One Leisler’s Bat were recorded foraging in the vicinity of this building on two nights in July 2021. However, no bats were recorded emerging from the building. Following a daytime visual search, it was concluded that Location B is of low potential roost value for bats as no signs of bat usage (i.e. staining, dropping etc.) were recorded. A pillbox (Location C in Figure 7B-8) close to the Shannon Estuary lacks suitable crevices for bats. Overall, the buildings within the Proposed Development site boundary are considered of low suitability as potential bat roosts (Potential Roost Feature (PRF)) under the guidelines set out in ‘*Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd end)*’ (Collins 2016).

A derelict farmhouse, part of a complex of farm buildings (Location A, in Figure 7B-8) which are outside the Proposed Development site boundary, was previously assessed in 2007 and a small colony of Common Pipistrelle (<20) was recorded. Although this building is outside the Proposed Development site boundary, this farmstead was re-surveyed in September 2020. Approximately eight Common Pipistrelle bats were recorded emerging from the disused farmhouse with a slate roof and feeding activity post emergence was recorded around the building complex. A second farm building within the same farm complex was also surveyed in September 2020. Although feeding activity by Common Pipistrelle was recorded in proximity to this building, no bats were recorded emerging from it during the 2020 bat survey. Both buildings are considered moderate PRFs Collins (2016).

No trees of potential value as bat roosts were recorded within the Proposed Development site boundary during the 2020-2021 bat surveys.

Surveys along internal hedgerows/ treelines, cliffs, scrub, reed bed and stream habitat found small numbers of bats foraging/ commuting in these areas. Three bat species were recorded i.e., Common Pipistrelle, Soprano Pipistrelle and Leisler’s Bat during bat surveys. The majority of registrations were along hedgerow habitat bordering agricultural grassland. Three Common Pipistrelle, one Soprano Pipistrelle and one Leisler’s Bat were recorded foraging along the cliff habitat at Ardmore Point. One Common Pipistrelle was recorded foraging over the reed bed habitat to the west of the Proposed Development site. Internal hedgerows and scrub within the Proposed Development site are considered to have moderate suitability for commuting and foraging bats under the guidelines set out Collins (2016).

Overall, the Proposed Development site is Local importance (Higher value) for bats. Common Pipistrelle, Soprano Pipistrelle and Leisler’s Bat were recorded foraging within the Proposed Development site but no roosting sites were recorded. It is noted that no Myotis bats (light-sensitive species) were recorded.

Figure 7B-8 Bat Survey Locations

7B.4.4.3 Otter

Full details of survey methods and results are included in Appendix A7B-1 of Volume 4. Otter is a qualifying interest for the Lower River Shannon cSAC and impacts on Otter are discussed further in the NIS which accompanies this planning application. An overview of the lands in the vicinity of the Proposed Development site boundary which were surveyed for Otter are shown in Figure 7B-9.

Initial Otter surveys were carried out in January 2007 with a more intensive survey for natal holts carried out in March 2007. These surveys indicated that the Ralappane Stream to the west of the Proposed Development site is used by Otter. A well-worn Otter track was recorded running alongside the tidal section of the stream. Along its length there were several sprainting sites. A path was also observed where Otter cross into the large reed bed to the west of the Proposed Development site boundary. A survey was carried out to locate any potential resting areas/ holts or natal holts along the stream. The survey did locate one obvious holt/ resting area at the base of an over-mature willow on the riverbank. It is noted that this holt/ resting area is outside the Proposed Development site boundary (Refer to Figure 7B-9).

A further survey was carried out an area of dense, impenetrable scrub vegetation in September 2007 (*Specialised Otter survey at Ballylongford, Co. Kerry,* DixonBrosnan, 2007). This survey used remote surveillance methods (Infra-red system to trigger a stationary camera) to determine if Otter were using this particular area. No evidence of Otter was recorded within this area which is located outside the Proposed Development site boundary (See Figure 7B-9 for location).

A DixonBrosnan Otter survey in 2011 did not find evidence of Otter along the Ralappane Stream or along the Shannon Estuary shoreline of the Proposed Development site and no evidence was recorded to indicate that resting site recorded in 2007/ 2008 was still being utilised. There was no obvious track running alongside the stream and no spraint sites were recorded. There was sufficient indentation in the grass margin of the stream to suggest some possible sporadic usage. The results of the 2011 suggested that whilst Otter were possibly using the Ralappane Stream and the Shannon Estuary shoreline sporadically, at the time of the survey this habitat was not of high value Otter.

In October 2019 an Otter sprainting site was recorded along the tidal section of the Ralappane Stream outside the western Proposed Development site boundary. An Otter was recorded foraging along the Shannon Estuary shoreline near Knockfinglas Point and to the west of the Proposed Development site. Otter was also recorded foraging at the lagoon to the west of the Proposed Development site in October 2019. In January 2020 an Otter was also recorded moving along a field bordering the Shannon Estuary approximately 900m west of the Proposed Development site. It is noted that no signs of Otter were recorded along the upper reaches of the Ralappane Stream within the Site boundary or along any of the drainage ditches within the Proposed Development site during any of the surveys between 2007 and 2021.

In June 2019, trail cameras recorded two adult Otter close to the confluence of the Ralappane Stream and the Shannon Estuary, outside the Proposed Development site boundary (Refer to Figure 7B-9). Otter are generally solitary and therefore the presence of two adults may be indicative of breeding behaviour. However, no holts were recorded within 150m of the Proposed Development site.

Overall, the Proposed Development site is of Local Importance (Higher value) for Otter. Otter was recorded in the vicinity of the Proposed Development site but there are no records of Otter within the site boundary.

Figure 7B-9 Otter Survey Results

7B.4.4.4 Other Terrestrial Mammals

Nine other species of terrestrial mammal have been recorded within R04, the grid square within which the Proposed Development site is located (NBDC). Five of these are protected under the Wildlife Act 1976, as amended, namely Red Squirrel *Sciurus vulgaris*, Fallow Deer *Dama dama*, Irish Hare *Lepus timidus subsp. hibernicus*, Sika Deer *Cervus nippon* and Hedgehog *Erinaceus europaeus*.

Red Squirrel

Red Squirrel is known to occur in the wider area (NBDC records). The closest record of Red Squirrel in approximately 1 km southeast of the Proposed Development site at Cockhill, Tarbert in 2017. However, no signs of Red Squirrel were recorded during site surveys and given there is no valuable woodland habitat within the Proposed Development site for this species. The site is of negligible local ecological value for Red Squirrel.

Hedgehog

No signs of Hedgehog were recorded during site surveys, although they are likely to use hedgerows and treelines within the Proposed Development site boundary. The site of Local importance (Lower value) for Hedgehog.

Irish Hare

Irish Hare was recorded within the Proposed Development site boundary during the 2011 surveys, although not in the 2007 surveys. Two Hares were recorded foraging in grassland at the southeast of the Proposed Development site on the 22nd of April 2021. A single Hare was also recorded along the shoreline to the east of the Proposed Development site boundary on the 21st January 2019. (Figure 7B-10). The Proposed Development site of Local importance (Lower value) for Irish Hare.

Fallow Deer

No sign of Fallow Deer was recorded during the surveys within the Proposed Development site boundary and habitats present are suboptimal for this species. The Proposed Development site is of negligible local ecological value for Fallow Deer.

Sika Deer

No sign of Sika Deer was recorded during the surveys within the Proposed Development site boundary and habitats present are suboptimal for this species. The Proposed Development site is of negligible local ecological value for Sika Deer.

Figure 7B-10 Other Species Recorded within Proposed Development Site

7B.4.5 Amphibians and Reptiles

7B.4.5.1 Amphibians

According to records held by the NBDC, Common Frog *Rana temporaria* and Smooth Newt *Lissotriton vulgaris* are the only amphibians recorded within grid square R04, the grid square in which the Proposed Development site is located.

A single Common Frog was recorded in wet grassland near the west of the site on the 22 April 2021 (Figure 7B-10). No other amphibian species were recorded during site surveys. The Proposed Development site is of Local importance (Higher value) for Common Frog.

7B.4.5.2 Reptiles

Common Lizard *Lacerta vivipera* has been recorded within R04 on two occasions, however the most recent record dates back to 1976. No sign of Common Lizard was recorded during site surveys. The Proposed Development site is of negligible value for reptiles. No habitats of particular significance for this species will be affected by the Proposed Development.

7B.4.6 Birds

7B.4.6.1 Breeding Birds

The NBDC online database lists 128 species of bird recorded within grid square R04. Of these species, a number are listed under Annex I of the Birds Directive and are Red Listed Birds of Conservation Concern in Ireland (Gilbert *et al.* 2021). Corncrake *Crex crex*, Grey Partridge *Perdix perdix*, Curlew *Numenius arquata*, Barn Owl *Tyto alba* and Yellowhammer *Emberiza citrinella* have historically bred within 10 km of the Proposed Development site (Sharrock 1976, Gibbons *et al.* 1993). However, the proposed site does not contain suitable habitat for breeding Curlew, Barn Owl or Grey Partridge. A national survey of breeding Hen Harriers in Ireland in 2016, recorded no evidence of breeding Hen Harriers in the 10 km grid square containing the Proposed Development (Ruddock *et al.* 2016). It is noted that a juvenile (Ringtail) Hen Harrier was recorded over the reed bed habitat to the west of the Proposed Development site in July 2021 (19th July 2021). However, there is no high value foraging or suitable breeding habitat for this species within the Proposed Development site boundary and there are no records of breeding Hen Harrier within 10 km of the site boundary. Given the habitats within the Proposed Development site, it is of negligible value for breeding Hen Harrier and of low potential value for foraging Hen Harrier.

Breeding bird surveys were carried out at the Proposed Development site in March 2019, July 2019, April 2020 and May 2020. Full details of this survey are included in Appendix A7B-2 of Volume 4.

A total of 37 bird species were recorded during breeding bird surveys, the majority of which are common farmland and woodland edge species. Green List species were recorded primarily along field boundaries and included Woodpigeon *Columba palumbus*, Blackbird *Turdus merula*, Song thrush *Turdus philomelos*, Wren *Troglodytes troglodytes* and Great tit *Parus major*.

Breeding birds of conservation concern recorded during the site surveys are included in Table 7B-5. One Annex I species, Little Egret *Egretta garzetta*, was recorded during site surveys. It is noted that Little Egret was recorded within the salt marsh habitat which is located outside the Proposed Development site boundary. Four red-listed species were recorded in the 2019/ 2020 surveys i.e., Meadow Pipit *Anthus pratensis*, Merlin *Falco columbarius,* Quail *Coturnix coturnix* and Stock Dove *Columba oenas* (Gilbert *et al.* 2021). A single Woodcock *Scolopax rusticola*, a Red List species, was also recorded on a trail camera recording during January 2020, although no sign of this species was recorded during breeding surveys. A male Quail was recorded within wet grassland at the Proposed Development site on one occasion. However, no signs of breeding were recorded and this is likely to be a migrant species passing through the Proposed Development site. Merlin was recorded foraging to the east of the Proposed Development site, near coniferous forestry in July 2019. However, no signs of breeding Merlin were recorded within the Proposed Development site boundary.

Eleven Amber List species were recorded. A number of these species such as Skylark *Alauda arvensis* and Linnet *Carduelis cannabina* as well as the Red List species Snipe *Gallinago gallinago*, Meadow Pipit and Quail are under threat due to intensification of agricultural practices as they rely on less intensively manged agricultural grassland habitat. Less intensively managed agricultural land and wet grassland at the Proposed

Development site provides valuable habitat for these species. It is noted that Snipe were not recorded during the breeding bird surveys but were recorded on a number of occasions during winter bird surveys at the Proposed Development site. They could potentially breed in wet grassland or less intensely managed agricultural grassland at the west of the Proposed Development site. Snipe have recently been moved from Amber List to the Red List species of conservation concern due to a significant drop in their breeding numbers.

It is noted that four juvenile White-Tailed Sea Eagles *Haliaeetus albicilla* have been released in the Tarbert area to date and a further eight birds are scheduled for release in 2021 (Allan Mee, personal communication). White-tailed Sea Eagle have a foraging range of up to 250 km^2 (Evans *et al.* 2011). No signs of this species were recorded during any of the site surveys. The terrestrial habitats within the Proposed Development site do not provide breeding or foraging habitat for White-tailed Sea Eagle, however they could potentially forage along the Shannon Estuary in the vicinity of the site.

There are a number of Red List and Amber List species breeding and foraging within the Proposed Development site. Overall, the Proposed Development site is of Local Importance (Higher value) for birds of conservation concern and Local importance (Higher value) for other breeding birds. Sandwich Tern *Thalasseus sandvicensis*, an Annex I (and Amber List) species was recorded foraging within intertidal waters to the west of the Proposed Development site in summer 2021 (Refer to Section 7B.4.6.2 for detail). Sandwich Tern and Common Tern *Sterna hirundo* breed within the Shannon Estuary at Rat Island, approximately 33 km northeast of the Proposed Development site. Common Tern, which were not recorded during any site survey, also breed at Sturamus Island 24 km east of the Proposed Development site (Hannon *et al*. 2007; Natura 2012). However, there are no breeding tern colonies in the vicinity of the Proposed Development site. Although White-tailed Sea Eagle were not recorded, given the foraging range of this species and the release of birds within 7 km of the Proposed Development site, the site has been classified as Local importance (Lower value) for this Annex I species.

Table 7B-5 Birds of Conservation Concern Recorded during Site Surveys

Species		Breeding Status	Estimated number of territories within site boundary	Conservation Status: Annex I of Birds Directive or Red/ Amber List*
Black-headed Gull	*Larus ridibundus*	Possible	0	Amber List
Herring Gull	*Larus argentatus*	Possible	0	Amber List
House sparrow	*Passer domesticus*	Probable	1	Amber List
Linnet	*Carduelis cannabina*	Probable	1	Amber List
Little egret	*Egretta garzetta*	Possible	0	Annex I
Mallard	*Anas platyrhynchos*	Confirmed	0	Amber List
Meadow pipit	*Anthus pratensis*	Possible	2-3	Red List
Merlin	*Falco columbarius*	Possible	0	Red List
Quail	*Coturnix coturnix*	Non-breeding	0	Red List
Sand Martin	*Riparia riparia*	Possible	0	Amber List
Shelduck	*Tadorna tadorna*	Possible	0	Amber List
Skylark	*Alauda arvensis*	Possible	1	Amber List
Starling	*Sturnus vulgaris*	Possible	2	Amber List
Stock dove	*Columba oenas*	Probable	1	Red List
Swallow	*Hirundo rustica*	Confirmed	2	Amber List
Willow warbler	*Phylloscopus trochilus*	Possible	1	Amber List
Woodcock	*Scolopax rusticola*	Non-breeding	0	Red List

7B.4.6.2 Estuarine Birds

As detailed in Section 7B.4.2, the terrestrial habitats within the Proposed Development site are adjacent to the River Shannon and River Fergus Estuaries SPA. The River Shannon and River Fergus Estuaries SPA is an internationally important site that supports an assemblage of over 20,000 wintering waterbirds. The SPA holds internationally important populations of four species, i.e., Light-bellied Brent Goose, Dunlin, Black-tailed Godwit and Redshank. In addition, there are 17 species that have wintering populations of national importance. The site also supports a nationally important breeding population of Cormorant. Of particular note is that three of the species which occur regularly are listed on Annex I of the E.U. Birds Directive, i.e., Whooper Swan, Golden Plover and Bar-tailed Godwit.

The proposed jetty extends into the SPA boundary (Figure 7B-3). Winter bird surveys were conducted from four vantage points to the east and west of the Proposed Development site on the southern shores of the Shannon Estuary between Richard’s Rock and Ardmore Point (Figure 7B-11). Initially the survey focused on three points (Points A, B and C). A fourth site was added in February of 2019 (Point D). During summer 2021 two additional points (Point E and F) were added to the east of the Proposed Development site and surveys at all six points were extended in the summer months (May to July 2021).

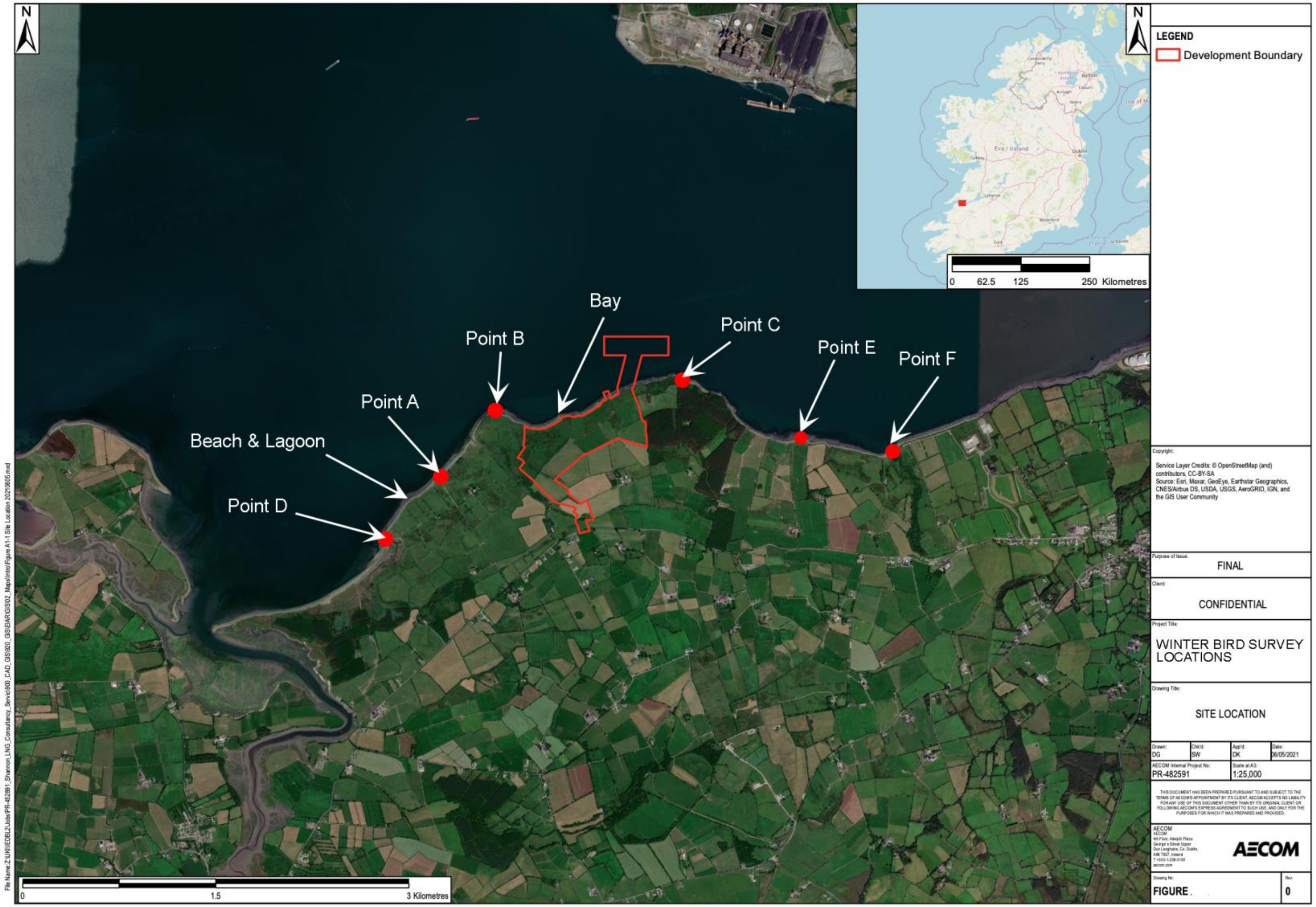

Figure 7B-11 Estuarine Bird Survey Locations

Winter bird surveys within the Shannon Estuary were carried out in 2006/ 2006, 2011/ 2012, 2018/ 2019 and 2019/ 2020. Summer bird surveys were conducted in 2021. Full details of estuarine bird surveys are included in Appendix A7B-3 of Volume 4 and within the NIS which accompanies this application.

Cork Ecology conducted six surveys at monthly intervals between October 2006 and March 2007 at Points A, B and C. On each visit, three bird counts were made over the coastal waters between Knockfinglas Point and Ardmore Point. A total of 29 waterfowl species were recorded during counts over the coastal waters. Two species listed on Annex I of the EU Birds Directive (79/ 409/ EEC) i.e. Red-throated Diver *Gavia stellata* and Great Northern Diver *Gavia immer*, were recorded during the 2006/2007 winter bird surveys. Both species were regularly recorded in low numbers from Point A (Refer to Figure 7B-11). No nationally or internationally important numbers of birds were recorded during the 2006/ 2007 winter bird surveys. Ten SCI species for the SPA were recorded during the 2011/ 2012 surveys i.e., Black-headed Gull, Cormorant, Curlew, Dunlin, Lapwing, Redshank, Ringed Plover, Scaup, Teal and Wigeon. During the 2006/ 2007 winter bird surveys, peak bird numbers were recorded from Point A.

Further bird surveys were carried out by DixonBrosnan in the period 2011-2012 from Points A, B and C along the shoreline of the Shannon Estuary. The Annex I bird species Great Northern Diver and Whooper Swan were recorded during these 2011/ 2012 site surveys. Great Northern Diver was recorded in the area around Knockfinglas point. Whooper Swan was recorded within the lagoon to the west of the Proposed Development site. No nationally or internationally important numbers of birds were recorded during the 2011/ 2012 winter bird surveys. Eight SCI species for the SPA were recorded during the 2011/ 2012 surveys i.e. Whooper Swan, Cormorant, Teal, Ringed Plover, Lapwing, Curlew, Redshank and Black-headed Gull. During the 2011/ 2012 winter bird surveys, peak bird numbers were recorded from Point A.

As part of the current application DixonBrosnan carried out winter bird surveys 2018-2020 from Points A, B and C, as well as Point D from February 2019. Surveys were carried out at all six points (Points A-F) in summer 2021. A total of 33 bird species were recorded during the 2018/ 2019 and 2019/ 2020 winter bird counts. Four Annex I species were recorded i.e. Great Northern Diver, Red-throated Diver, Golden Plover and Little Egret. Fourteen of the 21 SCI species for the River Shannon and River Fergus Estuaries SPA were recorded during the 2018-2021 surveys including Cormorant, Wigeon, Shelduck, Teal, Light-bellied Brent Goose, Ringed Plover, Golden Plover, Grey Plover, Lapwing, Dunlin, Curlew, Redshank, Greenshank and Black-headed Gull. During the summer 2021 surveys a total of 20 species were recorded. This included three species which had not been recorded during winter surveys i.e., Sandwich Tern, Whimbrel *Numenius phaeopus* and Water Rail *Rallus aquaticus*. Three SCI species were recorded during summer 2021 i.e., Cormorant, Curlew and Shelduck.

During the 2018/ 2019 survey, peak numbers were recorded in December (3rd December 2018). During the 2019/ 2020 survey, peak numbers were recorded in February (22nd February 2020). While the peak numbers by month varied between the two survey seasons, the species diversity by month was consistent between both survey seasons. Peak bird numbers were recorded during low tides, with 260 Dunlin and 100 Light-bellied Brent Goose recorded at Point D (west of the Proposed Development site) during low tide. In general, the largest density of birds was recorded from Point D, which was added to the survey area in 2019. Lowest bird numbers and species diversity were recorded during the summer months.

The proposed jetty location is between Point B and Point C (refer to Figure 7B-11). Point B is located at Knockfinglas Point to the west of the Proposed Development site. Low numbers of gulls, diving birds, and waders were recorded here during both low and high tide surveys. A flock of 64 Black-headed Gull and 23 Turnstone *Arenaria interpres* were recorded loafing on the water at high tide. Within the Bay adjacent to Point B, only three wading bird species were recorded and in small numbers i.e. Curlew (peak number 10) and Turnstone (peak number 23), Oystercatcher *Haematopus ostralegus* (peak number 9).

Point C is located at Ardmore Point to the east of the Proposed Development site. This overlooks slightly deeper waters than the other survey points with limited intertidal habitats. Gulls and divers were regularly recorded at this site, albeit in small numbers. Few waders were recorded here, likely due to the limited foraging habitat present; Oystercatcher (peak number 5), Curlew (peak number 2) and Redshank (peak number 4) and Turnstone (peak number 7). Small numbers of duck species i.e., Mallard *Anas platyrynchos* (peak number 2) and Wigeon (peak number 12), were recorded here at low tide.

The grassland habitats near the north-western boundary of the Proposed Development site may serve as high tide foraging locations for terrestrial foraging waders such as Curlew, Lapwing and Golden Plover. It is noted that flocks of Curlew were recorded foraging on wet grassland within the Proposed Development site during the 2007/ 008, 2018/ 2019 and 2019/ 2020 winter bird surveys (max. 78 individuals in January 2008). Snipe were also recorded in wet grassland habitats during the 2018/ 2019 and 2019/ 2020 winter bird surveys. Curlew and Snipe, which are Red List species of Conservation Concern (Gilbert *et al.* 2021), were the only terrestrial foraging wading birds recorded within the Proposed Development site. No other wading birds were recorded on terrestrial habitats within the Proposed Development site.

The deeper waters of the estuary provide foraging grounds for seabirds and divers including Black Guillemot *Cepphus grylle*, Common Guillemot *Uria aalge*, Great Crested Grebe *Podiceps cristatus*, Great Northern Diver and Razorbill *Alca torda*. These birds generally occurred in small numbers at both high and low tides.

The estuarine bird survey area has small areas of shingle and gravel shores, shingle beach and boulders shores with limited exposed mudflat at low tide. The stretch of the shore between Point A and Point E has low value for wading birds and this is reflected in the low numbers of these species recorded here. Few SCI birds were recorded between Point B and Point C (the proposed jetty location) and with the exception of a flock of 123 Black-headed Gull in December 2018, were recorded in low peak numbers Cormorant (4), Curlew (10) Greenshank (1), Whimbrel (1) and Wigeon (10). Point D, approximately 1 km west of the Proposed Development site, is closer to an area of intertidal mudflats along Ballylongford Creek. Bird numbers and diversity were notably higher at Point D compared to Points A, B or C. This would suggest that the habitats to the west of the Proposed Development site are likely to provide the valuable intertidal habitats which are lacking within the survey area.

The peak number of benthic foraging divers were recorded feeding within deeper waters of the survey area including Great Northern Diver (4), Red-throated Diver (2) and Great Crested Grebe (11) as well as other piscivorous species such as Cormorant (4), Shag *Phalacrocorax aristotelis* (5) and Sandwich Tern (3). The majority of sightings were from Point A although a number of these species were recorded between Point B and Point C and the peak numbers were as follows: Great Northern Diver (3), Great Crested Grebe (2), Red-throated Diver (2), Cormorant (4). No Shag or Sandwich Tern were recorded foraging within the intertidal waters at the Proposed Development site. While peak numbers of birds were generally recorded to the west of the survey area, the waters around the proposed jetty location are also regularly used by small numbers of piscivorous and diving birds. The foraging distribution of these birds is highly influenced by water depth and tidal conditions. Many of these species however exhibit a widespread coastal distribution during winter, utilising shallow nearshore waters to a greater degree at certain times (e.g., storms, driving onshore winds).

Part of the Proposed Development site overlaps with the River Shannon and River Fergus Estuaries SPA and SCI birds use the waters in the vicinity of the site. However, no birds were recorded in nationally or internationally important numbers. It is noted that an extensive survey of the Shannon Estuary found that bird species richness within the SPA was generally correlated with intertidal habitat area (MKO 2019). MKO noted that the Proposed Development site had limited intertidal foraging habitat and subsequently very low numbers of birds.

Overall, the Proposed Development site is of County importance for Annex I species, Local importance (Higher value) for SCI species and Local importance (Higher value) for non-SCI wintering/ estuarine birds.

7B.4.7 Fish

Aquatic Services Unit carried out a fisheries assessment of the Ralappane Stream on 4 October 2006. The characteristics/ locations of the sites and the species detected are shown in Table 7B-6.

A resurvey of the stream was not considered necessary in 2011. However, a visual examination of the stream did not record any signs of a significant deterioration in water quality such as odour, siltation or excessive algae development.

Table 7B-6 Fisheries Assessment – Survey Locations

Site	Location	Species Captured
Site F1	Located in sluggish water in the lower reach of the stream about 120m upstream from the seashore.	1 stone loach (*Nemacheilus barbatus*)
Site F2	Site 2 was situated about 1 field due north of the southern farmyard	2 sticklebacks (*Gasterosteus aculeatus*) and 3 Eels (*Anguilla anguilla*)
Site F3	Site 3 was located due east of the same farmyard.	20 stickleback (*Gasterosteus aculeatus*) and 1 eel (*Anguilla anguilla*)

Small numbers of fish were caught during the electrofishing survey and only three species were detected. Two species (Stone Loach *Nemacheilus barbatus* and European Eel *Anguilla anguilla*) were found in low numbers with higher numbers of Stickleback *Gasterosteus aculaeatus* recorded. European Eel is listed by the International Union for Conservation of Nature (IUCN) as a critically endangered species, with numbers in catastrophic decline. No salmonids were recorded. This could be due to the short length of the stream, low flows, lack of available spawning substrate or due to debris and marginal vegetation blocking migration routes through the stream. There is no evidence to indicate that the stream has significant spawning habitat or is generally of high value for fish. It is noted that European Eel and Stickleback were also observed within the stream during kick sampling carried out by DixonBrosnan in April 2021 (Refer to Appendix A7B-4 of Volume 4).

Small numbers of fish use the stream, and no Annex II species were recorded. However, European Eel which is critically endangered, was recorded within the stream. Overall the Ralappane Stream is of Local importance (Higher value) for fish species.

7B.4.8 Aquatic Invertebrates

The results of the ASU survey are outlined in Table 7B-7 and the location of sampling sites shown in Figure 7B-12. Water chemistry monitoring within the Ralappane Stream is discussed in Chapter 06, Section 6.5.10.3. This section notes that the analytical results indicate that surface waters at the Proposed Development site are locally impacted by some minor water quality issues.

Table 7B-7 Kick Sampling Results 2006

Site	GPS	Characteristics	Q Value
Stream Site 1	Strandline Stream Outlet R01525 48553	The mainstream flowed to the estuary across the boulder-cobble-gravel shoreline Here the channel, without banks, was 2.5m wide and 15-20cm deep flowing swiftly and turbulently over the substrate of smooth boulders cobbles gravel and fine gravel. The water was quite turbid, presumably due to re-suspended shore sand. Conductivity was recorded at 491 µS/cm. The substrate was largely plant-free except for green alga *Enteromorpha. sp.*	Not assigned due to tidal influence
Stream Site 2	GR (R10860 48268)	The stream flows over boulder cobble and coarse sand; and is largely plant-free. The channel is about 0.7m wide and 0.37m deep with a moderate to swift laminar flow. The overgrown banks were dominated by bramble, with an understorey of rushes and nettles. The channel is very shaded with vertical banks of about 0.6m.	Q4

Stream Site 3	This site is upstream of Site 2 at R01965 48180	The right bank was heavily overgrown with bramble and hawthorn, while the left bank had low elm suckers backed by marshy grassland. The channel was 1m wide and 0.28m deep in heavy shade. The substrate comprised boulders, cobbles, gravel and coarse sand in a moderate to swift flow. The substrate was plant free. The water was colored and had a conductivity of 309 µS/cm.	Q4

The Ralappane Stream has a fairly typical mix of taxa, but numbers of Mayfly *Ephemeroptera* spp were low and stoneflies *Plecoptera* spp were absent. This may indicate a marginal degree of water quality impairment although; a Q-value of Q4 (unpolluted) was assigned. A value of Q3-4 (slightly polluted) might also have been assigned, especially to Site 3 as there were relatively more oligochaetes and leeches at this location.

An aquatic survey of the Ralappane Stream was undertaken by DixonBrosnan on the 22 April 2021. Biological sampling was carried out at each station using the kick-sampling technique as described by Clabby *et al* (2001).

The Ralappane Stream arises approximately 3.5 km south-east of the Proposed Development site and passes through a landscape dominated by intensive agriculture with blocks of planted woodland, before discharging to the estuary. Although there are sections with a natural riffle-glide flow pattern, sections of the stream have been straightened and deepened leading to sluggish flows and a soft substrate. Three sampling stations were selected along the Ralappane Stream as shown below on Figure 7B-12. Further detail on the sample locations including instream conditions and surrounding vegetation is included in the report *Biological Assessment of Ralappane Stream, Ballylongford, Co. Kerry 2021* (DixonBrosnan, 2021) which is included in Appendix A7B-4 of Volume 4.

Figure 7B-12 Aquatic Sampling Locations

Macro-invertebrates found at each site were identified down to the lowest taxon required for the determination of Q value. All three sites were assigned a Q value of 3 which is indicative of a degree of water quality impairment and the most sensitive species (Group A) were absent from all three sites. No sites achieved the target of good status (Q4) water quality, as specified under the Water Framework Directive (2000/ 60/ EC).

Site 1 and 2 adjoin intensive grassland with cattle drinking points evident within this section of the watercourse. Site 3 adjoins wet grassland which is less intensively managed, and diversity was generally higher at site 3.

The results from chemical analysis of water samples were not indicative of significant water quality impairment; however it is noted that cattle drinking points have the potential to cause significant localised nutrient enrichment in small streams where dilution is limited. European Eel and Stickleback were noted within the watercourse which is considered highly unlikely, given its limited size, to support salmonids. No salmonids were recorded during the fish stock assessment in 2006.

Overall the Ralappane Stream is of Local importance (Lower value) for invertebrate species.

7B.4.9 Invasive Species

The Birds and Natural Habitats Regulations 2011 (SI 477 of 2011), section 49(2) prohibits the introduction and dispersal of species listed in the Third Schedule, which includes Japanese Knotweed (*Fallopia japonica*), as follows: 'any person who plants, disperses, allows or causes to disperse, spreads or otherwise causes to grow [….] shall be guilty of an offence.'

A survey for invasive species was carried out in conjunction with habitat surveys and any observations of invasive species made during other surveys were recorded. No third schedule invasive species were recorded within the planning boundary (Wildlife Act 1976, as amended) or any High impact or Medium impact invasive species as classified by the NBDC were recorded within the Proposed Development site.

7B.4.10 Other Species

In 2007 (9th September 2007) a specialised Lepidopteran survey was carried out following consultation with the NPWS. A Robinson pattern moth trap was placed at the reed bed adjacent to the Ralappane Stream to the west of the Proposed Development site and was run and supervised overnight. This reed bed is included in the Lower River Shannon Special Area of Conservation (Site Code 002165) and is outside the Proposed Development site boundary. Other habitats in the immediate surroundings include wet grassland and agriculturally improved grassland with unmanaged hedgerows. No specialised survey was carried out for butterflies and day flying moths. However, a variety of species were recorded during general survey work in 2006 and 2007. Overall, no Lepidopteran species of particular rarity were recorded, although some of the moth species did have specialised or localised distributions (Table 7B-8, Table 7B-9). The prevalence of the Wainscot moths i.e. Smokey wainscot *Leucania impure*, Striped wainscot *Leucania pudorina*, Large Wainscot *Arenostola pygmina*. is largely related to the presence of their food plants in the area including coarse grasses, sedges and in particular Common Reed.

Table 7B-8 Moth Species Recorded during 2007 Reed Bed Survey

Common Name	Latin Name	Notes
Canary shouldered thorn	*Deuteronomos alniaria*	Distributed throughout Ireland. Its primary food plants are Birch and Willow
August thorn	*Deuteronomos quercinaria*	Distributed throughout Ireland. Its primary food plants are Hawthorn and Willow.
Smokey wainscot	*Leucania impura*	Widely distributed. Primary foodplants are grasses.

Common Name	Latin Name	Notes
Striped wainscot	*Leucania pudorina*	Recorded from Galway, Cork and Kerry. Its foodplant is Common Reed
Large Wainscot	*Arenostola pygmina*	Fens and marshy ground. Foodplants sedges and Marram Grass Ammophila spp..
Pink barred sallow	*Citria lutea*	Throughout Ireland. Food plants sallow and Birch *Betula* spp..
Frosted orange	*Gortyna flavago*	Throughout Ireland. Local. Foodplants thistles *Cirsium* spp. and burdock *Arctium* spp..
Rosy rustic	*Gortyna micarea*	Widespread coastal species. Foodplant roots of dock *Rumex* spp. etc.
Large yellow underwing	*Noctua pronuba*	Common. Foodplant grasses.
Copper underwing	*Amphipyra pyramidea*	Widespread; mainly a woodland species. Foodplants various tree and shrub species including Birch, Willow and Hawthorn.
Angle shades	*Phlogophora meticulosa*	Widespread, common. Main foodplants dock, Groundsel *Senecio vulgaris* etc.
Crimson ear	*Hudraecia crinanensis*	Widespread. Foodplant Yellow Iris *Iris pseudacorus.*
Autumn green carpet	*Chloroclysta miata*	Widespread. Foodplants willow and Alder *Alnus* spp..
Brimstone moth	*Opisthograptis luteolata*	Numerous and widespread. Foodplant Hawthorn etc.

Table 7B-9 Butterflies and Day-flying Moth Species Recorded during Site Survey

Common Name	Latin Name	Notes
Small tortoiseshell	*Aglais urticae*	Widely distributed in Ireland, although abundance varies. Highly mobile and can be seen in many habitats.
Meadow brown	*Maniola jurtina*	Widely distributed in Ireland and common in fields, roadsides and woodland.
Painted lady	*Vanessa cardui*	Found in a number of locations around Ireland. Main foodplants thistles and nettle

Common Name	Latin Name	Notes
Red admiral	*Vanessa atalanta*	Widespread and highly mobile. Main foodplant nettle and hop.
Five spotted burnet moth	*Zygaena trifolii*	Locally distributed, and occupies damp meadows, marshes and sea cliffs.
Common blue	*Polyommatus icarus*	Widespread and common. Foodplants include Bird's foot trefoil Lotus corniculatus, Black Medick. Medicago lupulina and White Clover Trifolium repens.
Ringlet	*Aphantopus hyperantus*	Widespread. Main foodplants Cock's-foot *Dactylis glomerata*, Common Couch Elymus repens, and meadow grasses.
Green veined white orange tip	*Pieris napi*	Distributed throughout Ireland. Charlock *Sinapis arvensis*, Cuckooflower *Cardamine pratensis*, Watercress *Nasturtium officinale*.
Small white	*Pieris rapae*	Found throughout most of Ireland. Main foodplants crucifers *Brassicaceae* spp., nasternium *Tropaeolum* spp. and Wild Cabbage *Brassica oleracea*.
Large white	*Pieris brassicae*	Distributed throughout most of Ireland. Foodplant mainly crucifers, nasternium.
Small heath	*Coenonympha pamphilus*	Found in a number of areas around Ireland. Main foodplants bents *Agrostis* spp. and fescues *Festuca* spp..

In 2007 (30 August 2007), terrestrial and aquatic invertebrates were collected from several habitats within and adjoining the reedbed site. Terrestrial invertebrates were collected by sieving dead plant material, breaking up tussocks of vegetation, trampling a small area of soil splashing water margins to disturb invertebrates. Aquatic invertebrates were collected with a pond net whilst disturbing the substratum and marginal and emergent vegetation. Invertebrates were identified to species level where possible. These were mainly terrestrial and aquatic beetles,

Twenty-six species of terrestrial beetles were recorded. Most of these are common and widespread species, frequently occurring wherever suitable habitat exists. Two species of rove beetle recorded that are uncommon in Ireland. *Quedius fumatus* is noted by Anderson (1997) as widespread but local, in moss and damp litter in wooded swamps. *Philonthus fumarius* is also a species of damp litter in fens and marshes. Anderson (1997) mentions one relatively recent record of this species for the Northern Ireland and Johnson and Halbert (1902) regarded the species as very local in Ireland as a whole.

Amongst the thirteen aquatic beetle species recorded three are restricted to brackish water habitats. *Ochthebius punctatus* and *Enochrus bicolor* are locally common in brackish water all around the coast of Ireland and Great Britain. *Ochthebius viridus* is uncommon and sparsely distributed around the coast of Ireland. Only four species of mollusc were recorded and all are common and widespread in Ireland.

Overall, the reed bed supported a good diversity of beetle species although this is limited by the homogeneous nature of reed stands and the lack of standing water on the site. Other small areas of habitats on the site i.e. the stands of Willow *Salix sp.* and the area of putrid pools contained three uncommon beetle species which are restricted to a particular habitat and have a limited distribution in Ireland which makes the site of some ecological interest.

A search of NBDC records recorded one notable species within 2 km of the Proposed Development site (R04J and R04E) i.e., *Ochthebius (Ochthebius) viridis* which was recorded during the reed bed surveys.

During the 2018 to 2021 surveys within the Proposed Development site boundary, no rare or notable species were observed within the Proposed Development site boundary. Whilst no site is without invertebrate interest, it is considered highly unlikely, given the habitat types within the site boundary, that the Proposed Development site would support any protected, rare or uncommon invertebrate species and no specialised surveys were considered necessary.

7B.5 Assessment of Impact and Effect

7B.5.1 Likely Significant Effects

Annex III of the amended Directive 2014/ 52/ EU requires that the EIAR should assess:

- The magnitude and spatial extent of the impact (for example geographical area and size of the population likely to be affected);
- The nature of the impact;
- The transboundary nature of the impact;
- The intensity and complexity of the impact;
- The probability of the impact;
- The expected onset, duration, frequency and reversibility of the impact;
- The cumulation of the impact with the impacts of other existing and/ or approved projects; and
- The possibility of effectively reducing the impact.

Potential effects of the construction, operational and decommissioning phases of Proposed Development on terrestrial and aquatic biodiversity include:

- Potential Effects on Terrestrial and Aquatic Habitats;
- Potential Effects on Badgers;
- Potential Effects on Bats;
- Potential Effects on Otter;
- Potential Effects on Other Mammals;
- Potential Effects on Birds;
- Potential Effects on Fish;
- Potential Effects on Other Species;
- Potential effects on Air Quality;
- Potential Effects from Non-native Invasive Species;
- Potential Effects on Climate Change and Biodiversity;
- Potential Effects from Accidents; and
- Potential Effects of Decommissioning.

7B.5.2 Impact Assessment

7B.5.2.1 Potential Impacts

When describing changes/ activities and impacts on ecosystem structure and function, important elements to consider include positive/ negative, extent, magnitude, duration, frequency and timing, and reversibility.

Section 3.7 of the *Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports'*, (EPA 2017) provides standard definitions which have been used to classify the effects in respect of ecology. This classification scheme is outlined below in Table 7B-10**.**

Table 7B-10 EPA Impact Classification

Impact Characteristic	Term	Description
Quality	Positive	A change which improves the quality of the environment.
	Neutral	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
	Negative	A change which reduces the quality of the environment.
Significance	Imperceptible	An effect capable of measurement but without significant consequences.
	Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences
	Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
	Moderate	An effect that alters the character of the environment in a manner consistent with existing and emerging trends.
	Significant	An effect, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
	Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
	Profound	An effect which obliterates sensitive characteristics.
Duration and Frequency	Momentary Effects	Effects lasting from seconds to minutes.
	Brief Effects	Effects lasting less than a day.
	Temporary Effects	Effects lasting less than a year.
	Short-term	Effects lasting one to seven years.
	Medium-term	Effects lasting seven to fifteen years.
	Long-term	Effects lasting fifteen to sixty years.
	Permanent	Effects lasting over sixty years.
	Reversible Effects	Effects that can be undone.
	Frequency	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)
	Irreversible	When the character, distinctiveness, diversity, or reproductive capacity of an environment is permanently lost.
	Residual	Degree of environmental change that will occur after the proposed mitigation measures have taken effect.
	Synergistic	Where the resultant effect is of greater significance than the sum of its constituents.
	'Worst Case'	The effects arising from a development in the case where mitigation measures substantially fail.

7B.5.2.2 Determining Impact Significance

According to the EPA (2017), significance of effects is usually understood to mean the importance of the outcome of the effects and is determined by a combination of objective (scientific) and subjective (social) concerns.

The EPA further notes that:

'*While guidelines and standards help ensure consistency, the professional judgement of competent experts plays a role in the determination of significance. These experts may place different emphases on the factors involved. As this can* *lead to differences of opinion, the EIAR sets out the basis of these judgements so that the varying degrees of significance attributed to different factors can be understood*'.

With this in mind, the geographic frame of reference applied to determining impact significance by the NRA (2009) in Ireland and CIEEM (2019) in Ireland and the UK, has been adopted in this report in tandem with the EPA's qualitative significance criteria. Table 7B-11 compares the qualitative versus geographic approaches to determining the significance of effects.

Table 7B-11 Equating the Definitions of Significance of Effects Using a Geographic vs. Qualitative Scale of Reference

Geographic Scale of Significance (NRA, 2009; CIEEM, 2019)	Qualitative Scale of Significance of Effects (EPA 2017)
Negligible or Local Importance (Lower Value). No significant effects predicted to significant ecological features.	**Imperceptible**. An effect capable of measurement but without significant consequences. **Not significant**. An effect which causes noticeable changes in the character of the environment but without significant consequences.
Local Importance (Higher Value), County, National, Regional, or International.	**Slight/ Moderate/ Significant/ Very Significant/ Profound** i.e. effects can be slight, moderate, significant, very significant, or profound at Local scale, subject to the proportion of the local population/ habitat area affected.

The geographic frame of reference can be a good fit to assessments of biodiversity impacts because it allows clear judgements to be made about the scale of significance, with reference to published estimates for the population size of a given species at county, national and/ or international scales or areas of habitats at such scales.

The proportion of a known feature impacted at county scale (i.e., 1% of the known or estimated population in a given county) is measurably different from that impacted at national scale (i.e., 1 % of the known or estimated national population).

A non-geographic qualitative approach can be a poor fit to assessments of biodiversity, since the definitions provided for the different qualitative terms do not relate to measurable units of space such as a county or national boundary. For instance, a significant effect is defined by the EPA as '*an effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment without affecting its sensitivities*', whilst a very significant effect is that which '*by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment'*.

7B.5.2.3 Summary Valuation of Significant Terrestrial Ecology Features

As per the impact assessment methodology outlined in Section 7B.5.2.2, significant ecological features are considered to be those valued at Local Importance (Higher Value) or higher as per NRA (2009) and CIEEM (2019) definitions. Table 7B-12 summarises all significant ecological features identified within the Zone of Influence of potentially significant impacts.

It is noted that direct and indirect impacts on marine/ intertidal habitats within the Lower River Shannon cSAC and River Shannon and River Fergus Estuaries SPA are discussed in Chapter 07A – Marine Biodiversity and the NIS. Indirect impacts on these sites, as well as the Ballylongford Bay pNHA, via water discharges are also discussed in Chapter 06 – Water.

Table 7B-12 Summary Valuation of Significant Terrestrial Ecological Features and Identification of Features Scoped Out From the EIA

Feature		Highest Value within Zone of Influence	At risk of significant impact	Scoped into terrestrial ecology assessment
	Lower River Shannon cSAC	International	Yes	Yes

Feature		Highest Value within Zone of Influence	At risk of significant impact	Scoped into terrestrial ecology assessment
Designated sites	River Shannon and River Fergus Estuaries SPA	International	Yes	Yes
	Ballylongford Bay pNHA	National	Refer to Chapter 06	No
	Other National Sites	National	No	No
Habitats	Wet grassland GS4/ Improved agricultural grassland GA1	Local importance (Lower value)	Yes	Yes
	Improved Agricultural grassland GA1	Local importance (Lower value)	Yes	Yes
	Hedgerows WL1/ Treelines WL2	Local importance (Higher value)	Yes	Yes
	Sedimentary Sea Cliffs CS3	International importance	Yes	Yes
	Scrub WS1	Local importance (Higher value)	Yes	Yes
	Eroding River FW1	Local importance (Higher value)	Yes	Yes
	Drainage ditches FW4	Local importance (Lower value)	Yes	Yes
Terrestrial mammals	Badger	Local Importance (Higher Value)	Yes	Yes
	Bats (Common Pipistrelle, Soprano Pipistrelle, Leisler)	Local Importance (Higher Value)	Yes	Yes
	Otter	Local Importance (Higher Value)	Yes	Yes
	Red Squirrel, Fallow Deer, Sika Deer, Red Fox, Mink	Negligible	No	No
	Hedgehog, Irish Hare	Local importance (Lower value)	Yes	Yes
Amphibians	Common Frog	Local importance (Higher Value)	Yes	Yes
Reptiles	Common Lizard	Negligible	No	No
Birds	SCI birds (River Shannon and River Fergus Estuaries SPA)	Local importance (Higher Value)	Yes	Yes
	Annex I species (Great Northern Diver, Red-throated Diver, Little Egret, Golden Plover, Sandwich Tern)	County importance	Yes	Yes
	Red list bird species (Non SCI) (Meadow Pipit, Merlin, Stock Dove, Quail, Oystercatcher, Snipe, Razorbill)	Local importance (Higher Value)	Yes	Yes

Feature		Highest Value within Zone of Influence	At risk of significant impact	Scoped into terrestrial ecology assessment
	Amber list bird species (Several)	Local importance (Higher Value)	Yes	Yes
	Other breeding birds (Several)	Local importance (Higher Value)	Yes	Yes
	Annex I (White-tailed Sea Eagle)	Local importance (Lower value)	Yes	Yes
	Annex I (Hen Harrier)	Negligible value	No	No
Aquatic species	Fish (Stickleback, Eel, Stone Loach)	Local importance (Higher value)	Yes	Yes
	Aquatic invertebrates	Local importance (Lower value)	Yes	Yes
Other species	Invertebrates	Negligible	No	No

7B.5.3 Construction Phase

In the absence of mitigation measures, construction phase impacts have the potential to remove a range of habitats and disturb or displace protected species throughout the estimated 32 month duration of construction. Significant potential impacts to terrestrial biodiversity include habitat loss, noise and visual disturbance (including lighting) to protected fauna species, and the potential for suspended solids or other contaminants to be carried into local watercourses, particularly following topsoil stripping and bridge construction.

It is noted that main sources of noise and vibration associated with the construction of the Proposed Development are the piling rigs used in the construction of the jetty and blasting within onshore habitats. Piling works will take place around the offshore elements i.e., jetty and FRSU at the northeast of the Proposed Development site. Piling works offshore have the potential to generate above ground and underwater noise. Jetty works will take place 24 hours a day 6 days a week. Vibration levels are expected to be highest during blasting operations, however these will be carefully managed. No more than three blasts are envisaged to occur in any given day and associated noise and vibration levels will be transient and very short lived. Excluding the jetty construction works construction works will take place during normal daytime hours.

Three watercourse crossing are required within the Proposed Development site i.e. a bridge over the Ralappane Stream and two culverts on drainage ditches. Direct impacts on Ralappane Stream will be avoided through the use of the single span bridge for the stream crossing and no instream works will be carried out. Two drainage ditches, which do not have the potential to support fish, in the southwest section of the Proposed Development site will be culverted (Section 2.4.4.2 of Chapter 02 – Project Description). The proposed crossings of the watercourses within the Proposed Development have been adequately sized to have a minimal impact on the current hydraulic regime in the area. This section, which presents potential construction phase impacts for the Proposed Development alone, should be read in conjunction with summary tables of potential impacts (Table 7B-15).

7B.5.3.1 Terrestrial and Freshwater Habitats

The Proposed Development site layout is shown on Figure 7B-3. The majority of habitats and flora in this area will be removed during the construction phase. Potential impacts on terrestrial habitats, are included in Table 7B-13. As noted in Section 7B.4.2.1, a small area of terrestrial habitat along the shoreline overlaps with the Lower River Shannon cSAC i.e., Sedimentary sea cliffs CS3. Potential impacts on habitats within the Lower River Shannon cSAC are discussed in the NIS.

It should be noted that the value of a habitat is site specific and will be partially related to the amount of that habitat in the surrounding landscape. The classification scheme, used in Table 7B-10 and Table 7B-11 for the value of habitats and the impacts on them, is detailed in the NRA publication *Guidelines for assessment of ecological impacts of National Road Schemes* (Appendix A7B-7 of Volume 4). Predicted impacts on habitats within the Proposed Development site in the absence of mitigation are detailed in Table 7B-13.

Table 7B-13 Impact on Habitats within Proposed Development Site Boundary

Habitat type	Approximate extent within the site (ha or linear km)	Maximum extent habitat loss during construction	Habitat value	Impacts
Wet grassland GS4/ Improved agricultural grassland GA1	7.41 ha	7.41 ha	Local importance (Lower value)	The majority of the Proposed Development site will be developed and a high proportion of this habitat will be completely removed. **Negative, slight, long-term at local level.**
Improved agricultural grassland GA1	31.2 ha	31.2 ha	Local importance (Lower value)	Most of the Proposed Development site will be developed and a high proportion of this habitat will be completely removed. **Negative, slight, long-term at local level.**
Hedgerows (WL1)/ Treelines (WL2)	4.9 km	4.9 km	Local importance (Higher Value)	Most of the Proposed Development site will be developed and a high proportion of this habitat will be completely removed. **Negative, moderate, long-term at local level.**
Sedimentary sea cliffs CS3	100 m	100 m	International importance	The development of the offshore elements will result in the removal of a small area of this habitat. This habitat is located within the Lower River Shannon cSAC However, this is not an example of the Annex I qualifying habitat vegetated sea cliff 1230. **Negative, significant, long-term at local level.**
Scrub WS1	Small, scattered distribution (not measurable)	Small, scattered distribution (not measurable)	Local importance (Higher Value)	Small areas of scrub will be removed. **Negative, slight, long-term at local level.**
Eroding river FW1	137 m (approximately)	0 m	Local importance (Higher Value)	A single-span bridge will cross the Ralappane Stream at the site entrance. While no instream works are

Habitat type	Approximate extent within the site (ha or linear km)	Maximum extent habitat loss during construction	Habitat value	Impacts
				proposed, this may lead to bank destabilisation. Indirect impacts on water quality through the generation of excessive silt levels or spillage of cement or hydrocarbons during construction. **Negative, moderate, short-term at local level.**
Drainage ditch FW4	600 m (approximately)	80 m	Local importance (Lower Value)	Two drainage ditches at the southwest of the site will be culverted. This will lead to minor habitat loss. Indirect impacts on water quality through the generation of excessive silt levels or spillage of cement or hydrocarbons during construction. **Negative, slight, long-term at local level.**

7B.5.3.2 Badger

Two main Badger setts occur in proximity to the Proposed Development site, namely Sett 3 and Sett 4. However, neither sett will be directly impacted by the Proposed Development. Bait marking surveys indicate that Sett 2 is a subsidiary sett and the main sett for this social group is Sett 3, which will be unaffected by the Proposed Development. Sett 1 which has contracted since initial surveys in in 2007, now consists of one unused sett entrance and is an outlier sett just within the site boundary. Sett 1 is linked to the main sett, Sett 4 which is located to the east of the Proposed Development site.

During construction two smaller setts (Sett 1 and Sett 2) which are located within the Proposed Development site boundary will be removed. Neither of the main setts (Sett 3 and Sett 4) will be impacted by the Proposed Development and exclusion of the Badgers from subsidiary or outlier setts is a viable option. Piling and blasting works will take place within 150 m of Sett 1. This has the potential to create significant disturbance to Sett 1 and/ or block or damage tunnels that radiate from the entrance to the sett, leading to Badger injury or mortality. Construction works close to breeding setts can cause serious disturbance to Badgers and mortality of cubs. All other setts are a significant distance from vibration impacts. It is noted that a range of measures will be adopted during the blasting stage of the construction phase to minimise the impact of air overpressure as far as practicable. Given the distance from Badger setts overpressure and vibration impacts from blasting will not be significant.

The development of the Proposed Development site will result in a net loss of foraging habitat within agricultural grassland. Conservatively it is estimated that this will be greater than 25% habitat loss within the territories of both social groups. Where loss of habitat is likely to be greater than 25%, the impact may be considered as significant on the affected social group (NRA 2005a). Furthermore, Badgers may be killed or injured by road traffic as they attempt to access their feeding areas. However, given that the recommended speed limit at the Proposed Development site is 15 km/hr, there is unlikely to be any significant impact from traffic fatalities within the site.

During construction Badgers are likely to remain *in situ* and continue to use existing territories. However, the reduction in territory size is likely to create a contraction in the size of both social groups. It is noted that no Badger latrines were recorded in the large agricultural fields as the southeast of the Proposed Development site, so this habitat may not be critical within their foraging territories. A net loss of grassland foraging habitat will therefore be a long-term impact of the Proposed Development but given the alternative resources available both Badger territories will remain extant.

Impacts to Badgers during the construction phase in the absence of mitigation will be **negative, significant** and **long-term** at a local geographic level.

7B.5.3.3 Bats

No buildings with significant potential to support bats were recorded within the Proposed Development site boundary. A small bat roost of Common Pipistrelle was recorded in a disused farm building to the southwest of the Proposed Development site boundary (Location A Figure 7B-8). This building will not be removed as part of the Proposed Development. No trees with potential to support bat roosts were recorded within the Proposed Development site boundary and no other buildings of value for bats will be affected. Two structures (Location B and Location C Figure 7B-8) within the Proposed Development site boundary will be removed as part of the Proposed Development, however neither supports bats.

While direct impacts to bat roosting sites will be avoided, the removal of treelines and hedgerows will result in a reduction in foraging resources within the Proposed Development site (Table 7B-13). Linear features within the Proposed Development site boundary, including hedgerows, treelines, cliffs and scrub, have moderate suitability as foraging/ commuting areas, to link roost sites to foraging areas and facilitate the dispersal of bats into the wider landscape. Small numbers of Common Pipistrelle, Soprano Pipistrelle and Leisler’s Bat were recorded foraging along these habitats at the Proposed Development site. During construction all internal hedgerows/ treelines as well as scrub and a small area of cliff habitat will be removed. In the absence of mitigation, the construction phase of the Proposed Development will result in the long-term loss of moderate value bat foraging and commuting habitat. However, given the availability of similar habitat in the immediate vicinity and the relatively low numbers of bats recorded at the Proposed Development site, there is unlikely to be any fragmentation impacts or loss of connectivity within the wider landscape.

Noise and lighting onshore during construction has the potential to significantly impact foraging habitats of Common Pipistrelle and Soprano Pipistrelle. Construction works within terrestrial habitats will be confined to daytime hours and therefore disturbance from lighting during onshore construction works will be minimal. However, jetty works will take place over a 24-hour period and lighting along the coast has the potential to disrupt foraging bats in this area, particularly Leisler’s Bat. Bat foraging along the coastline near the jetty location may also be disrupted by increase disturbance and lighting i.e. Common and Soprano Pipistrelle and Leisler’s Bat. Lighting deters some bat species, in particular Myotis species, from foraging. No Myotis species were recorded within the Proposed Development site or along the coastline to the north of the site. Pipistrelle species appear to be more tolerant of light and disturbance (Speakman 1991; Stones *et al.* 2009; Haffner 1986). It is also noted that Leisler’s Bats will opportunistically feed on such insect gatherings in lit areas (Bat Conservation Ireland 2010). This exposed section of coastline does not appear to provide valuable bat foraging habitat, with small numbers of Common Pipistrelle, Soprano Pipistrelle and Leisler’s Bat using this area.

Overall, the loss of semi-natural habitat and increased lighting and disturbance during construction will reduce the feeding area available for bats. The impact on foraging bats will be **negative, moderate** and **medium term** at a local geographic level.

Migratory Bats

While the migratory movements have long been known and described (Popa-Lisseanu and Voight 2009), recent advances in research methods as well as the increase in perceived threats from offshore infrastructure such as windfarm has led to increase in research on the topic (Ahlen *et al.* 2009, Hutterer *et al.* 2005, McGuire *et al.* 2011, McGuire *et al.* 2013 and Popa-Lisseanu *et al*. 2012). Bat migration is a relatively uncommon phenomenon with less than 3% of bats understood to be migratory and only 12 species worldwide for which long-distance movements of more than 1000 km have been recorded (Bisson *et al.* 2009).

The key reason why fewer species of bat migrate than birds, relates to the ability of bats to sustain torpor in hibernation which gives bats the option of hibernating in response to lack of insect prey during the winter months. Most temperate bats that migrate do so to travel to hibernation sites with optimum conditions for surviving the winter. Many species of bats e.g., Less Horseshoe Bats and Myotis bats hibernate underground in systems that offer consistent microclimates in winter and characteristically undertake relatively short migrations to hibernation sites. Long-distance migrants are typically tree roosting species that are offered insufficient protection from extreme cold during hibernation and migrate to climates that are mild in the winter (Popa-Lisseanu and Voight 2009). Further detail on bat migration is included in Appendix A7B-1 of Volume 4.

Following an extensive review of the available literature no evidence of bat migration along the Shannon Estuary was found. Bat Conservation Ireland confirmed that there are no records of bat migration along the Shannon Estuary or in the vicinity of the Proposed Development site (personal communication Conor Kelleher). All bat surveys at the Proposed Development site found very low numbers of common bat species along the coastal habitats. Leisler's Bat is a migratory bat species. While is it noted that a small number of Leisler's bat was recorded along the coastline in June 2021, this bat was exhibited foraging behaviour (repeating same flight path for 20 minutes). No records of migratory bats were recorded during site surveys. No risk to migratory bats has been identified from the construction phase of the Proposed Development.

7B.5.3.4 Otter

Otter activity was recorded west of the Proposed Development site along the lower reaches of the Ralappane Stream. No signs of Otter were recorded in the eastern section of the site where shoreline works are proposed or on the section of the Ralappane Stream where bridge is proposed. No breeding holts were recorded during surveys.

There is no evidence of Otter usage upstream of the tidal section of the Ralappane Stream (or drainage ditches) and given its limited size this small watercourse is unlikely to be a critical foraging resource for this species. The bridging works could potentially indirectly affect existing fish stocks via impacts on water quality. However, it is noted that this stream is small with limited fish stocks and it is unlikely to be a significant source of prey for Otter. The drainage ditches do not support fish species, are unlikely to provide significant breeding habitat for Common Frog and have negligible value for Otter foraging. Construction works which will result in a minor, temporary loss of potential low quality Otter foraging habitat.

During the construction phase it is expected that there will be considerable disturbance of the site, particularly during blasting and piling works. However, the disturbance will be centred to the east of the Proposed Development site, a significant distance from the areas of Otter activity. While there may be some short-term displacement of Otter, this increased noise and disturbance during the construction phase is unlikely to significantly impact on Otter due to their ability to move away from and/ or adapt to short-term disturbance. No adverse impacts on Otter from underwater noise have been identified.

It is noted that onshore construction works will primarily take place during daytime hours which will avoid the largely nocturnal foraging habits of Otter. Jetty works will take place over 24 hours. However, it is noted that all records of Otter were over 1 km from the jetty works area.

Chapter 07A notes that impacts on fish stocks from piling vibration (Section 7.5.5) , entrainment (Section 7.5.9) or changes in water quality (Section 7.5.3, Section 7.5.4) will be negative and not significant. However, the loss of wet grassland within the Proposed Development site, where frogs are known to occur, may lead to a small loss of prey availability for Otter (Section 7B.5.3.6). While frogs use this habitat, it is limited in extent and is unlikely to support a significant population of Common Frog (only one was observed within the site boundary), and this habitat is unlikely to be a significant foraging area for Otter.

Overall, it is expected that effects on Otter will be **negative, not significant** and **long-term** at a local geographic level in the absence of mitigation.

7B.5.3.5 Other Terrestrial Mammals

The only other protected mammal species (Wildlife Act 1976 (as amended)) which was recorded within the Proposed Development site during 2018-2021 surveys was Irish Hare. While there were no confirmed field signs (or trail camera recordings) of Hedgehog observed during site surveys, this species is nocturnal, and field signs are less frequently observed than for other mammals. Given the mix of habitats onsite they are very likely to be present.

The habitats to be affected are common and there is no evidence to indicate that the Proposed Development areas are of particular value for these species in the context of the surrounding countryside. Effects on these species during construction due to loss of habitat, increased noise and disturbance and lighting are predicted to be **negative, not significant** and **temporary** at a local geographic level in the absence of mitigation.

7B.5.3.6 Amphibians

One Common frog was recorded in grassland at the west of the Proposed Development site. Small numbers of frog are likely to utilise this habitat within the Proposed Development site. In the absence of mitigation, construction works could lead to habitat loss as well as direct mortality or injury during vegetation clearance. The impact on this species during construction will be **negative, moderate** and **long-term** at a local geographic level.

7B.5.3.7 Birds

Breeding Birds

The most significant impacts on breeding birds will be direct impacts during the construction phase through habitat loss, fragmentation and modification. The majority of hedgerows, treelines, scrub areas, grasslands and disused farm buildings within the construction area of the site will be lost during the course of construction. This will result in loss of connectivity with the wider environment, as well as loss of habitat for birds. During the construction phase it is expected that there will be indirect impacts with considerable disturbance of the site, particularly during blasting and piling works. The duration of works (approximately 32 months) means that works will overlap with two breeding bird seasons. This is likely to displace foraging and breeding birds from the Proposed Development site. During construction works, noise levels will fall off quickly outside the Proposed Development site boundary even during peak construction works (Refer to Appendix A7B-3, Vol. 4). Given the mobile nature of birds, the common nature of habitats within the site and the availability of alternative foraging habitat in the immediate vicinity, the impact from disturbance will be moderate during the construction phase at a local level. There are no trees suitable for breeding Cormorant within the Proposed Development site and there are no recorded roosting sites within 10 km of the Proposed Development site (NPWS 2012c). No seabirds breed in the vicinity of the Proposed Development site and there will be no impact on breeding seabirds during the construction phase.

Several territories of breeding birds of conservation concern including the Red List species i.e. Meadow Pipit and Snipe, as well as Amber List species Skylark, House Sparrow, Linnet, Starling *Sturnus vulgaris,* Stock Dove and Willow Warbler *Phylloscopus trochilus* will be removed during the construction phase (Gilbert *et al.* 2021). While displaced birds are likely to use alternative grassland and hedgerow/ treeline habitats in the vicinity, intensification of agriculture and the loss of suitable grassland habitats is a significant threat to these species. In the absence of mitigation, potential impacts include disturbance and injury to eggs, young and nests, and long-term loss of potential nesting sites and foraging habitat. Assuming several pairs of each Red List and Amber List species are impacted, this would not be a significant impact on the local population. The impact on breeding birds of conservation concern is likely to be **negative, moderate** and **long-term** at a local level due to loss of breeding territories.

Several birds of conservation concern forage within, but breed outside the site i.e. Black-headed Gull, Herring Gull *Larus argentatus*, Little Egret, Mallard, Merlin, Quail, Sand Martin *Riparia riparia*, Shelduck, Woodcock and Swallow *Hirundo rustica.* The Annex I species White-tailed Sea Eagle could also potentially forage within subtidal habitats at the Proposed Development site. On the basis of short-term disturbance impacts during construction the impact birds of conservation concern which forage within but breed outside the Proposed Development site is likely to be **negative, not significant** and **short-term** at a local level.

Several territories of many common Green List bird species (Blackbird, Great Tit, Wren etc.) will be removed. In the absence of mitigation, potential impacts include disturbance and injury to eggs, young and nests, and long-term loss of potential nesting sites and foraging habitat. The impact on Green List bird species will be **negative, imperceptible**, and **long-term** at a local level.

Estuarine Birds

From a species conservation viewpoint, the most significant potential impact arising from the Proposed Development will be the loss of individuals of a rare or uncommon species. The following rare/ uncommon bird species were recorded during winter and summer surveys of estuarine habitats:

- Three Annex I listed species, Red-throated Diver, Great Northern Diver and Sandwich Tern, were recorded in the inshore waters bordering the Proposed Development as well as the Red List species Razorbill;
- The Annex I (and Red List) species Golden Plover was recorded over 2 km from site within intertidal mudflats. This species does not use habitats in the vicinity of the Proposed Development site and will not be impacted by construction works;
- The Annex I species Little Egret was recorded west of the Proposed Development site, foraging on the shoreline and within salt marsh habitat. Seven other Red List species i.e., Curlew, Dunlin, Grey Plover, Lapwing, Oystercatcher, Redshank and Snipe were recorded foraging on intertidal habitats to the west of Proposed Development site. It is noted that Dunlin, Grey Plover and Lapwing forage at least 1 km from the Proposed Development site and will not be impacted by construction works;
- Two of these Red List species, Curlew and Snipe, were regularly recorded feeding in agricultural/ wet grassland within the Proposed Development site during the winter months; and
- Fourteen of the 21 SCI species for the River Shannon and River Fergus Estuaries SPA were recorded within the survey area including Cormorant, Wigeon, Shelduck, Teal, Ringed Plover, Golden Plover, Grey Plover, Lapwing, Dunlin, Curlew, Redshank, Greenshank and Black-headed Gull. Further details on the impact of the Proposed Development on the SPA and SCI birds are discussed in the NIS which accompanies this application.

Potential impacts on estuarine birds during the construction phase include habitat loss due to the construction of the jetty, land-based construction noise and visual disturbance (including lighting), underwater noise and changes in prey availability due to a deterioration in water or via fish mortality during vibration from piling works. Further detail on potential impacts on estuarine birds is discussed in Appendix A7B-3 of Volume 4 and the NIS which accompanies this application.

There are no significant areas of mudflat or sandflat habitat within the Proposed Development site and no habitat which could support large numbers of wading birds or waterfowl. The intertidal habitats encountered are typical of cobbly rocky shores in Ireland being dominated by *Pelvetia canaliculata*, *Fucus* sp. and *Ascophyllum nodosum* (Chapter 07A). The intertidal waters of the proposed jetty location provides foraging habitat for small numbers of diving birds including two Annex I species i.e., Red-throated Diver and Great Northern Diver as well as Cormorant and Great Crested Grebe. Sandwich Tern, also an Annex I species could potentially forage here, although none were recorded foraging inshore. These species could potentially lose foraging habitat during construction due to seabed habitat loss following placement of the jetty piling (163m² of subtidal habitat). However, given the low numbers of birds using the Proposed Development site, the availability of alternative foraging habitat in the immediate vicinity and the foraging range of diving birds within the estuary, no significant impact from habitat loss will occur. Whilst the amount of foraging habitat available to foraging birds will be very slightly reduced during the construction of the Proposed Development, this does not represent critical foraging habitat for seabirds or shorebirds and this will not have a significant impact on the overall numbers of birds within the Shannon Estuary.

The potential for release of pollutants and increased sedimentation (plumes) from piling works to impact on water quality and subsequently on fish and invertebrate numbers is discussed in the Chapter 07A Section 7.5.4. This concluded that in the absence of mitigation, spills of hydrocarbons and chemicals can give rise to tainting of fish or, if large enough, fish kills and invertebrate kills. Given the scale and temporary nature of piling works any elevated turbidity would be limited spatially and temporally to the immediate project area and consequently there is no risk of significant effects. While there may be small overlap between wetland foraging habitats for birds and sediment deposition plumes, given the small numbers of birds foraging in this area and the localised nature of the plume, there will be no significant impact on intertidal or subtidal foraging birds.

Chapter 07A notes that impacts on fish stocks from piling vibration (Section 7.5.5), entrainment (Section 7.5.9) or changes in water quality (Section 7.5.3, Section 7.5.4) will be negative and not significant following mitigation. Impacts on marine habitats from sedimentation and/ or release of pollutants during construction are predicted to be not significant, and therefore no impacts on macro-invertebrate populations are predicted to occur. Mitigation measures to prevent release of sediments, chemical and pollutants during construction are detailed in Section 7.7. Therefore, there will be no significant impact to estuarine birds from loss of prey species during the construction phase due to piling vibration, entrainment, accidental spills, pollution or sedimentation.

As noted in Section 7B.4.6.2, very small numbers of wading birds were recorded foraging along the shoreline in the vicinity of the jetty. Noise contour modelling has been carried out for peak construction noise, i.e., when site clearance, enabling works, piling and heavy civil engineering operations related to the Terminal are expected to occur concurrently (see Appendix A7B-3 in Volume 4). The noise contour model illustrates that during construction noise levels will attenuate quickly outside the immediate piling works. Noise levels of 70 dB and above are regularly cited within the literature as being the threshold beyond which disturbance to estuarine bird species can be predicted to occur (Cutts *et al.* 2013). In the absence of mitigation, significant noise levels i.e., >70dB will be confined to a small area of subtidal waters and shoreline in the immediate vicinity of the jetty. Based on disturbance distances calculated by Cutts *et al.* (2013), visual disturbance impacts for wading birds will be confined to the shoreline within 300m of the jetty works and given the small numbers of birds foraging in this area, the impacts of visual disturbance will not be significant. Therefore, during peak construction works, where high-level noise levels and visual disturbance will occur in the vicinity of the jetty works area, a very small number of wading birds would be temporarily displaced and this would not have a significant impact on overall numbers of birds foraging within the estuary.

Diving birds, such as Red-throated Diver and Great Northern Diver, are generally regarded as highly sensitive to disturbance (Furness *et al.* 2013)). Small numbers of these species forage in the vicinity of the jetty (peak numbers of 2 Red-throated Diver and 3 Great Northern Diver within 500m of jetty). However, disturbance impacts for these species can extend up to 1.2 km (Red-throated Diver (750m ± 437m)). Using a conservative approach and extending the displacement area to 2 km, few Great Northern Diver (peak n=4) and Red-throated Diver (peak n=2) forage within this area. The worst-case scenario will be that construction works will temporarily displace up to 0.06-0.07% of the flyaway population of Great Northern Diver (5,100-6,300) and 0.0004-0.0009% of Red-throated Diver (216,000-429,000) (Burke *et al*. 2018). In a worst-case scenario, a small number of these species will be displaced during construction works. However, it should be noted that other seabirds and diving birds are relatively flexible with respect to habitat use (Garthe and Hüppop 2004; Furness and Wade 2012), and show significantly lower disturbance distances e.g. Black Guillemot (417m ± 186m), Great Crested Grebe (308m ± 248m), Cormorant (258m ± 215m), Lesser Black-backed Gull (157m ± 105mm), Herring Gull (133m ± 83m) and Black-headed Gull (84m ± 70m). Sandwich Tern as also regarded as to have low behavioural sensitivity to disturbance (Furness *et al.* 2013). While estuarine birds may temporarily avoid water in the immediate vicinity of construction, these species are likely to readily forage in other areas within the estuary during peak construction works.

Higher numbers of birds were recorded to the west/ southwest of Knockfinglas Point, over 1 km from the onshore construction area, although none in nationally or internationally important numbers. During construction the Proposed Development will be visible within the Shannon Estuary (and SPA), but the topography of the coastline largely hides works from shoreline habitats to the west of the Knockfinglas Point (Appendix A10-1 Photomontages). Noise levels west of Knockfinglas Point will be <40dB(A) during peak construction works (Appendix A7B-3). Given the distance involved, the topography of the shoreline and predicted noise levels, there will be no disturbance impacts to birds west of Knockfinglas Point during construction works.

Disturbance from artificial lighting used during the construction phases could potentially cause disruption to birds foraging within the Shannon Estuary. It is noted that artificial light may have a positive impact on waterbirds in intertidal habitats by enhancing the efficiency of nocturnal foraging (Dwyer *et al.* 2013) and may also reduce predation risk to roosting birds (cf. Gorenzel and Salmon, 1995). However, in the absence of mitigation, lighting during construction may cause displacement of birds foraging in the vicinity of the jetty works.

Although lethal effects of hard underwater noise, such as blasting and pile driving are well-known on cetaceans and fish, the effects of hard underwater sound on seabirds has been the focus of limited studies. Bird species most likely to be vulnerable to underwater sound are those that forage by diving after fish or shellfish i.e., Red-throated Diver, Great Northern Diver, Razorbill, Cormorant, Shag, Black Guillemot, Common Guillemot and Great Crested Grebe. Several gull species were recorded in the vicinity of offshore works in higher densities as well as small numbers of Sandwich Tern in offshore waters, but they feed at the surface only, and are considered the least vulnerable to underwater noise. Based on noise predictions modelled by Vysus Group (Refer to Appendix A7A-3 of Volume 4), the most significant source of noise during construction would be from piling works. Underwater noise during piling works would be significantly below the threshold for mortality or injury in diving birds (Refer to NIS for further detail). As described in Section 7B.3.5.6, small numbers of diving birds were recorded in the vicinity of the proposed offshore works area.

The presence of the large construction machinery is likely to make the waters around the jetty unattractive to seabirds and diving birds and these birds are unlikely to forage in the immediate vicinity of construction works (Garthe and Hüppop 2004; Topping and Peterson 2011; Furness and Wade 2012). Underwater noise is likely to lead to a temporary displacement of a small number of birds foraging in the vicinity of the jetty works. However, given the small numbers of birds using this area no significant impacts are predicted to occur to seabirds during construction.

The impact on SCI birds, including wading and diving birds, from disturbance/ displacement during construction as well as accidental release of pollutants will be negative, slight and short-term at an international level in the absence of mitigation.

The impact on Annex I species i.e. Red Red-throated Diver, Great Northern Diver and Sandwich Tern from disturbance/ displacement during construction as well as accidental release of pollutants will be negative, slight and short-term at a county level in the absence of mitigation.

The impact on other estuarine species from disturbance/ displacement during construction as well as accidental release of pollutants will be **negative, slight** and **short-term** at a local level in the absence of mitigation.

7B.5.3.8 Fish

Stickleback and European Eel were recorded within the Ralappane Stream in 2021, and Stone Loach, was also recorded in 2006. There is no evidence to indicate that the stream has significant spawning habitat or is generally of high value for fish and it is of insufficient size to be of value for salmonids or lamprey species.

The removal of hedgerow/ treeline vegetation along the Ralappane Stream may reduce cover and foraging opportunities for fish. During construction, potential impacts on water quality could arise from mobilised suspended solids as well as spillage of fuels, lubricants, hydraulic fluids and cement from construction plant. In the absence of appropriate mitigation measures, site stripping, earthworks and material stockpiles associated with the construction could potentially give rise to a high degree of solids washout which could discharge into the local drainage network and the Ralappane Stream. Bank destabilisation during bridge construction could lead to increased risk of bank collapse and silt generation. Silt generated during the construction phase could potentially interfere with spawning of Stone Loach and Stickleback smothering spawning gravels and deposited eggs and newly hatched larvae. If sufficient quantities of silt enter local watercourses it could potentially settle on the bottom, smothering benthic flora, ultimately affecting faunal feeding and breeding sites.

It is noted that piling works are confined to marine habitats and any impacts to fish from underwater noise/ vibration associated with piling works are addressed in Chapter 07A – Marine Biodiversity. This concluded that since the distance within which fish mortalities and/ or mortal injuries could occur is relatively small, the overall fish population could not be impacted. Blasting works are confined to the east of the site and given the distance from the Ralappane Stream, no impacts on fish within the stream from vibration will occur. Potential effects of water quality are discussed in Chapter 06 – Water. The impact of construction works on the fish in the absence of mitigation will be **negative, not significant** and **short-term** at a local geographic level.

7B.5.3.9 Aquatic Invertebrates

If sufficient quantities of silt enter the Ralappane Stream, this could potentially settle on the bottom, smothering aquatic invertebrates. The Proposed Development site is of Local importance (Lower value) for aquatic invertebrates. Impacts during the construction phase will be **not significant** and **short-term** at a local geographic level.

7B.5.3.10 Spread of Invasive Species

As noted in Section 7B.4.9, no invasive species were recorded within the Proposed Development site. All excavated material will be used onsite and no import of soil is expected. Therefore, no impacts from the spread of invasive species during the construction phase is expected to occur.

7B.5.3.11 Air Quality

The primary concern in relation to air quality arises from the possible deposition of dust from construction operations on vegetation, within watercourses or protected habitats i.e. Lower River Shannon cSAC/ River Shannon, River Fergus Estuaries SPA and Ballylongford Bay pNHA. It is noted that the majority of the SAC/

SPA within 50 m of the Proposed Development site boundary is tidal estuary and should dust deposit beyond the site boundary, it is likely to be washed away naturally. Construction works will be located a significant distance from the Ballylongford Bay pNHA and no impacts are predicted to occur to habitats in the pNHA. No rare species or habitat which are sensitive to air quality impacts are located within the Proposed Development site. In the absence of mitigation, the impact from dust deposition on terrestrial, freshwater and estuarine habitat will be **not significant** and **short-term** at a local geographic scale.

7B.5.4 Operation Phase

7B.5.4.1 Proposed Development Features and Types of Impact

The Proposed Development would be operational 24 hours a day, seven days a week. In the absence of mitigation measures, significant operation phase impacts could include light spill onto retained vegetation outside the Proposed Development site boundary (it is assumed that all habitats within the site would be removed) used for feeding or breeding by protected species. Lighting of water around the jetty dock will also be required to detect spillage and possibly unauthorized craft. Disturbance to protected species could occur from noise or vibration associated with vehicles, shipping and human use of the operational site. The presence of the jetty within the estuary could lead to collision mortality effects to birds and bats. The new jetty may also change the habitats and micro-habitats present in the immediate area.

It is noted that an application to connect to the national electrical transmission network was submitted to EirGrid in September 2020 under the Enduring Connection Policy 2 (ECP2) process. As part of this grid connection application, Shannon LNG Limited made a specific connection method request for underground cabling, in lieu of overhead lines. Given the expressed preference for underground cabling by the Applicant, and the resistance of the Applicant to overhead powerlines, no assessment of collision risk to birds from overhead powerlines is required.

The operational impacts would affect ecological receptors over many decades subject, to the lifetime of the Proposed Development. The Proposed Development is expected to have a design life of 50 years, but this could be extended by maintenance, equipment replacement and upgrades or by the transition of the site to use hydrogen capability. This section, which presents potential operation phase impacts for the Proposed Development alone, should be read in conjunction with summary tables of potential impacts (Table 7B-15).

7B.5.4.2 Terrestrial and Freshwater Habitats

A detailed Flood Risk Assessment (FRA) concluded that with the exception of crossings of the watercourses for the access road, there is no development proposed within either Flood Zone 'A' or Flood Zone 'B' and therefore the Proposed Development will have a **negligible** impact on the existing flood regime within and around the site (Refer to Appendix A6-3 of Volume 4).

The proposed crossing/ culverting of the stream/ drainage ditches within the Proposed Development have been designed to have a minimal impact on the existing hydraulic regime within the Proposed Development site and downstream in the Ralappane Stream.

Combined stormwater flows and treated sanitary effluent and process effluent from the Proposed Development will be discharged directly to the Shannon Estuary below low tide level. There will be no direct discharges to surface water and no impact on freshwater habitats during the operational phase.

7B.5.4.3 Badger

The removal of subsidiary/ outlier setts could potentially have a long-term impact on social structure on Badgers in the vicinity of the Proposed Development site, even though both main setts will continue to exist outside the site boundary. However, Badgers are expected to continue using semi-natural habitats close to the site boundary. Increased activity and human presence, noise, fencing and additional lighting may disturb or displace Badger from retained foraging habitats once the Proposed Development site is operational. Badgers are nocturnal and as activity and noise levels will generally be lower at night, Potential impacts on Badgers during operation are predicted to be **negative, significant** and **long-term** at a local level in the absence of mitigation.

7B.5.4.4 Bats

Increased activity and human presence, noise and artificial lighting may impact and disturb or displace bats during the operational phase of the Proposed Development, including light spill onto previously unlit boundary habitats and the Shannon Estuary.

Lighting around the coastline near the jetty and at the Power Plant during the operational phase means that bat foraging in this area is likely be reduced or absent. Lighting deters some bat species, in particular Myotis species, from foraging. No Myotis species were recorded within the Proposed Development site or along the coastline to the north of the site. Pipistrelle species appear to be more tolerant to light and disturbance (Speakman 1991; Stones *et al.* 2009; Haffner 1986). It is also noted that Leisler's bats will opportunistically feed on such insect gatherings in lit areas (Bat Conservation Ireland 2010).

While the LNG Terminal will be manned for round-the-clock service for operations and maintenance purposes, planned maintenance activities will predominantly be conducted during daytime. Lighting levels will meet national and international engineering standards as a minimum, including a lighted area around the dock to detect spillage and unauthorised craft. However, given the small numbers of bats which forage along the exposed coastline, the impacts on local bat populations during operation will not be significant. Bats are likely to continue to forage in dark areas within the Proposed Development site although less frequently than previously.

Operational lighting and activity will lead to the loss of low value foraging habitats for bats. Impacts to bats during operation are predicted to be **negative, slight** and **long-term** at a local level in the absence of mitigation.

7B.5.4.5 Otter

Increased activity and human presence, noise and artificial lighting may impact and disturb or displace Otter during the operational phase of the Proposed Development, including light spill onto previously unlit boundary habitats and the Shannon Estuary. Badly designed lighting could displace Otter from nearby habitats and create a barrier to connectively in the wider area. It is noted that the jetty trestle will be elevated above the foreshore to allow access for walkers and wildlife and there will be no physical barrier to Otter movement along the shoreline.

Outdoor lighting at the Proposed Development site will be designed to minimise the potential for light spill. While the LNG Terminal will be manned round-the-clock for operations and maintenance purposes, planned maintenance activities will predominantly be conducted during daytime. Lighting levels will meet national and international engineering standards as a minimum, including a lighted area around the dock to detect spillage and unauthorised craft. It is noted that while Otter activity is centred to the west of the Proposed Development site away from the Proposed Development site buildings and jetty, given the importance of the Shannon Estuary for Otter, it cannot be ruled out that Otter forage in the vicinity of the proposed jetty location. If Otter were excluded from this area during operation due to disturbance and/ or lighting, this could potentially impact on Otter foraging range and numbers within the Shannon Estuary.

Otter are largely nocturnal and can habituate to human disturbance (Chanin, 2003). It is known that Otters use man-made structures for holting in addition to excavations (Natural England, 2006). For example, these would include the underneath of bridges or jetties, where secluded areas are created. Such areas can be prominent resting areas and thus fall under the 'couch' category. There are several examples of Otter usage around busy industrial structures in Ireland including at the IOWR facility in Corkbeg Island where Otter regularly forage and rest in the vicinity of the oil tanker docks (Macklin 2018) and at the jetty in the Ringaskiddy Port in Cork (RPS 2015). Reid *et al*. (2013) also found that Otter regular use bridges as sprainting sites. Manmade structures in nearshore areas e.g., ports, docks, jetties, canals, coastal protection can create additional habitat for a range of marine species including fish, invertebrates and algae. Brandl *et al.* (2017) found that artificial marine habitats, including dock pilings and jetties, can harbour diverse, regionally characteristic assemblages of vertebrates that follow macroecological patterns that are well documented for natural habitats. Toft *et al.* (2004) found significantly higher density of juvenile salmonid species around overwater structures in comparison to the surrounding natural habitat. The location of the new jetty along the Shannon Estuary is likely to create additional couch and sprainting sites for Otter, as well as additional foraging habitat during the operational phase.

Given Otter's ability to habituate to disturbance, their known usage of similar industrial sites around Ireland, the operational lighting design for the Proposed Development site, and the largely nocturnal habits of Otter, impacts to Otter during operation are predicted to be negative, not significant and long-term at a local level in the absence of mitigation.

7B.5.4.6 Other Mammals

Increased activity and human presence, noise, fencing and additional lighting may disturb or displace other mammal species such as Hedgehog and Irish Hare from favoured foraging habitats during the operational phases of the Proposed Development. However, given the availability of similar habitat in the vicinity and the mobile nature of these species, potential impacts on other mammals during operation are predicted to be **negative, slight** and **long-term** at a local level.

7B.5.4.7 Amphibians

Wet grassland habitat, where Common Frog has been recorded, will absent from the Proposed Development site during operation. In the absence of mitigation there will be no suitable habitat for Common Frog within the Proposed Development site. However, it is noted that wet grassland habitat is common outside the Proposed Development site boundary and frogs are likely to use alternative habitat in the absence of mitigation. The impact on this species will be **negative, slight** and **long-term** at a local geographic level.

7B.5.4.8 Birds

Terrestrial Birds

Following habitat removal during construction a number of Red List species i.e. Meadow Pipit and Snipe, as well as Amber List species Skylark, House Sparrow, Linnet, Starling, Stock Dove and Willow Warbler will be displaced and are no longer likely to use the Proposed Development site. This will also be the case for a number of common bird species, as hedgerow and grassland habitats will be absent from the majority of the site during operation. Birds of conservation concern which nest outside the site, but forage within the site e.g., Merlin and Sand Martin and occasionally Quail and Woodcock are unlikely to forage at the site due to the absence of semi-natural habitats. However, given the availability of similar habitat in the immediate vicinity, birds are likely to readily breed and/ or forage in adjoining habitats.

Visible human presence in previously undisturbed areas and increased noise and lighting may prevent birds from nesting or foraging in retained habitats within or adjacent to the Proposed Development site. In areas where nesting habitat is retained within the Proposed Development site, operational lighting may impact on breeding birds. Night-length can be very important for birds, as it can determine the onset of the breeding season and migration. Artificial lighting can induce hormonal, physiological and behavioural changes that initiate breeding in birds (Lofts and Merton 1968). Timing of singing and sleep are also strongly affected by light pollution (Kempenaers *et al.,* 2010; Da Silva *et al*. 2014; Raap *et al*. 2015), and such changes are suggested to have physiological consequences (Dominoni *et al.* 2016). The Power Plant will have area lighting installed on a down angle to cover the facility and the car parking areas while minimizing impact to surrounding neighbours. The height of the proposed light columns has been kept to a minimum throughout the Proposed Development site and light columns will be fitted with focused luminaires to avoid glare, sky glow and light spill. This will minimise any physiological impacts on birds using adjoining habitats.

The impact on birds of conservation concern which breed within the Proposed Development site is likely to be negative, moderate and long-term at a local level due to disturbance and/ or displacement of bird species including Meadow Pipit, Stock Dove, House Sparrow, Linnet, Skylark, Starling, Swallow, Willow Warbler.

The impact on birds of conservation concern which forage within but breed outside the Proposed Development site is likely to be negative, not significant and long-term at a local level due disturbance and/ or displacement i.e., Black-headed Gull, Herring Gull, Mallard, Sand Martin, Shelduck, Merlin, Quail, White-tailed Sea Eagle and Woodcock. It is noted that gull and tern species could potentially use the jetty for roosting and nesting during the operational phase, as they do in a number of ports throughout Ireland (RPS 2015, RPS 2017).

The impact on common bird species is likely to be **negative, slight** and **long-term** at a local level due disturbance and/ or displacement.

Estuarine Birds

Potential impacts on estuarine birds during the operational phase include disturbance due to increased land-based visual, lighting and noise disturbance (from human activity and shipping activity), increased underwater noise, physical disturbance and collision injury from ship traffic and a reduction in of prey availability due to changes in water quality resulting from wastewater discharges or entrainment/ impingement by the cooling system. The presence of the jetty could also potentially create a collision risk for bird species.

As noted in Section 7B.3.5.6, very small numbers of birds were recorded foraging along the shoreline and intertidal habitats in the vicinity of the proposed jetty. Noise contour modelling was carried out for two operational scenarios where peak noise levels are predicted (Appendix A7B-3 of Volume 4). These models illustrate that, noise levels will attenuate quickly outside the immediate Power Plant and jetty locations. Noise levels in the absence of mitigation are predicted to be below 65dB LAeq along the shoreline and outside the immediate FRSU location. This represents a moderate level of noise disturbance to which birds are likely to become habituated to over time (Cutts *et al*. 2013). Wading birds and waterfowl foraging along the shoreline are likely to habituate to the regular nature of the noise and disturbance associated with the jetty and shipping activity and continue to forage here, albeit potentially in smaller numbers than previously. In the absence of mitigation, outside subtidal/ intertidal habitats in the immediate vicinity of the Proposed Development site, noise levels within the estuary will be below 55dB(A) throughout the operational phase and will not cause significant disturbance impacts to estuarine birds.

During operation the Proposed Development will be visible within the Shannon Estuary (and SPA), but the topography of the coastline largely hides works from shoreline habitats to the west of the Knockfinglas Point, where larger bird numbers have been recorded. Along the shoreline in the immediate vicinity of the jetty, visual disturbance from shipping traffic and human activity has the potential to displace wading birds, waterfowl and seabirds. Species-specific disturbance responses to ship traffic vary considerably. Divers for example are generally regarded as highly sensitive to disturbance, while gulls and terns are the most tolerant. As described in Section 7B.5.3.7, of the species known to occur near the Proposed Development site, diving species such as Red-throated Diver and Great Northern Diver are the most sensitive to disturbance. While there is some evidence that Great Northern Diver may be able to habituate to shipping disturbance (Gittings *et al.* 2015), it is likely that these species will largely avoid the area during operational activity. However, both species occurred in very low numbers in the vicinity of the jetty. Other bird species which were recorded in the vicinity of the Proposed Development site (Black-headed Gull, Greenshank Wigeon, Curlew, Oystercatcher, Cormorant, Great Crested Grebe) are considerably more tolerant to disturbance and have been shown to habituate to visual (and noise) disturbance (Garthe and Hüppop 2004; Furness and Wade 2012; Cutts *et al*. (2013); Fliessbach *et al.* 2019). As discussed in Section 7B.5.4.5, the jetty structure may increase the availability of prey for piscivorous bird species as well as roosting sites for gulls. Seabirds are known to effectively forage and breed in the vicinity of busy ports throughout Ireland (RPS, 2012, 2014, 2017). While Great Northern Diver and Red-throated Diver may be displaced in small numbers during operation, other species are likely to continue to use the site throughout operational activities.

As discussed in Section 7B.5.3.7, bird species most likely to be vulnerable to underwater sound are those that forage by diving after fish or shellfish. Based on noise predictions modelled by Vysus Group, all activity during operation will be significantly below noise thresholds for mortality or injury in diving birds (Refer to Appendix A7A-3 of Volume 4). This assessment also determined that the FSRU alone, or the offloading scenario will only exceed the ambient noise within 0.5-1 km. As described in Section 7B.3.5.6, small numbers of diving birds were recorded within 1 km of the proposed offshore works area. Therefore, while underwater noise is likely to lead to a temporary displacement of a small number of birds foraging in the vicinity of the jetty works, given the small numbers of birds using this area no significant impacts are predicted to occur to seabirds during operation.

Disturbance from artificial lighting used during the operational phases could potentially cause disruption to estuarine birds. Lighting levels will meet national and international engineering standards as a minimum, including a lighted area around the dock to detect spillage and unauthorised craft. The Power Plant will have area lighting installed on a down angle to cover the facility and the car parking areas while minimizing impact to surrounding areas. The height of the proposed light columns has been kept to a minimum throughout the Proposed Development site, and light temperatures reviewed to minimise the content of blue light. L light columns will be fitted with focused luminaires to avoid glare, sky glow and light spill to the estuary. Modelling of light spillage from the jetty and Power Plant show that outside the immediate lit areas of the jetty, light spillage onto the estuary will be minimal (Figure F2-7 of Volume 3). It is noted that artificial light may have a positive impact on waterbirds in intertidal habitats by enhancing the efficiency of nocturnal foraging (Dwyer *et al.* 2013) and may also reduce predation risk to roosting birds (cf. Gorenzel and Salmon, 1995). While there may be short-term impacts from operational lighting, in the medium to long term birds are likely to habituate to additional lighting and foraging rates will return to pre-construction levels. Therefore, while lighting in the immediate vicinity of the jetty will increase, this will not have a significant on bird numbers or distribution of birds within the Shannon Estuary.

While entrainment has the potential to impact on small numbers of juvenile fish, no significant impact on fish numbers is predicted to occur and therefore there will be no impact on prey availably for foraging birds. Wastewater discharges will not impact on water quality or invertebrate and fish abundance in the estuary (Chapter 07B, Section 7.5.10). The Proposed Development will no impact on prey availability for estuarine birds during the operational phase.

Collision risk associated with built structures is highest amongst ‘heavy wing loading’ species such as geese and swans. It is also increased where birds undertake daily migrations during the hours of dusk and dawn to foraging and roosting locations. Within the Shannon Estuary, species most at risk are Whooper Swan and Light-bellied Brent Goose, and to a lesser extent Cormorant. The risk of diurnal collision for other bird species is not considered to be significant due to the small size and/ or agile flight ability of these species. It is also noted that the lattice structure of the jetty means that smaller birds can also fly beneath the structure.

The proposed jetty will be 364 m and +9 m high. It is noted that similar structures along the southern shores of the Shannon Estuary at Tarbert and Foynes do not appear to pose any current collision risk to birds. Observations on overflying birds at the proposed jetty location as well as to the east and west of this area confirmed that there were no commuting routes for heavy wing loading birds along this stretch of coastline or within 1 km east or west of the site. On one occasion, two Whooper Swans were observed flying close to the jetty area (Point B), 100-250 m offshore at a height of between 25-50 m. However, this flight height is significantly above the height of the jetty platform (9m OD). Cormorants are likely to fly in the vicinity of the proposed jetty during foraging and commuting flights. Blew *et al.* (2008) in a study of a Swedish windfarm found that resident cormorants will effectively avoid collision with wind turbines. Furthermore, cormorants are known to effectively forage and breed in the vicinity of busy ports throughout Ireland (RPS, 2012, 2014, 2017) and their risk of collision with the jetty structure is not significant.

Lighting of structures at night has been shown to increase the risk of bird collision and collision rates have been found to increase with increased lighting (Evans Ogden 2002, Zink and Eckles 2010). Migratory bird species are at an increased risk of collision at night, with collisions occurring during nocturnal migration, particularly in areas with strong levels of artificial light. Migrating birds can be diverted from their flight path by excessive light and collide with lit structures. (Winger *et al.* 2019; Arnold and Zink 2011). While the linear nature of the Shannon Estuary is likely to provide a flight path for nocturnal migrants, bird migration altitudes are likely to be between 2,000-6,000m (Lindstrom *et al.* 2021). As can be seen from Appendix A10-1 Photomontages (see Volume 4), the lighting of the jetty along the southern shore of the Shannon Estuary is not excessive. The levels of light of the Proposed Development within the Shannon Estuary means the risk of the jetty lighting at night diverting nocturnal migrants is not significant and no significant impact on nocturnal migrating birds is predicted to occur.

While bird collision is a well-documented phenomenon, it should be noted that following an extensive review of the available literature no studies were found which recorded bird collision with jetties, during day or night (piers, wharfs, marinas etc). Given the low risk of collision with jetty structures, the lattice design of the jetty, the location of the jetty outside commuting routes for heavy wing loading birds and the lighting design measures at the site, no significant risk of collision has been identified and no impact on birds due to collision is predicted to occur.

As noted in Section 7B.5.4.5, manmade structures in nearshore areas e.g., ports, docks, jetties, canals, coastal protection can create additional habitat for a range of marine species including fish, invertebrates and algae. The location of the new jetty along the Shannon Estuary is likely to create additional roosting sites for gulls, terns and Cormorant and as well as increased foraging opportunities for fish eating species such as Cormorant.

The impact on SCI birds, including wading and diving birds, from operational activities is predicted to be negative, slight and long-term at an international level in the absence of mitigation.

The impact on Annex I species i.e., Red-throated Diver, Great Northern Diver and Sandwich Tern from operational activities is predicted to be **negative, slight** and **long-term** at a county level in the absence of mitigation.

The impact on other estuarine species during operational is predicted to be **negative, slight** and **long-term** at a local level in the absence of mitigation.

7B.5.4.9 Fish

Combined stormwater flows and treated sanitary effluent and process effluent from the Proposed Development will be discharged directly to the Shannon Estuary below low tide level. There will be no direct discharges to surface water during the operational phase and no impact on freshwater habitats. There will be no significant impacts on fish during the operational phase.

7B.5.4.10 Aquatic Invertebrates

Combined stormwater flows and treated sanitary effluent and process effluent from the Proposed Development will be discharged directly to the Shannon Estuary below low tide level. There will be no direct discharges to surface water features during the operational phase and no impact on freshwater habitats. There will be no significant impacts on freshwater aquatic invertebrates during the operational phase.

7B.5.4.11 Other Species

No significant impacts on other species during the operational phase have been identified.

7B.5.4.12 Air Quality

The operation of the Proposed Development will include a number of sources with emissions to air associated with combustion plant, to generate heat and power for onsite activity. Emissions to air associated with such plant vary with the type of plant and its purpose, the thermal capacity of the plant and the fuel used to enable combustion.

Following UK EA guidance, pollutants and averaging periods at human health and nature conservation receptors reported were considered be not significant (Refer to Chapter 08 – Air Quality, Section 8.6.1). For the normal operational scenario, impacts at the closest sensitive receptors are not to the extent that operation of the Proposed Development would cause a risk of an exceedance of an Air Quality Standard or Environmental Assessment Level, nor will it increase total pollutant concentrations to the extent that it would constrain future development of the area. No significant impacts from operational air emissions are predicted to occur.

7B.5.4.13 Climate Change and Biodiversity

The EU Commission guidance document on integrating climate change and biodiversity into environmental impact assessment (EU Commission, 2013) aims to improve the way in which climate change and biodiversity are integrated into Environmental Impact Assessment.

An assessment of the impact of the Proposed Development on climate change is included in Chapter 15 – Climate. This assessment looked at the influence of climate change to the Project-related impacts to neighbouring sensitive receptors. Technical specialists used the climate change projections to examine if there were any changes to either the likelihood or severity of impact to their receptors, however no combined impacts were identified. This assessment also looked at the influence of climate change to the Proposed Development itself, particularly its physical and functional aspects. Any identified vulnerabilities were found to be sufficiently mitigated against by aspects of the design, particularly aspects of flood design such as drainage systems and building/ infrastructure heights that take sea level rise into account. It is noted that biodiversity enhancement planting will be provided within the Proposed Development site, which will also minimise any impact of the Proposed Development on climate change and biodiversity.

In the absence of any significant impacts of the Proposed Development on sensitive neighbouring receptors no significant interactions between the effects on biodiversity resulting from this development and climate change have been identified.

7B.5.4.14 Accidents

The likelihood of large-scale oil and LNG spills due to accident during operations and vessel collision at the Proposed Development is regarded as remote, while the risk of accidental small spillages of pollutants (including fuels, hydrocarbons, oils etc.) is considered to be low.

Specifically, the assessment of likelihood of release events from the Proposed Development are set out in the following:

- Marine Navigation Risk Assessment, which was prepared by the Shannon Foynes Port Company (see Appendix A2-2, Vol. 4);
- Quantitative Risk Assessment (QRA) and associated Major Accidents to the Environment (MATTE) submitted to the HSA as part of the planning application (see Appendix A2-5, Vol. 4);
- EIAR for the Proposed Development submitted ABP as part of the planning application; and
- OCEMP (see provided in Appendix A2-4, Vol. 4).

Additionally, the operation of the Proposed Development will be controlled and regulated by the following bodies:

- Environmental Protection Agency;
- Commission for Regulation of Utilities;
- Health and Safety Authority;
- KCC; and
- The Shannon Foynes Port Company.

However, in consultation with Shannon Foynes Port Company and the Shannon Estuary Anti-Pollution Team (SEAPT), Shannon LNG has prepared an Oil and Hazardous and Noxious Substances (HNS) Spill Plan Development Framework (see Appendix A2-6, Vol. 4). This document describes the graduated and tiered response process to fulfil these obligations and to provide a robust and coordinated response to release incidents in the unlikely event they should occur. The developed plans will follow international best practice guidelines of the International Maritime Organization (IMO), The Society of International Gas Tanker and Terminal Operators (SIGTTO), and International Petroleum Industry Environmental Conservation Association (IPIECA) while taking into account relevant Irish legislative and regulatory approval requirements. In particular the plans will follow the requirements made within the National Maritime Contingency Plan Oil and HNS Spills 2019 (NCP) and the National Framework for the Management of Major Emergencies. The plans will be developed to cover both In-Land (onshore) and Marine based releases and shall cover the Construction and Operational Phases of the Proposed Project. Key objectives and the format of the Oil and HNS Spill Plan Oil and how the plan relates to the National Contingency Plan (NCP) are described in Section 7.6.5.

The development has (provisional to project go-ahead) been accepted as member of the Shannon Estuary Anti-Pollution Team (SEAPT). Membership of SEAPT will enable the development to interface directly with the approved Shannon Estuary Oil/HNS Plan and access additional response equipment to augment that held within the terminal (refer to Chapter 07A Section 7.6.5 for further details)

LNG is stored on the FSRU and LNGC site as a liquefied gas and when released to its surroundings it vaporises rapidly to form natural gas, leaving no residue. LNG (methane and other light hydrocarbons) is classed under the COMAH Regulations as 'Liquefied Flammable Gasses'. As LNG and natural gas are not toxic to the environment, hazards are associated with exposure to low temperatures from an LNG release (cryogenic burns), or fires if a release of LNG or natural gas is ignited. Environmental receptors at risk are flora and fauna.

The MATTE assessment determined that thermal radiation from jet fires and flash fires will not affect the NHA and onshore cSAC to the west of the Site. LNG Pool fires on the sea surface could lead to thermal radiation effects at the NHA and onshore cSAC to the west of the Site. The frequency of these events have been calculated within the Safeti QRA Model and are at most 3.7 x 10-6 per year (once in 270,270 years) at the closest point of the onshore cSAC. This frequency is considered to be very low. It should be noted that the 5 kw/m^2 thermal radiation intensity is below that which would lead to a fire and therefore recovery from this type of event would be less than three years. Modelling indicates that the jet and pool fire contours of 5 kW/m^2 reach areas of the estuary that forms part of the cSAC and SPA close to the jetty/terminal. While harm to birds present on the estuary surface close to the Proposed Development may be possible in the event of a fire, bird surveys have identified that there are no significant populations of bird species in the vicinity of the Proposed Development site (see Section 7.3.6.2). Based on the definition of a MATTE jet fires and LNG pool fires are not considered credible MATTE events. All of the MATTE events identified are considered to be low frequency and consequently low risk.

Based on the assessments described above, the risk of major accident is predicted to be very low and therefore does not pose a significant risk to habitats or species within or in the vicinity of the Proposed Development site.

7B.5.5 Decommissioning

As described in Chapter 02 – Project Description, the Proposed Development is expected to have a design life of 50 years, but this could be extended by maintenance, equipment replacement and upgrades or by the transition of the site to use hydrogen capability (which would be subject to a future planning application). It is expected that it would be a condition of the industrial emissions licence for the Proposed Development that a closure and residuals management plan, including a detailed decommissioning plan, be submitted to the EPA for their approval.

Decommissioning activities will include, as a minimum:

- All wastes at the facility at time of closure will be collected and recycled or disposed of by an authorised waste contractor, as appropriate;
- Utilities will be drained of all potential pollutants such as lubricating oils or sealed to prevent leakage if being moved offsite or recused elsewhere;
- All raw materials, oils, fuels, etc. onsite at the time of closure will be returned to the supplier, or collected and recycled or disposed of by an authorised waste contractor, as appropriate,
- All buildings and equipment will be decontaminated, decommissioned and demolished in accordance with a phased demolition plan, and either sold for reuse or recycled, or disposed of by an authorised waste contractor, as appropriate. In general, specialist equipment, pipelines and storage tanks will be sold for reuse, where possible, or disposed of offsite;
- Roadways to be broken up and removed and security fences dismantled;
- All hazardous and non-hazardous process substances to be removed;
- All roads and hardstanding areas to be removed and recycled or disposed of by an authorised waste contractor, as appropriate;
- Landscaped will be reinstated in accordance with a landscape reinstatement plan; and
- On completion of safe decommissioning of equipment, the potable water, fire water and electrical power supplies could be disconnected, and removed or abandoned in place.

When operations have ceased, and assuming confirmation from the monitoring programme that all emissions have ceased, it is expected that there would be no requirement for long-term aftercare management at the Proposed Development site.

During decommissioning, measures would be undertaken by the Applicant to ensure that there would be no significant, negative environmental effects during the decommissioning phase. The decommissioning plan would incorporate measures to satisfy all regulatory requirements and to achieve targeted environmental goals. The decommissioning measures would have to be implemented to the satisfaction of the EPA. As the terrestrial site of the Proposed Development is generally of relatively low habitat and species value, the impact of decommissioning will be **temporary** and **not significant** following the implementation of standard mitigation and monitoring measures.

7B.6 Cumulative Impacts

The cumulative impacts of the Proposed Development and nearby consented projects in the vicinity of the Proposed Development are discussed below. A planning search of granted and pending planning applications made within the vicinity of the Proposed Development site is presented in Chapter 04 – Energy and Planning Policy.

7B.6.1 Summary of Schemes Considered in Cumulative Impact Assessment

7B.6.1.1 LNG Pipeline

Permission was granted in 2009 for a pipeline to connect the Proposed Development to the existing national gas network near Foynes, Co. Limerick. The application was accompanied by an EIAR. No significant residual effects were identified to hydrogeology and surface water in the EIAR for the LNG pipeline.

Potential cumulative impacts for terrestrial fauna could occur in the vicinity of the Proposed Development site, if the adjacent pipeline route contained rare habitats or valuable habitats for rare species. Habitats recorded within this section of the pipeline route were common. No signs of terrestrial mammals were recorded within 1 km of the Proposed Development site. A small number of the Red List species Meadow Pipit were recorded within this area, however given the availability of alternative grassland habitat in the immediate vicinity, no in-combination impact on this species is predicted to occur.

Given the location of these projects (in areas of relatively low habitat and species value), together with the implementation of good practice standard construction environmental measures and the OCEMP for the Proposed Development as detailed, no significant cumulative effects on biodiversity will result.

Data Centre Campus

A Data Centre Campus is to be constructed to the west of the Proposed Development. This will be subject to its own EIAR and planning application.

220 kV and Medium Voltage (10/ 20 kV) Power Transmission Network

An application to connect to the national electrical transmission network via a 220 kV high voltage connection was submitted to EirGrid in September 2020. An offer has yet to be received. It is expected that the high voltage connection will run 5 km east under the L1010 road to the Electricity Supply Board Networks (ESBN)/ EirGrid Kilpaddoge 220 kV substation.

The LNG Terminal may need to be operational before the Power Plant and/ or 220 kV high voltage grid connection are completed or operational. Therefore, the LNG Terminal design will also require an onsite substation and a separate medium voltage (10/ 20 kV) connection, from the existing ESBN/ EirGrid Kilpaddoge substation. This will be used as a back-up electricity system when the Power Plant is undergoing maintenance.

The medium voltage (10/ 20 kV) and 220 kV power connections will be constructed in parallel with the Proposed Development but will be subject to separate planning design and planning applications.

7B.6.1.2 Construction Impact

If works associated with these three schemes (described above) in close proximity to the Proposed Development site are concurrent with the bulk excavation works at the Proposed Development, there is potential for cumulative impacts and effects on terrestrial ecology features. Should this situation arise, construction activities will be planned and phased, in consultation with the construction management team for the Shannon Technology and Energy Park.

The implementation of best practice standard construction environmental measures and the OCEMP for the Proposed Development as detailed, no significant cumulative effects on biodiversity will result.

If works are concurrent with the bulk excavation works on the Proposed Development site, there is potential for cumulative disturbance effects, as the sites are located close to each other. Should this situation arise, construction activities will be planned and phased, in consultation with the construction management team for the scheme.

Discharges from both this project and the Proposed Development are governed by strict limits to ensure compliance with quality standards. No long-term cumulative impact on water quality will occur.

Given the location of these projects (in areas of relatively low habitat and species value), together with the implementation of good practice standard construction environmental measures and the OCEMP for the Proposed Development as detailed, no significant cumulative effects on biodiversity will result.

7B.6.1.3 Operational Impacts

Potential impacts from consented development elsewhere, combined with the potential impacts of the Proposed Development, could result in increased disturbance to sensitive fauna.

Potential effects to terrestrial biodiversity from the Proposed Development range from significant to negligible and mitigation measures proposed to manage and control potential impacts during operation would further reduce the magnitude and significance of effects.

Potential impacts primarily relate to disturbance impacts from increase noise, activity and lighting at the site. The site is located in a largely rural area with little or no disturbance. Therefore, the cumulative operational effect of the Proposed Development and other consented or potential developments on terrestrial biodiversity is considered to be **imperceptible**.

7B.7 Mitigation and Monitoring Measures

7B.7.1 Construction

The mitigation and monitoring measures have been drawn up in line with current best practice and include an avoidance of sensitive habitats at the design stage and mitigation measures will function effectively in preventing significant ecological impacts. The following mitigation and monitoring measures will be implemented.

7B.7.1.1 General Mitigation and Monitoring Measures

An OCEMP has been prepared (included in Appendix A2-4 of Volume 4). The OCEMP contains the construction mitigation and monitoring measures, which are set out in this EIAR and the NIS. This will have particular emphasis on the protection of habitats and species of the cSAC, SPA and pNHA which adjoin the site.

These sites (cSAC, SPA and pNHA) are by definition internationally/ nationally important for their habitats and/ or the species they support. It is essential that all construction staff, including all sub-contracted workers, be notified of the boundaries of these Natura 2000 sites and be made aware that no construction waste of any kind (rubble, soil, etc.) is to be deposited in these protected areas and that care must be taken with liquids or other materials to avoid spillage.

Mitigation and monitoring measures (of relevance in respect of any potential ecological effects) will be implemented throughout the project, including the preparation and implementation of detailed method statements. The works will incorporate the relevant elements of the guidelines outlined below:

- *Control of water pollution from construction sites. Guidance for consultants and contractors (C532). CIRIA.* Masters-Williams et al (2001); and
- *Control of water pollution from linear construction projects. Technical guidance (C648). CIRIA.* Murnane, *et al.* (2006).

All personnel involved with the Proposed Development will receive an onsite induction relating to construction and operations and the environmentally sensitive nature of European sites and to re-emphasise the precautions that are required as well as the precautionary measures to be implemented. Site managers, foremen and workforce, including all subcontractors, will be suitably trained in pollution risks and preventative measures.

All staff and subcontractors have the responsibility to:

- Understand the importance of avoiding pollution onsite, including noise and dust, and how to respond in the event of an incident to avoid or limit environmental impact;
- Respond in the event of an incident to avoid or limit environmental impact;
- Report all incidents immediately to the project manager and the Environmental (Ecological) Clerk of Works (ECoW);
- Monitor the workplace for potential environmental risks and alert the site manager if any are observed; and

- Co-operate as required, with site inspections.

As part of the assessment of the required construction mitigation, best practice construction measures which will be implemented for the Proposed Development were considered. A summary of the measures relevant to hydrology are provided as follows and are in accordance with Construction Industry Research and Information Association (CIRIA) guidance – *Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors* (Masters-Williams *et al*. 2001). Further detail is provided in Chapter 05 – Land and Soils, Chapter 06 – Water, Chapter 09 – Airborne Noise and Groundborne Vibration and in the OCEMP included in Appendix A2-4 of Volume 4.

7B.7.1.2 Water Quality

Details of water quality mitigation and monitoring measures are included in Chapter 06 – Water and in the OCEMP included in Appendix A2-4 of Volume 4.

7B.7.1.3 Bridge and Culvert Construction

Bridge construction on the Ralappane Stream will use a single span, pre-cast concrete bridge near the southern boundary of the Proposed Development site. Two drainage ditches within the Proposed Development site will be culverted. In addition to the general measures described above, the following specific mitigation measures will be implemented for crossing of the Ralappane Stream and drainage ditch:

- Works will comply with The IFI's *Guidelines on protection of fisheries during construction works in and adjacent to waters* (IFI, 2016);
- No instream works will take place in the Ralappane Stream;
- Appropriate silt control measures such silt barriers (e.g. straw or silt fence) will be employed where required;
- Construction activities will be undertaken during daylight hours only. This will ensure that there is potential for undisturbed fish passage at night. The works will be temporary and will not create a significant long-term barrier to fish movement;
- An appropriate native grass seed mix as determined by the ECoW based on ground conditions, will be utilised to re-vegetate any disturbed areas along the bank of the Ralappane Stream; and
- Although no Common Frog were observed in drainage ditches within the Proposed Development site boundary, they will be surveyed prior commencement of site works by the ECoW as a precautionary measure. Any Common Frog, if recorded, will be moved to suitable habitat in the wider landscape under licence from NPWS.

7B.7.1.4 Noise

The employment of good construction management practice, as described in the OCEMP and in Chapter 09 – Airborne Noise and Groundborne Vibration, will minimise the risk of adverse impacts from the noise and vibration during the construction phase.

Mitigation and monitoring measures will be employed to ensure that potential noise and vibration impacts at nearby sensitive receptors due to construction activities are minimised. The preferred approach for controlling construction noise is to reduce source levels where possible, but with due regard to practicality.

The OCEMP will be updated by the contractor, prior to construction, to include any specific conditions attached to the approval and other specific construction information, but will at a minimum, include the measures described in Chapter 09, Section 9.8.

7B.7.1.5 Lighting

Lighting associated with the Proposed Development site works could cause disturbance/ displacement of fauna. If of sufficient intensity and duration, there could be impacts on reproductive success.

Site lighting will typically be provided by tower mounted temporary portable construction floodlights. The floodlights will be cowled and angled downwards to minimise spillage to surrounding properties. Lighting mitigation measures will follow *Bats & Lighting Guidance Notes for: Planners, engineers, architects and developers* (Bat Conservation Ireland, 2010). The following measures will be applied in relation to construction works lighting:

- Lighting will be provided with the minimum luminosity necessary for safety and security purposes. Where possible, lighting will be restricted to the working area and using the cowl and angling noted above, will minimise overspill and shadows on sensitive habitats outside the construction area; and
- During construction, lighting will be positioned and directed so that it does not to unnecessarily intrude on adjacent ecological receptors and structures used by protected species. The primary area of concern is the potential impact at the cSAC/ SPA boundary, the Ralappane Stream as well as hedgerows, treelines. With the exception of the jetty dock, there will be no directional lighting focused towards these areas and cowling and focusing lights downwards will minimise light spillage.

7B.7.1.6 Protection of Habitats

The Wildlife Act 1976, as amended, provides that it is an offence to cut, grub, burn or destroy any vegetation on uncultivated land or such growing in any hedge or ditch from 1st March to 31st August. Exemptions include the clearance of vegetation in the course of road or other construction works or in the development or preparation of sites on which any building or other structure is intended to be provided. If works are carried out during the breeding season, a pre-construction survey will be carried out by the ECoW and if birds are detected appropriate mitigation measures will be implemented. Where possible, vegetation will be removed outside of the breeding season and in particular, removal during the peak-breeding season (April-June inclusive) will be avoided. This will also minimise the potential disturbance of breeding birds outside of the Proposed Development site boundary.

Particular care will be taken at the boundary between the Proposed Development site and the cSAC, SPA and pNHA so that construction activities do not cause damage to habitats in this area. These habitats will be securely fenced off early in the construction phase. The fencing will be clearly visible to machine operators.

The Ralappane Stream runs from the Proposed Development site through the cSAC and pNHA to the estuary, it is important that construction activities do not result in pollution of this watercourse, either through siltation, which interferes with water flow, vegetation growth and aquatic fauna, or pollution (e.g. chemical). Refer to Chapter 06 Section 6.10 for further details on mitigation and monitoring measures for water.

To prevent incidental damage by machinery or by the deposition of spoil during site works, hedgerow, tree and scrub vegetation which are located in close proximity to working areas will be clearly marked and fenced off to avoid accidental damage during excavations and site preparation. The ECoW will specify appropriate protective fencing where required.

Habitats that are damaged and disturbed will be reinstated and landscaped once construction is complete. Disturbed areas will be seeded or planted using appropriate native grass or species native to the areas where necessary. Details on landscaping are included in Figure F2-4 in Volume 3. Natural regeneration of vegetation will also occur.

There will be a defined working area which will be fenced off with designated haul routes to prevent inadvertent damage to adjoining habitats.

Tree root systems can be damaged during site clearance and groundworks. Materials, especially soil and stones, can prevent air and water circulating to the roots. No materials will be stored within the root protection area/ dripline of trees earmarked for retention. The ECoW will specify appropriate protective fencing where required.

7B.7.1.7 Badgers

This will require exclusion of Badgers from subsidiary/ outlier setts, however in both instances both social groups of Badgers would be expected to continue to use their main setts.

Badger sett tunnel systems can extend up to approximately 20 m from sett entrances. Therefore, no heavy machinery should be used within 30m of Badger setts (unless carried out under licence); lighter machinery (generally wheeled vehicles) should not be used within 20 m of a sett entrance; light work, such as digging by hand or scrub clearance should not take place within 10 m of sett entrances.

During the breeding season (December to June inclusive), none of the above works should be undertaken within 50 m of active setts nor blasting or pile driving within 150 m of active setts.

Affected Badger setts will be clearly marked and the extent of bounds prohibited for vehicles clearly marked by fencing and signage.

The most recent surveys show that the two main Badger setts are located outside of the Proposed Development site boundary and the two setts to be directly affected are subsidiary setts. The bait marking survey indicates that the setts are linked as follows:

- Sett 4 (main sett) is located to the east of the Proposed Development. Sett 1 is located within the Proposed Development site boundary. These setts are used by the same social group; and
- Sett 3 (main sett) is located to the east of the Proposed Development. Sett 2 is located within the Proposed Development site boundary. These setts are used by the same social group.

The presence of alternative setts within the particular social group’s territory is required to ensure that excluded Badgers are able to relocate to a suitable alternative refuge. The objective is to allow the Badgers to remain within their territory, even though a portion of their current territory may be lost as a result of a particular development. There is a standard methodology which can be utilised to exclude Badgers from setts

A methodology for the exclusion of Badgers from affected setts and displacement of Badgers to artificial setts is outlined in the National Roads Authority publication *Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes* (NRA 2005a). Detailed mitigation and monitoring measures including method statements will be agreed with the NPWS prior to implementation as part of a licence application.

Prior to the commencement of works, setts will be surveyed by the ECoW to determine current usage patterns.

Exclusion of Badgers from any currently active sett will only be carried out during the period of July to November (inclusive) in order to avoid the Badger breeding season.

In the instance of disused setts or setts verified as inactive, and to prevent their reoccupation, the entrances may be lightly blocked with vegetation and a light application of soil (soft blocking). The purpose of soft-blocking is to confirm that an apparently inactive sett is not occupied by Badgers. If all entrances remain undisturbed for approximately five days, the sett should be destroyed immediately using a mechanical digger, under the supervision of the licensee. Should there be any delay in sett destruction, the soft-blocked entrances should be hard-blocked and the sett destroyed as soon as possible, again under the supervision of the licensee. Hard-blocking is best achieved using buried fencing materials and compacted soil with further fencing materials laid across and firmly fixed to blocked entrances and surrounds

Where field signs or monitoring reveal any suggestion of current or recent Badger activity at any of the sett entrances, the sett requires thorough evacuation procedures.

Inactive entrances may be soft and then hard-blocked, as described for inactive setts, but any active entrances should have one-way gates installed (plus proofing around sides of gates) to allow Badgers to exit but not to return. The gates should be tied open for three days prior to being set to exclude. Sticks should be placed at arm’s length within the gated tunnels to establish if Badgers remain within the sett.

Gates should be left installed, with regular inspections, over a minimum period of 21 days (including period with gates tied open) before the sett is deemed inactive. Any activity at all will require the procedures to be repeated or additional measures taken. Gates might be interfered with by other mammals or members of the public - hence the importance of regular exclusion monitoring visits. Sett destruction should commence immediately following the 21-day exclusion period, provided that all Badgers have been excluded.

Badgers will often attempt to re-enter setts after a period, and if gates are left in place for any long period, they may attempt to dig around them or even create new entrances and tunnels into the sett system.

Where an extensive sett is involved, an alternative method of evacuating Badgers is to erect electric fencing around the sett (ensuring all entrances are included) with one-way Badger-gates installed within the electric fence at points where the fence crosses Badger paths leading to and from the sett. The exclusion should again take place over a minimum period of 21 days before sett destruction; this monitoring period would be contingent upon no Badger activity being observed within the fenced area. Fencing may not be practical in many situations due to the topography or the terrain – and can be difficult to install effectively. If no activity is observed, then the sett may be destroyed, under supervision by the ECoW under licence.

The destruction of a successfully evacuated Badger sett may only be conducted under the supervision of qualified and experienced personnel under licence from the NPWS. The possibility of Badgers remaining within a sett must always be considered; suitable equipment should be available on hand to deal with Badgers within the sett or any Badgers injured during sett destruction.

Destruction is usually undertaken with a tracked 12-25 tonne digger, commencing at approximately 25m from the outer sett entrances and working towards the centre of the sett, cutting approximately 0.5 m slices in a trench to a depth of 2 m. Exposed tunnels may be checked for recent Badger activity, with full attention paid to safety requirements in so doing. The sett should be destroyed from several directions, in the above manner, until only the central core of the sett remains.

Once it is ensured that no Badgers remain, the core may then also be destroyed and the entire area back-filled and made safe. Sett excavation should, preferably, be concluded within one working day, as Badgers may re-enter exposed tunnels and entrances.

A report detailing evacuation procedures, sett excavation and destruction, and any other relevant issues should be submitted to the NPWS, in fulfilment of usual wildlife licence conditions.

Construction activities within the vicinity of affected setts may commence once these setts have been evacuated and destroyed under licence from the NPWS. Where affected setts do not require destruction, construction works may commence once recommended alternative mitigation measures to address the Badger issues have been complied with.

Badger access points will be provided to allow Badgers to access the development area once complete See NHBS, 2021 or similar. Gates will be placed within fences along the western, eastern and southern boundaries to maximise potential usage by the different social groups that occur within this area.

Monitoring of Badger setts will be carried out during construction works and a five-year post-construction monitoring programme will be implemented.

7B.7.1.8 Bats

During the site works, general mitigation measures for bats will follow the National Road Authority's '*Guidelines for the Treatment of Bats during the Construction of National Road Schemes*' NRA (2005c) and *'Bat Mitigation Guidelines for Ireland: Irish Wildlife Manuals, No. 25*' (Kelleher, C. & Marnell, F. (2006)). These documents outline the requirements that will be met in the pre-construction (site clearance) stage to minimise negative effects on roosting bats, or prevent avoidable effects resulting from significant alterations to the immediate landscape.

A Common Pipistrelle colony was recorded in a farm building southwest of the Proposed Development site. This building will not be affected. No bat roosts were recorded within the site boundary. Mitigation measures will be agreed with the National Parks and Wildlife Service prior to any demolition works and will include the following.

Two buildings within the Proposed Development site will be demolished as part of the development. No signs of bats were recorded within these buildings. However, as a precautionary measure, the following measures will be implemented prior to and/ or during demolition:

- In all cases immediately in advance of demolition a bat specialist will undertake an examination of the building. If bats are present at the time of examination it is essential to determine the nature of the roost (i.e. number, species, whether it is a breeding population) as well as its exact location;
- If bats are recorded in buildings earmarked for demolition, special mitigation measures to protect bats will be put in place and a license to derogate from the conservation legislation will be sought from the NPWS;
- The contractor will take all required measures to ensure works do not harm individuals by altering working methods or timing to avoid bats, if necessary; and
- If roosting habitat for bats is removed, replacement habitat will be provided.

A number of trees will be removed prior to construction. Although mature trees with the potential of be of value as bat roosts are absent from the site, the following precautionary measures will be implemented.

- The bat specialist will work with the contractor to ensure that the loss of trees is minimised and that trees earmarked for retention are adequately protected;
- Tree-felling will ideally be undertaken in the period September to late October/ early November. During this period bats are capable of flight and may avoid the risks of tree-felling if proper measures are undertaken;
- Felled trees will not be mulched immediately. Such trees will be left lying several hours and preferably overnight before any further sawing or mulching. This will allow any bats within the tree to emerge and avoid accidental death. The bat specialist will be on-hand during felling operations to inspect felled trees for bats. If bats are seen or heard in a tree that has been felled, work will cease and the local NPWS Conservation Ranger will be contacted;
- Tree will be retained where possible and no 'tidying up' of dead wood and spilt limbs on tree specimens will be undertaken unless necessary for health and safety;
- Treelines outside the Proposed Development area but adjacent to it and thus at risk, will be clearly marked by a bat specialist to avoid any inadvertent damage;
- During construction directional lighting will be employed to minimise light spill onto adjacent areas. Where practicable during night-time works, there will be no directional lighting focused towards watercourses or boundary habitats and focusing lights downwards will be utilised to minimise light spillage;
- If bats are recorded by the bat specialist within any trees no works will proceed without a relevant derogation licence from the NPWS; and
- As a biodiversity enhancement measure it is proposed that bat boxes will be put up within the Proposed Development site. It is proposed that eight bat boxes will be located within the overall site (see Wildcare, 2021 for box proposed or similar). The boxes will be erected by the ECoW taking into account landscape plans, vehicle movements and lighting.

As noted in Section 7B.7.1.5, lighting mitigation measures will follow *Bats & Lighting Guidance Notes for: Planners, engineers, architects and developers* (Bat Conservation Ireland, 2010).

All mitigation measures including detailed method statements will be agreed with the NPWS prior to commencement of works, which could affect any bat populations onsite.

7B.7.1.9 Otter

No signs of Otter or Otter holts were noted within 150 m of the Proposed Development site however Otter was recorded along the Ralappane Stream and to the west of the Proposed Development site. A detailed pre-construction survey will be carried out no more than 10-12 months prior to the commencement of construction works to confirm the absence of Otter holts within 150 m of the Proposed Development site.

If Otter holts are recorded at that time, the ECoW will determine the appropriate means of minimising effects i.e. avoidance, moving works, timing of works etc. If required the ecologist will obtain a derogation licence from the NPWS, to facilitate licenced exclusion from the breeding or resting site in accordance with a plan approved by the NPWS.

Any holts found to be present will be subject to monitoring and mitigation as set out in the NRA publication *Guidelines for the Treatment of Otter prior to the Construction of National Road Schemes* (2008). If found to be inactive, exclusion of holts may be carried out during any season. No wheeled or tracked vehicles (of any kind) will be used within 20m of active, but non-breeding, Otter holts. Light work, such as digging by hand or scrub clearance will also not take place within 15m of such holts, except under licence. The prohibited working area associated with Otter holts will be fenced and appropriate signage erected. Where breeding females and cubs are present no evacuation procedures of any kind will be undertaken until after the Otters have left the holt, as determined by the ECoW. Breeding may take place at any season, so activity at a holt must be adjudged on a case-by-case basis. On occasion, Otter holts may be directly affected by the scheme. To ensure the welfare of Otter, they must be evacuated from any holts present prior to any construction works commencing. The exclusion process, if required, involves the installation of one-way gates on the entrances to the holt and a monitoring period of 21 days to ensure the Otters have left the holt prior to removal.

7B.7.1.10 Common Frog

A visual search of the wet grassland habitat and drainage ditches to be removed will be carried out in the days prior to commencement of works and any frogs will be removed to alternative wet grassland habitat elsewhere within the landholding. This will be carried out under licence from the NPWS and under supervision of the ECoW.

7B.7.1.11 Birds

Breeding Birds

No signs of nesting birds were recorded in disused farm buildings during the 2018-2021 surveys. However, prior to demolition buildings will be checked for nesting Swallows (and other birds). If nesting birds are recorded, all demolition operations will be carried out between October and March, when birds have finished breeding.

As noted in Section 7B.7.1.6, where possible, vegetation will be removed outside of the breeding season and in particular, removal during the peak-breeding season (April-June inclusive) will be avoided. This will also minimise the potential disturbance of breeding birds outside of the Proposed Development site boundary.

As a biodiversity enhancement measure ten bird nesting boxes (various types) will be located within the Proposed Development site boundary at locations specified by the ECoW. It is noted that provision of woodland planting and the use of more diverse grassland planting will provide additional nesting and feeding sites for birds, particularly as these habitats mature.

Estuarine Birds

A detailed method statement will be drawn up by the ECoW and agreed with the NPWS prior to commencement of works. The method statement will specify the timing of blasting operations and the need, if any, for ecological supervision.

As noted in Chapter 07A Section 7.7.2 a soft-start will be required for piling works or any source, including equipment testing, exceeding 170 dB re: 1μPa @1m an appropriate ramp-up procedure (i.e. ‘soft-start’) must be used. This should be a minimum of 20 minutes and no longer than 40 minutes.

7B.7.1.12 Biodiversity and Landscaping Plans

Details of the landscaping plan for the Proposed Development are included in Figure F2-4 in Volume 3. This includes detailed areas of native woodland and native scrub habitat as well as native grassland planting.

The woodland planting mix will be dominated by native species including Scots Pine *Pinus sylvestris*, Willow, Pedunculate Oak *Quercus robur* and Sessile Oak *Quercus petraea*, Alder, Rowan *Sorbus* spp. and Crab Apple *Malus* spp.. The woodland edge planting mix will include Hazel *Corylus* spp., Hawthorn, Blackthorn, Elder *Sambucus* spp. and Holly Ilex spp.. The objective of these elements is to create natural, multi-layered woodland habitat which will be of local ecological value and has the potential to support native flora and fauna. A linear strip of woodland along the southern boundary will help to maintain connectivity (east to west) between habitats in the wider landscape.

Additional native specimen trees (Willow, Wild Cherry *Prunus avium*, Rowan, Whitebeam *Sorbus subg. Aria* and Silver Birch) will be planted on peripheral areas such as the road edge and administration area.

As detailed in Figure F2-4 in Volume 3 a native wildflower/ grass mix will be utilised to provide a more diverse sward which is of higher ecological value for invertebrates and birds. Perennial Rye Grass or other vigorous amenity/ agricultural grass species will not be utilised as they tend to over-dominate the sward and reduce overall biodiversity. The final grassland/ wildflower mix for same will be specified by the ECoW based on final ground conditions including alkalinity, fertility and moisture levels.

Based on the seed mix utilised and on prevailing ground conditions, the ECoW will specify the management regime, including weed control and mowing regime, necessary to maximise biodiversity and habitat value.

Five insect nesting boxes suitable for *Hymenoptera* spp. (bees and wasps) will be put in place within the site boundary as a biodiversity enhancement measure.

7B.7.1.13 Invasive Species

Prior to the commencement of construction works an invasive species survey will be undertaken within the Proposed Development boundary by a competent ecologist to determine if invasive species listed under Part 1 of the Third Schedule of S.I No. 477 of 2011 have established in the area in the period between pre-planning and post consent. In the event that invasive species are identified within the works area a site-specific Invasive Species Management Plan will be developed and implemented by a competent specialist on behalf of the Contractor. In addition, in order to comply with Regulations 49 and 50 of the European Communities (Birds and Natural Habitat) Regulations (2011) the appointed Contractor will ensure biosecurity measures are implemented throughout the construction phase to ensure the introduction and translocation of invasive species is prevented. The appointed ECoW will carry out a toolbox talk which will identify invasive species and will also implement biosecurity measures such as the visual inspection of vehicles for evidence of attached plant or animal material prior to entering and leaving the works area.

7B.7.2 Operations

During the operational phase the site environmental management system will address management of potentially contaminating materials such as fuel, lubricating oils, solvent, etc. and ensure such material is appropriately controlled, in accordance with regulatory requirements and industry best practice.

The drainage design for the Power Plant will consider the magnitude of the changes in infiltration and runoff characteristics and the significance of potential impacts at the wetland. Further details on operational water management are included in Chapter 06 – Water.

Lighting shall be provided in plant areas where safe access and safe conditions for work activities is required at night. Lighting will also be required on the water around the jetty dock to detect spillage and possibly unauthorized craft. The onshore receiving facilities would have area lighting installed on a down angle to cover the LNG Terminal and Power Plant. The terminals will have a level of lighting sufficient to ensure that all ship/ shore interfaces activities can be safely conducted during periods of darkness. Lighting levels will meet national and international engineering standards as a minimum

The principal mitigation measures required for the development in relation to noise concern selection of equipment, sound containment, and acoustic attenuators, in order to achieve the required limits. The predicted noise levels, as outlined in Chapter 09 – Airborne Noise and Groundborne Vibration are considered to be readily technically achievable using standard methods.

7B.8 Do Nothing Scenario

Most of the habitats to be affected have been significantly modified from their natural state by human activity. In pockets of semi-natural habitats within the Proposed Development site boundary, the general pattern of succession from grassland to scrub to woodland would be expected to continue In the absence of development, it is expected that the lands within the planning boundary would largely remain under the same management regimes. No significant changes to the habitats within the boundary are likely to occur, in the 'do nothing' scenario.

7B.9 Residual Impacts

7B.9.1 Habitats

Replacement planting of native tree species within the Proposed Development site will provide alternative forging and commuting habitat for fauna (Refer to Figure F2-4 in Volume 3). This will compensate for some of the habitat loss at the site including hedgerows/ treelines, scrub and grassland habitat.

Table 7B-14 Residual Impacts on Habitats within Proposed Development Site Boundary Following Mitigation

Habitat type	Habitat value	Impacts
Wet grassland GS4	Local importance (Lower value)	**Negative, slight, long-term**
Improved agricultural grassland GA1	Local importance (Lower value)	**Negative, slight, long-term**
Hedgerows (WL1)/ Treelines (WL2)	Local importance (Higher Value)	**Negative, not significant, long-term**
Sedimentary sea cliffs CS3	International importance	**Negative, significant, permanent**
Scrub WS1	Local importance (Higher Value)	**Negative, not significant, long-term**
Eroding river FW1	Local importance (Higher Value)	**Negative, slight, long-term**
Drainage ditch FW4	Local importance (Lower Value)	**Negative, not significant, long-term**

7B.9.2 Badgers

Based on conservative estimates, it is probable that 25% of the feeding territory of both feeding groups will be impacted by the Proposed Development. The reduction in territory size is likely to create a reduction in the size of both social groups. A net loss of grassland foraging habitat will therefore be a long-term impact of the Proposed Development but given the alternative resources available, both Badger territories will remain extant.

Noise modelling which was carried out for peak construction noise at Sett 3 and Sett 4, found that peak noise (LAeq) at Sett 3 would be 49.9dB(A) during daytime works and 32.1 dB(A) during night-time works. At Sett 4 this would be 43.6dB(A) during daytime and 37.1dB(A) during night-time (Refer to Appendix A7B-3, Vol. 4). Therefore, even during peak construction works there will no disturbance impacts to the main Badger setts in the vicinity of the Proposed Development site. During operation noise levels at Sett 3 and Sett 4 will be 35dB(A) for all operational scenarios.

Given the alternative resources available, both Badger territories will remain extant. Impacts to Badgers during the construction phase in following mitigation will be **negative, significant** and **long-term** at a local level.

7B.9.3 Bats

The residual impact of the Proposed Development will include loss of hedgerows/ treelines as well as smaller areas of scrub and cliff habitat which are used as commuting and foraging habitat. Lit areas of the Proposed Development site will be avoided by bats, although they are likely to continue to forage in dark areas. The Proposed Development will result in a net loss of moderate value feeding habitat. Replacement planting of native tree species within the Proposed Development site boundary will provide alternative foraging and commuting habitat for bats. This will also help to shield retained boundary habitats from lighting within the Power Plant and create dark areas for bat foraging. The residual impact of the Proposed Development is expected to be **negative, slight** and **long-term** at a local level on Common Pipistrelle, Soprano Pipistrelle and Leisler's Bat.

7B.9.4 Otter

Otter is known to forage outside the Proposed Development site, but no Otters were recorded within the site boundary. During peak construction works (including jetty works), noise levels along the tidal section of the Ralappane Stream (R8), the closest location to the Proposed Development site where Otter was recorded, will be 58.3 dB(A) during daytime and 36.3dB(A) during night-time (Refer to Appendix A7B-3, Vol. 4). During operation noise levels at R8 will be less than 37dB(A) for all operational scenarios. Therefore, even in during the worst-case scenario for noise, there will no significant disturbance at known Otter foraging sites. There may be some short-term displacement of Otters foraging offshore during the works period. However, this species is tolerant to a high degree of noise and/ or disturbance. Thus, any impacts during the construction phase are expected to be localised, slight and short-term.

Otters in Ireland regularly use manmade habitat such as jetties for foraging and resting and it is noted that the new jetty is likely to provide additional foraging opportunities for Otter. During the operational phase, Otters at the Proposed Development site are likely to adapt successfully to increased disturbance and forage along the artificial reef habitat created by the jetty. The residual impact on Otter will be **not significant** at a local level.

7B.9.5 Other Terrestrial Mammals

Hares are a highly mobile species which can move away from the site of disturbance. There will be a net loss of feeding habitat. The residual impact on Irish Hare is predicted to the **negative, slight** and **long-term** at a local level.

Hedgehog is likely to recolonise newly planted hedgerows/ treelines at the Proposed Development site following the new landscape planting. The residual impact is predicted to the **negative, slight** and **long-term** at a local level.

7B.9.6 Amphibians

Common Frog will no longer use the site following the removal of wet grassland. However, following relocation the residual impact on Common Frog will not be significant.

7B.9.7 Birds

7B.9.7.1 Terrestrial Birds

Breeding birds will be displaced from grassland and boundary habitats at the site. Noise levels within terrestrial habitats during construction are likely to be significant and birds will be displaced during peak construction works. During operation and following the implementation of the landscape plan, woodland edge species are likely to recolonise the new hedgerows/ treelines at the Proposed Development site. Native seeded grassland is likely to provide alterative nesting habitat for ground nesting species such as Meadow Pipit, Skylark and Snipe. The residual impact will be **negative, minor** and **long-term** at a local level.

7B.9.7.2 Estuarine Birds

The numbers of estuarine birds displaced during construction, following mitigation and monitoring measures for noise and lighting, will be minimal. Outside of blasting works, birds are predicted to continue to forage along all areas of the Shannon Estuary outside the immediate working area. According to Cutts *et al.* (2013), a single sudden sound such as blasting will generally cause more disturbance than a constant or regular noise regardless of noise level. The typical response would be for birds to move away from affected areas to less disturbed areas. Birds that remain in the affected area may not forage effectively and this may impact on survival and foraging rates. Blasting works will take place only within terrestrial habitats i.e., grassland on southeast of Proposed Development site. No significant estuarine bird numbers were recorded in the vicinity of the Proposed Development site and given the limited use of blasting and the distance from more valuable bird foraging areas (i.e., west of Knockfinglas Point), no significant impact is predicted to occur to estuarine birds during construction works.

Following mitigation, peak operational noise levels will be 45-55 dB(A) along the along the Shannon Estuary shoreline adjacent to the Proposed Development site. To the east and west of the Proposed Development site, noise levels will be 35-40 dB(A) falling to <35 dB(A) west of Knockfinglas Point (Appendix A7B-3 of Volume 4). In the subtidal waters in the immediate vicinity of the FRSU, noise levels following mitigation will be <65 dB(A). During operation, more sensitive bird species such as Red-throated Diver and Great Northern Diver are likely to avoid foraging in the vicinity of the jetty and ships. Other estuarine bird species are likely to habituate to operational noise and disturbance and continue to forage along the intertidal and sub-tidal habitats. The new jetty is likely to create foraging and roosting opportunities for a number of species including gull and tern species, Cormorant and Shag.

The residual impact on SCI birds will be negative, not significant and long-term at an international level following mitigation.

The residual impact on Annex I species i.e., Red-throated Diver, Great Northern Diver and Sandwich Tern will be **negative, slight** and **long-term** at a county level following mitigation.

The residual impact on other estuarine species will be **negative, not significant** and **long-term** at a local level following mitigation.

7B.9.8 Fish

Residual impacts on water quality are predicted to be **imperceptible**. The impact of residual impact on fish will be **not significant**.

7B.9.9 Aquatic Invertebrates

Residual impacts on water quality are predicted to be **imperceptible**. The impact of residual impact on fish will be **not significant**.

7B.9.10 Other Species

No residual impacts identified.

7B.9.11 Spread of Invasive Species

No residual impacts identified.

7B.9.12 Air Quality

No residual impacts predicted.

Table 7B-15 Summary of Potential impacts from the Proposed Development for Designated Sites, Habitats and Flora

Feature		Highest Value within Zone of Influence	Potential Construction Phase impacts	Significance of Potential Construction-Phase Impact	Potential Operational Phase impacts	Significance of Potential Operational-Phase Impact	Mitigation Proposed	Residual Impact Significance (Construction and Operation)	Cumulative Residual Impact Significance
Designated sites	Lower River Shannon cSAC	International	Direct habitat loss/ Pollution	Refer to NIS	Refer to NIS	Refer to NIS	Refer to NIS	Refer to NIS	Refer to NIS
	River Shannon and River Fergus Estuaries SPA	International	Direct habitat loss/ Pollution	Refer to NIS	Refer to NIS	Refer to NIS	Refer to NIS	Refer to NIS	Refer to NIS
	Ballylongford Bay NHA	National	Pollution	Refer to Chapter 06	Refer to Chapter 06	Refer to Chapter 06	Refer to Chapter 06	Refer to Chapter 06	Refer to Chapter 06
	Other National Sites	National	Not significant	Not significant	Not significant	N/A	N/A	N/A	N/A
Habitats	Wet grassland GS4	Local importance (Lower value)	Direct habitat loss	Local	None	N/A	Yes	Local	Local
	Improved Agricultural grassland GA1	Local importance (Lower value)	Direct habitat loss	Local	None	N/A	Yes	Local	Local
	Hedgerows WL1/ Treelines WL2	Local importance (Higher value)	Direct habitat loss	Local	None	N/A	Yes	Local	Local

Feature		Highest Value within Zone of Influence	Potential Construction Phase impacts	Significance of Potential Construction-Phase Impact	Potential Operational Phase impacts	Significance of Potential Operational-Phase Impact	Mitigation Proposed	Residual Impact Significance (Construction and Operation)	Cumulative Residual Impact Significance
	Sedimentary Sea Cliffs CS3	International importance	Direct habitat loss	Local	None	N/A	No	Local	Local
	Scrub WS1	Local importance (Higher value)	Direct habitat loss	Local	None	N/A	Yes	Local	Local
	Eroding River FW1	Local importance (Higher value)	Pollution	Local	Not significant	N/A	Yes	Not significant	Not significant
	Drainage ditches FW4	Local importance (Lower value)	Direct habitat loss/ Pollution	Local	Pollution	Local	Yes	Local	Local
Fauna	Badger	Local Importance (Higher Value)	Mortality or injury Disturbance/ Displacement/ Loss of foraging habitat/ territory	Local	Disturbance/ displacement from noise and lighting	Local	Yes	Local	Not significant
	Bats (Common Pipistrelle, Soprano Pipistrelle, Leisler)	Local Importance (Higher Value)	Loss of foraging habitat/ Habitat fragmentation/ Disturbance/ Displacement	Local	Disturbance/ displacement from noise and lighting	Local	Yes	Local	Not significant
	Otter	Local Importance (Higher Value)	Loss of foraging habitat/ Disturbance/ Displacement	Local	Disturbance/ displacement from noise and lighting	Local	Yes	Not significant	Not significant

Feature		Highest Value within Zone of Influence	Potential Construction Phase impacts	Significance of Potential Construction-Phase Impact	Potential Operational Phase impacts	Significance of Potential Operational-Phase Impact	Mitigation Proposed	Residual Impact Significance (Construction and Operation)	Cumulative Residual Impact Significance
	Hedgehog, Irish Hare	Local importance (Lower value)	Loss of habitat/ Disturbance/ Displacement	Local	Disturbance/ displacement from noise and lighting	Not significant	Yes	Not significant	Not significant
Amphibians	Common Frog	Local importance (Higher Value)	Mortality or injury during vegetation clearance/ Habitat loss	Local	None	Not significant	Yes	Not significant	Not significant
Birds	Red list bird species (Terrestrial) (Meadow Pipit, Merlin, Stock Dove, Quail)	Local importance (Higher Value)	Mortality or injury, Disturbance/ displacement Direct loss of breeding/foraging habitat	Local	Disturbance/ displacement	Local	Yes	Local	Not significant
	Amber list bird species (Several)	Local importance (Higher Value)	Mortality or injury Disturbance/ displacement Direct loss of breeding/ foraging habitat	Local	Disturbance/ displacement	Local	Yes	Local	Not significant
	Other breeding birds	Local importance (Higher Value)	Mortality or injury Disturbance/	Local	Disturbance/ displacement	Local	Yes	Local	Not significant

Feature		Highest Value within Zone of Influence	Potential Construction Phase impacts	Significance of Potential Construction-Phase Impact	Potential Operational Phase impacts	Significance of Potential Operational-Phase Impact	Mitigation Proposed	Residual Impact Significance (Construction and Operation)	Cumulative Residual Impact Significance
	(Green list species)		displacement Direct loss of breeding/ foraging habitat						
	Annex I species (Great Northern Diver, Red-throated Diver, Little Egret, Golden Plover, Sandwich Tern)	County importance	Disturbance/ displacement Direct loss of foraging habitat/ Pollution	County	Disturbance/ Displacement/ Collision mortality/ Pollution (reduction in prey availability)	County	Yes	County	Not significant
	SCI birds (River and River Fergus Estuaries SPA	Local importance (Higher Value)	Disturbance/ displacement Direct loss of foraging habitat/ Pollution (reduction in prey availability)	International	Disturbance/ Displacement/ Collision mortality/ Pollution (reduction in prey availability)	International	Yes	Not significant	Not significant
	Non-SCI estuarine birds	Local importance (Higher value)	Displacement Direct loss of foraging habitat/ Pollution (reduction in prey availability)	Local	Disturbance/ Displacement/ Collision mortality/ Pollution	Local	Yes	Local	Not significant

Feature		Highest Value within Zone of Influence	Potential Construction Phase impacts	Significance of Potential Construction-Phase Impact	Potential Operational Phase impacts	Significance of Potential Operational-Phase Impact	Mitigation Proposed	Residual Impact Significance (Construction and Operation)	Cumulative Residual Impact Significance
					(reduction in prey availability)				
Aquatic species	Fish (Including Stickleback, Eel, Stone Loach)	Local importance (Higher value)	Pollution	Local	Pollution	Not significant	Yes	Not significant	Not significant
	Invertebrates	Local importance (Lower value)	Pollution	Local	Pollution	Not significant	Yes	Not significant	Not significant
Other species		Negligible	None	Not significant	None	N/A	N/A	N/A	N/A

7B.10 Summary

The impacts on the ecological environment as a result of the Proposed Development are summarised as follows:

The terrestrial elements of the Proposed Development overlap with the Lower River Shannon cSAC and the River Shannon and River Fergus Estuaries SPA. Following mitigation, there will be no adverse impacts on designated sites overlapping with the terrestrial elements of the project. The OCEMP implemented by the Contractor will contain the industry standards and appropriate measures regarding pollution prevention;

Semi-natural habitats within the Proposed Development site will be removed. While replacement habitat will be provided with the Proposed Development site boundary including native woodland, scrub and grassland areas, overall there will be a net loss of semi-natural habitats at the Proposed Development site.

No invasive species were recorded within the Proposed Development site.

No bats were identified roosting in buildings or trees within the Proposed Development site. Three species of foraging and commuting bats were identified using semi-natural habitat, mainly hedgerows. No light sensitive Myotis species were recorded. Lighting design and replacement tree planting will be implemented to minimise impacts on bats.

Two Badger setts will be removed from the Proposed Development site during construction. These are outlier setts and while two Badger social groups will be impacted, Badger are likely to remain extant during operation. However, it is probable that 25% of the feeding territory of both feeding groups will be impacted by the Proposed Development and this reduction in territory size is likely create a contraction in the size of both social groups.

Otter was not recorded within the Proposed Development site, but regularly use areas to the west of the Proposed Development site as well as the Shannon Estuary. Mitigation and design measures will be implemented to ensure that Otter continue to use the site following development including allowing access for Otter (and other species) under the jetty and the retention of habitats to the west of the Proposed Development site will continue to provide habitat for this species.

The site currently includes low value habitat for breeding birds, including a number of birds of conservation concern. Timing of vegetation removal will be scheduled to avoid impacts to breeding birds, whilst replacement planting will reduce the impacts to breeding and nonbreeding birds within the site.

The River Shannon and River Fergus Estuaries SPA supports internationally important numbers of wintering waterbirds. However, the area of the SPA within the Proposed Development site boundary and the SPA to the north of the Proposed Development site, support very small numbers of SCI and non-SCI bird species. While disturbance, particularly piling and blasting, during construction may disturb/ displace a small number of birds in the vicinity of offshore works, there will be no adverse impact to bird numbers within the SPA during construction or operation.

Common Frog has previously been recorded in wet grassland habitat within the Proposed Development site. Wet grassland habitat at the site will be removed. Mitigation measures including removal of this species under licence have been outlined to avoid direct mortality impacts to Common Frog.

No rare invertebrate species were recorded at the Proposed Development site.

A slight County impact on Annex I diving birds i.e. Red-throated Diver and Great Northern Diver is predicted to occur. Assuming successful implementation of mitigation measures as outlined above, all other impacts will not be significant above Local geographic scale of significance.

Table 7B-16 Summary

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance	EIAR Chapter Reference
Construction	General mitigation and monitoring measures	Low	Not assessed	Not assessed	An OCEMP has been prepared (included in Appendix A2-4 of Volume 4). The OCEMP contains the construction mitigation and monitoring measures, which are set out in this EIAR and the NIS. This will have particular emphasis on the protection of habitats and species of the cSAC, SPA and pNHA which adjoin the Proposed Development site. These sites are by definition internationally/ nationally important for their habitats and the species they support. It is essential that all construction staff, including all sub-contracted workers, be notified of the boundaries of these Natura 2000 sites and be made aware that no construction waste of any kind (rubble, soil, etc.) is to be deposited in these protected areas and that care must be taken with liquids or other materials to avoid spillage. Mitigation and monitoring measures (of relevance in respect of any potential ecological effects) will be implemented throughout the project, including the preparation and implementation of detailed method statements. The works will incorporate the relevant elements of the guidelines outlined below: • *Control of water pollution from construction sites. Guidance for consultants and contractors (C532). CIRIA.* Masters-Williams et al (2001); and • *Control of water pollution from linear construction projects. Technical guidance (C648). CIRIA.* Murnane, *et al.* (2006). All personnel involved with the Proposed Development will receive an onsite induction relating to construction and operations and the environmentally sensitive nature of European sites and to re-emphasise the precautions that are required as well as the precautionary measures to be implemented. Site managers, foremen and workforce, including all subcontractors, will be suitably trained in pollution risks and preventative measures. All staff and subcontractors have the responsibility to: • Work to agreed plans, methods and procedures to eliminate and minimise environmental impacts; • Understand the importance of avoiding pollution onsite, including noise and dust, and how to respond in the event of an incident to avoid or limit environmental impact; • Respond in the event of an incident to avoid or limit environmental impact; • Report all incidents immediately to the project manager and the Environmental (Ecological) Clerk of Works (ECoW); • Monitor the workplace for potential environmental risks and alert the site manager if any are observed; and • Co-operate as required, with site inspections.	Not significant	
Construction	Bridge and culvert construction	Medium	Culverting of two drainage ditches and bridging of Ralappane Stream	Moderate	Bridge construction on the Ralappane Stream will use a single span, pre-cast concrete bridge near the southern boundary of the Proposed Development site. Two drainage ditches within the Proposed Development site will be culverted. In addition to the general measures described above, the following specific mitigation measures will be implemented for crossing of the Ralappane Stream and drainage ditch: • Works will comply with The IFI's Guidelines on protection of fisheries during construction works in and adjacent to waters (IFI, 2016); • No instream works will take place in the Ralappane Stream; • Appropriate silt control measures such silt barriers (e.g. straw or silt fence) will be employed where required; • Construction activities will be undertaken during daylight hours only. This will ensure that there is potential for undisturbed fish passage at night. The works will be temporary and will not create a significant long-term barrier to fish movement; • An appropriate native grass seed mix as determined by the ECoW based on ground conditions, will be utilised to re-vegetate any disturbed areas along the bank of the Ralappane Stream; and	Not significant	7B

					• Although no Common Frog were observed in drainage ditches within the Proposed Development site boundary, they will be surveyed prior commencement of site works by the ECoW as a precautionary measure. Any Common Frog, if recorded, will be moved to suitable habitat in the wider landscape under licence from NPWS.		
Construction	Lighting	Medium	Disturbance and/ or displacement of sensitive fauna	Moderate	Lighting associated with the site works could cause disturbance/ displacement of fauna. If of sufficient intensity and duration, there could be impacts on reproductive success. Site lighting will typically be provided by tower mounted temporary portable construction floodlights. The floodlights will be cowled and angled downwards to minimise spillage to surrounding properties. Lighting mitigation measures will follow Bats & Lighting Guidance Notes for: Planners, engineers, architects and developers (Bat Conservation Ireland, 2010). The following measures will be applied in relation to construction works lighting: • Lighting will be provided with the minimum luminosity necessary for safety and security purposes. Where possible, lighting will be restricted to the working area and using the cowl and angling noted above, will minimise overspill and shadows on sensitive habitats outside the construction area and • During construction, lighting will be positioned and directed so that it does not to unnecessarily intrude on adjacent ecological receptors and structures used by protected species. The primary area of concern is the potential impact at the cSAC/ SPA boundary, the Ralappane Stream as well as hedgerows, treelines. With the exception of the jetty dock, there will be no directional lighting focused towards these areas and cowling and focusing lights downwards will minimise light spillage.	Slight	7B
Construction	Habitats	Medium	Removal of habitat	Slight to moderate	The Wildlife Act 1976, as amended, provides that it is an offence to cut, grub, burn or destroy any vegetation on uncultivated land or such growing in any hedge or ditch from 1st March to 31st August. Exemptions include the clearance of vegetation in the course of road or other construction works or in the development or preparation of sites on which any building or other structure is intended to be provided. If works are carried out during the breeding season, a pre-construction survey will be carried out by the ECoW and if birds are detected appropriate mitigation measures will be implemented. Where possible, vegetation will be removed outside of the breeding season and in particular, removal during the peak-breeding season (April-June inclusive) will be avoided. This will also minimise the potential disturbance of breeding birds outside of the Proposed Development site boundary. Particular care will be taken at the boundary between the Proposed Development site and the cSAC, SPA and pNHA so that construction activities do not cause damage to habitats in this area. These habitats will be securely fenced off early in the construction phase. The fencing will be clearly visible to machine operators. The Ralappane Stream runs from the Proposed Development site through the cSAC and pNHA to the sea, it is important that construction activities do not result in pollution of this watercourse, either through siltation, which interferes with water flow, vegetation growth and aquatic fauna, or pollution (e.g. chemical). Refer to Chapter 06 Section 6.10 for further details on mitigation. Any disturbance to cliff habitat from vehicular access should be minimised and will require a detailed method statement which will be agreed with the NPWS prior to commencement of works To prevent incidental damage by machinery or by the deposition of spoil during site works, hedgerow, tree and scrub vegetation which are located in close proximity to working areas will be clearly marked and fenced off to avoid accidental damage during excavations and site preparation. The ECoW will specify appropriate protective fencing where required. Habitats that are damaged and disturbed will be reinstated and landscaped once construction is complete. Disturbed areas will be seeded or planted using appropriate native grass or species native to the areas where necessary. Natural regeneration of vegetation will also occur. There will be a defined working area which will be fenced off with designated haul routes to prevent inadvertent damage to adjoining habitats. Tree root systems can be damaged during site clearance and groundworks. Materials, especially soil and stones, can prevent air and water circulating to the roots. No materials will be stored within the root protection area/ dripline of trees. The ECoW will specify appropriate protective fencing where required.	Not significant to slight	7B
Construction	Badger	Medium	Sett removal/mortality/injury disturbance and/displacement	Significant	This will require exclusion of Badgers from subsidiary/ outlier setts, however in both instances both social groups of Badgers would be expected to continue to use their main setts.	Significant	7B

Badger sett tunnel systems can extend up to approximately 20 m from sett entrances. Therefore, no heavy machinery should be used within 30 m of Badger setts (unless carried out under licence); lighter machinery (generally wheeled vehicles) should not be used within 20 m of a sett entrance; light work, such as digging by hand or scrub clearance should not take place within 10m of sett entrances.

During the breeding season (December to June inclusive), none of the above works should be undertaken within 50 m of active setts nor blasting or pile driving within 150m of active setts.

Affected Badger setts will be clearly marked and the extent of bounds prohibited for vehicles clearly marked by fencing and signage.

The most recent surveys show that the two main Badger setts are located outside of the Proposed Development site boundary and the two setts to be directly affected are subsidiary setts. The bait marking survey indicates that the setts are linked as follows:

Sett 4 (main sett) is located to the east of the Proposed Development. Sett 1 is located within the Proposed Development site boundary. These setts are used by the same social group.

Sett 3 (main sett) is located to the east of the Proposed Development. Sett 2 is located within the Proposed Development site boundary. These setts are used by the same social group.

The presence of alternative setts within the particular social group's territory is required to ensure that excluded Badgers are able to relocate to a suitable alternative refuge. The objective is to allow the Badgers to remain within their territory, even though a portion of their current territory may be lost as a result of a particular development. There is a standard methodology which can be utilised to exclude Badgers from setts

A methodology for the exclusion of Badgers from affected setts and displacement of Badgers to artificial setts is outlined in the National Roads Authority publication Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes (NRA 2005a). Detailed mitigation measures including method statements will be agreed with the NPWS prior to implementation as part of a licence application.

Exclusion of Badgers from any currently active sett will only be carried out during the period of July to November (inclusive) in order to avoid the Badger breeding season.

In the instance of disused setts or setts verified as inactive, and to prevent their reoccupation, the entrances may be lightly blocked with vegetation and a light application of soil (soft blocking). The purpose of soft-blocking is to confirm that an apparently inactive sett is not occupied by Badgers. If all entrances remain undisturbed for approximately five days, the sett should be destroyed immediately using a mechanical digger, under the supervision of the licensee. Should there be any delay in sett destruction, the soft-blocked entrances should be hard-blocked and the sett destroyed as soon as possible, again under the supervision of the licensee. Hard-blocking is best achieved using buried fencing materials and compacted soil with further fencing materials laid across and firmly fixed to blocked entrances and surrounds

Where field signs or monitoring reveal any suggestion of current or recent Badger activity at any of the sett entrances, the sett requires thorough evacuation procedures.

Inactive entrances may be soft and then hard-blocked, as described for inactive setts, but any active entrances should have one-way gates installed (plus proofing around sides of gates as illustrated) to allow Badgers to exit but not to return. The gates should be tied open for three days prior to being set to exclude. Sticks should be placed at arm's length within the gated tunnels to establish if Badgers remain within the sett.

Gates should be left installed, with regular inspections, over a minimum period of 21 days (including period with gates tied open) before the sett is deemed inactive. Any activity at all will require the procedures to be repeated or additional measures taken. Gates might be interfered with by other mammals or members of the public - hence the importance of regular exclusion monitoring visits. Sett destruction should commence immediately following the 21-day exclusion period, provided that all Badgers have been excluded.

Badgers will often attempt to re-enter setts after a period, and if gates are left in place for any long period, they may attempt to dig around them or even create new entrances and tunnels into the sett system.

Where an extensive sett is involved, an alternative method of evacuating Badgers is to erect electric fencing around the sett (ensuring all entrances are included) with one-way Badger-gates installed within the electric fence at points where the fence crosses Badger paths leading to and from the sett. The exclusion should again take place over a minimum period of 21 days before sett destruction; this monitoring period would be contingent upon no Badger activity being observed within the fenced area. Fencing may

					not be practical in many situations due to the topography or the terrain – and can be difficult to install effectively. If no activity is observed, then the sett may be destroyed, under supervision by the licensed wildlife expert. The destruction of a successfully evacuated Badger sett may only be conducted under the supervision of qualified and experienced personnel under licence from the NPWS. The possibility of Badgers remaining within a sett must always be considered; suitable equipment should be available on hand to deal with Badgers within the sett or any Badgers injured during sett destruction. Destruction is usually undertaken with a tracked 12-25 tonne digger, commencing at approximately 25 m from the outer sett entrances and working towards the centre of the sett, cutting approximately 0.5 m slices in a trench to a depth of 2 m. Exposed tunnels may be checked for recent Badger activity, with full attention paid to safety requirements in so doing. The sett should be destroyed from several directions, in the above manner, until only the central core of the sett remains. Once it is ensured that no Badgers remain, the core may then also be destroyed and the entire area back-filled and made safe. Sett excavation should, preferably, be concluded within one working day, as Badgers may re-enter exposed tunnels and entrances. A report detailing evacuation procedures, sett excavation and destruction, and any other relevant issues should be submitted to the NPWS, in fulfilment of usual wildlife licence conditions. Construction activities within the vicinity of affected setts may commence once these setts have been evacuated and destroyed under licence from the NPWS. Where affected setts do not require destruction, construction works may commence once recommended alternative mitigation measures to address the Badger issues have been complied with. Badger access points will be provided to allow Badgers to access the development area once complete See (NHBS, 2021 or similar). Gates will be placed within fences along the western, eastern and southern boundaries to maximise potential usage by the different social groups that occur within this area. Monitoring of Badger setts will be carried out during construction works and a five-year post-construction monitoring programme will be implemented.		
Construction	Bats	High	Disturbance/ displacement	Not significant	During the site works, general mitigation measures for bats will follow the National Road Authority's 'Guidelines for the Treatment of Bats during the Construction of National Road Schemes' NRA (2005c) and 'Bat Mitigation Guidelines for Ireland: Irish Wildlife Manuals, No. 25' (Kelleher, C. & Marnell, F. (2006)). These documents outline the requirements that will be met in the pre-construction (site clearance) stage to minimise negative effects on roosting bats, or prevent avoidable effects resulting from significant alterations to the immediate landscape. A Common Pipistrelle colony was recorded in a farm building southwest of the Proposed Development site. This building will not be affected. No bat roosts were recorded within the site boundary. Mitigation measures will be agreed with the National Parks and Wildlife Service prior to any demolition works and will include the following: Two buildings within the Proposed Development site will be demolished as part of the development. No signs of bats were recorded within these buildings. However as a precautionary measure, the following measures will be implemented prior to and/ or during demolition: • In all cases immediately in advance of demolition a bat specialist will undertake an examination of the building. If bats are present at the time of examination it is essential to determine the nature of the roost (i.e. number, species, whether it is a breeding population) as well as its exact location; • If bats are recorded in buildings earmarked for demolition, special mitigation measures to protect bats will be put in place and a license to derogate from the conservation legislation will be sought from the NPWS; • The contractor will take all required measures to ensure works do not harm individuals by altering working methods or timing to avoid bats, if necessary; • If roosting habitat for bats is removed, replacement habitat will be provided; • A number of trees will be removed prior to construction. Although mature trees with the potential of be value as bat roosts are absent from the site, the following precautionary measures will be implemented; • The bat specialist will work with the contractor to ensure that the loss of trees is minimised and that trees earmarked for retention are adequately protected;	Not significant	7B

					• Tree-felling will ideally be undertaken in the period September to late October/ early November. During this period bats are capable of flight and may avoid the risks of tree-felling if proper measures are undertaken; • Felled trees will not be mulched immediately. Such trees will be left lying several hours and preferably overnight before any further sawing or mulching. This will allow any bats within the tree to emerge and avoid accidental death. The bat specialist will be on-hand during felling operations to inspect felled trees for bats. If bats are seen or heard in a tree that has been felled, work will cease and the local NPWS Conservation Ranger will be contacted; • Tree will be retained where possible and no 'tidying up' of dead wood and spilt limbs on tree specimens will be undertaken unless necessary for health and safety; • Treelines outside the Proposed Development area but adjacent to it and thus at risk, will be clearly marked by a bat specialist to avoid any inadvertent damage; • During construction directional lighting will be employed to minimise light spill onto adjacent areas. Where practicable during night-time works, there will be no directional lighting focused towards watercourses or boundary habitats and focusing lights downwards will be utilised to minimise light spillage; • If bats are recorded by the bat specialist within any trees no works will proceed without a relevant derogation licence from the NPWS; and • As a biodiversity enhancement measure it is proposed that bat boxes will be put up within the Proposed Development site. It is proposed that eight bat boxes will be located within the overall site. The boxes will be erected by the ECoW taking into account landscape plans, vehicle movements and lighting. As noted in 7.5.1.5, lighting mitigation measures will follow Bats & Lighting Guidance Notes for: Planners, engineers, architects and developers (Bat Conservation Ireland, 2010). All mitigation measures including detailed method statements will be agreed with the NPWS prior to commencement of works, which could affect any bat populations onsite.		
Construction	Otter	Medium	Disturbance/ displacement	Not significant	No signs of Otter or Otter holts were noted within 150 m of the Proposed Development site. Although Otter were recorded along the Ralappane Stream and to the west of the Proposed Development site. A detailed pre-construction survey will be carried out no more than 10-12 months prior to the commencement of construction works to confirm the absence of Otter holts within 150m of the site. If Otter holts are recorded at that time, the ECoW will determine the appropriate means of minimising effects i.e. avoidance, moving works, timing of works etc. If required the ecologist will obtain a derogation licence from the NPWS, to facilitate licenced exclusion from the breeding or resting site in accordance with a plan approved by the NPWS. Any holts found to be present will be subject to monitoring and mitigation as set out in the NRA publication Guidelines for the Treatment of Otter prior to the Construction of National Road Schemes (2008). If found to be inactive, exclusion of holts may be carried out during any season. No wheeled or tracked vehicles (of any kind) will be used within 20m of active, but non-breeding, Otter holts. Light work, such as digging by hand or scrub clearance will also not take place within 15m of such holts, except under licence. The prohibited working area associated with Otter holts will be fenced and appropriate signage erected. Where breeding females and cubs are present no evacuation procedures of any kind will be undertaken until after the Otters have left the holt, as determined by the ECoW. Breeding may take place at any season, so activity at a holt must be adjudged on a case-by-case basis. On occasion, Otter holts may be directly affected by the scheme. To ensure the welfare of Otters, they must be evacuated from any holts present prior to any construction works commencing. The exclusion process, if required, involves the installation of one-way gates on the entrances to the holt and a monitoring period of 21 days to ensure the Otters have left the holt prior to removal.	Not significant	7B
Construction	Common Frog	Medium	Habitat loss/ mortality/ injury	Moderate	A visual search of the wet grassland habitat to be removed will be carried out in the days prior to commencement of development and any frogs will be removed to alternative wet grassland habitat elsewhere within the landholding. This will be carried out under licence from the NPWS.	Not significant	7B
Construction	Birds	Medium	Habitat loss/ mortality/ injury Mortality or injury, Disturbance/ displacement Direct loss of breeding/ foraging habitat	Not significant to moderate	No signs of nesting birds were recorded in disused farm buildings during the 2018-2021 surveys. However, prior to demolition buildings will be checked for nesting Swallows (and other birds). If nesting birds are recorded, all demolition operations will be carried out between October and March, when birds have finished breeding. As noted in Section 7.7.1.6, where possible, vegetation will be removed outside of the breeding season and in particular, removal during the peak-breeding season (April-June	Not significant	7B

					inclusive) will be avoided. This will also minimise the potential disturbance of breeding birds outside of the Proposed Development site boundary. As a biodiversity enhancement measure ten bird nesting boxes (various types) will be located within the Proposed Development site boundary at locations specified by the ECoW. It is noted that provision of woodland planting and the use of more diverse grassland planting will provide additional nesting and feeding sites for birds, particularly as these habitats mature. A detailed method statement will be drawn up by the ECoW and agreed with the NPWS prior to commencement of works. The method statement will specify the timing of blasting operations and the need, if any, for ecological supervision. As noted in Chapter 07A Section 7.7.2 a soft-start will be required for piling works or any source, including equipment testing, exceeding 170 dB re: 1μPa @1m an appropriate ramp-up procedure (i.e. 'soft-start') must be used. This should be a minimum of 20 minutes and no longer than 40 minutes.		
Construction	Biodiversity and landscaping	Low	Habitat loss	Slight positive	Details of the landscaping plan for the Proposed Development are included in Figure F2-4 in Volume 3. This includes detailed areas of native woodland and native scrub habitat as well as native grassland planting. The woodland planting mix will be dominated by native species including Scots Pine *Pinus sylvestris*, Willow, Pedunculate Oak *Quercus r*obur and Sessile Oak *Quercus petraea*, Alder, Rowan *Sorbus* spp. and Crab Apple *Malus* spp.. The woodland edge planting mix will include Hazel *Corylus* spp., Hawthorn, Blackthorn, Elder *Sambucus* spp. and Holly *Ilex* spp.. The objective of these elements is to create natural, multi-layered woodland habitat which will be of local ecological value and has the potential to support native flora and fauna. A linear strip of woodland along the southern boundary will help to maintain connectivity (east to west) between habitats in the wider landscape. Additional native specimen trees (Willow, Wild Cherry *Prunus avium*, Rowan, Whitebeam *Sorbus subg*. Aria and Silver Birch) will be planted on peripheral areas such as the road edge and administration area. As detailed in Figure F2-4 in Volume 3 a native wildflower/ grass mix will be utilised to provide a more diverse sward which is of higher ecological value for invertebrates and birds. Perennial Rye Grass or other vigorous amenity/ agricultural grass species will not be utilised as they tend to over-dominate the sward and reduce overall biodiversity. The final grassland/ wildflower mix for same will be specified by the ECoW based on final ground conditions including alkalinity, fertility and moisture levels. Based on the seed mix utilised and on prevailing ground conditions, the ECoW will specify the management regime, including weed control and mowing regime, necessary to maximise biodiversity and habitat value. Five insect nesting boxes suitable for Hymenoptera spp. (bees and wasps) will be put in place within the site boundary as a biodiversity enhancement measure.	Slight positive	7B
Construction	Invasive species	Slight	Loss of habitat for native flora	Not significant	Prior to the commencement of construction works invasive species survey will be undertaken within the Proposed Development boundary by a competent ecologist to determine if invasive species listed under Part 1 of the Third Schedule of S.I No. 477 of 2011 have established in the area in the period between pre-planning and post consent. In the event that invasive species are identified within the works area a site-specific Invasive Species Management Plan will be developed and implemented by a competent specialist on behalf of the Contractor. In addition, in order to comply with Regulations 49 and 50 of the European Communities (Birds and Natural Habitat) Regulations (2011) the appointed Contractor will ensure biosecurity measures are implemented throughout the construction phase to ensure the introduction and translocation of invasive species is prevented. The appointed ECoW will carry out a toolbox talk which will identify invasive species and will also implement biosecurity measures such as the visual inspection of vehicles for evidence of attached plant or animal material prior to entering and leaving the works area.	Not significant	7B
Operation	General	Medium	Displacement/ disturbance	Slight	During the operational phase the site environmental management system will address management of potentially contaminating materials such as fuel, lubricating oils, solvent, etc. and ensure such material is appropriately controlled, in accordance with regulatory requirements and industry best practice. The drainage design for the Power Plant will consider the magnitude of the changes in infiltration and runoff characteristics and the significance of potential impacts at the wetland. Further details on operational water management are included in Chapter 06 – Water. Lighting shall be provided in plant areas where safe access and safe conditions for work activities is required at night. Lighting will also be required on the water around the jetty dock to detect spillage and possibly unauthorized craft. The onshore receiving facilities	Not significant	7B

would have area lighting installed on a down angle to cover the LNG Terminal and Power Plant. The terminals will have a level of lighting sufficient to ensure that all ship/ shore interfaces activities can be safely conducted during periods of darkness. Lighting levels will meet national and international engineering standards as a minimum

The principal mitigation measures required for the development in relation to noise concern selection of equipment, sound containment, and acoustic attenuators, in order to achieve the required limits. The predicted noise levels, as outlined in Chapter 09 – Airborne Noise and Groundborne Vibration are considered to be readily technically achievable using standard methods.

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AECOM Delivering a better world

CHAPTER 08
Air Quality

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park
Environmental Impact Assessment Report

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8. Air Quality

8.1 Introduction

This chapter describes the potential for the construction, operation and decommission of the Proposed Development to have a significant effect on local air quality. Impacts on air quality can affect human receptors through harm to health and amenity, and nature conservation receptors through harm to vegetation and habitat.

This chapter provides a description of relevant legislation and policy framework, assessment methodology, baseline conditions at the Proposed Development site and its surroundings, an estimate of the anticipated air emissions associated with each of the phases of the Proposed Development, the mitigation measures required to prevent, reduce, or offset any significant adverse effects, and the likely residual effects after these measures have been employed.

8.1.1 Competent Expert

The assessment has been undertaken by Gareth Hodgkiss, an Associate Director with AECOM who has over 15 years of experience in the field of air quality assessment. Gareth holds a Masters of Science degree in Environmental Management from the University of Nottingham (UK) and is a Member of the Institute of Air Quality Management and a Member of the Institution of Environmental Sciences. He has experience of undertaking air quality assessment to support planning and licence applications for industrial sources across Ireland, and experience of assessing air quality impacts in the oil and gas sector for projects in the UK, Central Asia and Africa.

8.1.2 Scope of Assessment

The construction and operational phases of the Proposed Development are covered by this assessment. The air quality impacts arising from these are summarised as follows:

- Construction phase
  - Emissions of dust and particulates from construction activity; and
  - Emissions of oxides of nitrogen (NO_X) (including nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$) from construction phase traffic movements, site plant and Non-Road Mobile Machinery.
- Operational Phase
  - Combustion emissions associated with combustion sources for generating heat and power, including NO_X (including NO_2), PM_{10} and $PM_{2.5}$, Total Hydrocarbons (THC) and Volatile Organic Compounds (VOC) (with Formaldehyde (CH_2O) considered separately), carbon monoxide (CO) and sulphur dioxide (SO_2); and
  - Emissions of NO_2 and particulate matter PM_{10} and $PM_{2.5}$ from operational phase traffic movements.

Being an industrial development with storage facilities for natural gas and associated processes, including the storage of diesel fuel and odorants, there is a risk of potential odour emissions from fugitive sources during the operation of the Proposed Development. The Proposed Development will be operated under the conditions of an Industrial Emissions (IE) Licence. The terms of the Licence will require that any fugitive emissions are controlled at source through appropriate management/ mitigation, possibly set out as part of an Operational Emissions Management Plan, or a specific Odour Management Plan. This will reference the application of the Environmental Protection Agency (EPA) guidance 'Odour Impact Assessment Guidance for EPA Licensed Sites (AG5)' (EPA, 2019). The enforcement of the IE licence will ensure that fugitive emissions of odour are minimised and any associated impact at the nearest sensitive locations are negligible and as such, odour emissions are not considered further in this assessment.

There is no detailed plan for decommissioning at this stage, but it is considered that potential air quality impacts during the decommissioning phase will be no worse than those during the construction and operational phase scenarios that are being assessed.

8.2 Legislation and Policy

8.2.1 National Air Quality Standards

The National Air Quality Standards (Government of Ireland, 2011) were transcribed from the following EU legislation:

- European Union (EU) air quality legislation is provided within Directive 2008/50/EC (Clean Air for Europe (CAFE)), which came into force on 11th June 2008. This Directive consolidated previous legislation which was designed to deal with specific pollutants in a consistent manner and provided new air quality objectives for particulate matter with an aerodynamic diameter of less than 2.5 µm ($PM_{2.5}$). The consolidated Directive includes:
  - Directive 99/30/EC - the First Air Quality 'Daughter' Directive - sets ambient Air Quality Limit Values (AQLVs) for NO2, oxides of nitrogen (NOX), sulphur dioxide, lead and particulate matter with an aerodynamic diameter of less than 10µm (PM10);
  - Directive 2000/69/EC - the Second Air Quality 'Daughter' Directive - sets ambient AQLVs for benzene and carbon monoxide; and
  - Directive 2002/3/EC - the Third Air Quality 'Daughter' Directive - seeks to establish long term objectives, target values, an alert threshold and an information threshold for concentrations of ozone in ambient air.
- The fourth daughter Directive was not included within the consolidation and is described as Directive 2004/107/EC. This sets health-based limits on polycyclic aromatic hydrocarbons, cadmium, arsenic, nickel and mercury, for which there is a requirement to reduce exposure to as low as reasonably achievable.
- Directive 2008/50/EC has been implemented through the Air Quality Standards Regulations 2011 (EPA, 2011). These regulations set out upper and lower assessment thresholds for the pollutants of concern. The Air Quality Standards include thresholds to encourage a higher standard of air quality where possible.

The EU Limit Values and National Air Quality Standards that are of relevance to this assessment are presented in Table 8-1.

In addition to the Limit Values and Air Quality Standards, Table 8-1 provides relevant Environmental Assessment Levels and averaging periods for other pollutants, as referred to within EPA guidance (2020). These, which are commonly associated with industrial emissions, are not covered by the EU Directives listed above, but are considered potentially harmful to the environment and human health if present at concentrations exceeding the Environmental Assessment Levels listed.

Table 8-1 also provides Critical Loads for nutrient nitrogen and acid (nitrogen and sulphur), set by the Convention on Long-Range Transboundary Air Pollution (APIS, 2016), for habitats that may potentially be affected by emissions associated with the Proposed Development.

Table 8-1 Air Quality Standards and Environmental Assessment Levels

Pollutant	Averaging Period	Irish Air Quality Standard/ EU Limit Value/ Environmental Assessment Level	Allowable Exceedance
Irish Air Quality Standard/ EU Limit Value			
Nitrogen dioxide (NO_2)	Annual mean	40 µg/m^3	No exceedances allowed
	Hourly mean	200 µg/m^3	18 allowable exceedances (99.79th percentile of hours/year)
Particulate matter (PM_{10})	Annual mean	40 µg/m^3	No exceedances allowed
	Daily mean	50 µg/m^3	35 allowable exceedances (99.41st percentile of days/year)

Pollutant	Averaging Period	Irish Air Quality Standard/ EU Limit Value/ Environmental Assessment Level	Allowable Exceedance
Fine particulate matter ($PM_{2.5}$)	Annual mean	25 µg/m^3	No exceedances allowed
Carbon monoxide (CO)	Rolling 8-hour maximum	10,000 µg/m^3	No exceedances allowed
Sulphur dioxide (SO_2)	Daily mean	125 µg/m^3	3 allowable exceedances (99.18th percentile of days/year)
	Hourly mean	350 µg/m^3	24 allowable exceedances (99.73th percentile of hours/year)
Benzene (C_6H_6)	Annual mean	5 µg/m^3	No exceedances allowed
Oxides of nitrogen (NO_X) – for the protection of ecosystems	Annual mean	30 µg/m^3	No exceedances allowed
Sulphur dioxide (SO_2) – for the protection of ecosystems	Annual mean	20 µg/m^3	No exceedances allowed
UK EA Environmental Assessment Levels			
Carbon monoxide (CO)	Hourly maximum	30,000 µg/m^3	No exceedance allowed (100th percentile rolling 8-hour periods/year)
Sulphur dioxide (SO_2)	15-minute mean	266 µg/m^3	35 allowable exceedances (99.99th percentile of 15-minute periods/year)
Benzene (C_6H_6)	Hourly maximum	195 µg/m^3	No exceedance allowed (100th percentile of hours/year)
Formaldehyde (CH_2O)	Annual Mean	5 µg/m^3	No exceedances allowed
	Hourly maximum	100 µg/m^3	No exceedance allowed (100th percentile of hours/year)
Oxides of nitrogen (NO_X) – for the protection of ecosystems[1]	Daily maximum	75 µg/m^3	No allowable exceedances (100th percentile of days/year)
Sulphur dioxide (SO_2) – for the protection of ecosystems	Annual Mean	10-20 µg/m^3	No exceedances allowed
Convention on Long-Range Transboundary Air Pollution Critical Loads			
Nutrient nitrogen deposition	Annual	Habitat relevant Critical Loads[2]	No exceedances allowed
Acid deposition	Annual	Habitat relevant Critical Loads[2]	No exceedances allowed

Notes:

[1] Research cited in IAQM guidance (2020) states that the daily NO_X standard is of less importance than the annual NO_X standard at nature conservation sites. The daily NO_X standard is typically only of concern at a nature conservation site when SO_2 and O_3 concentrations are elevated close to or in excess of their Air Quality Standards for the protection of ecosystems. The SO_2 concentrations reported in Table 8-17 and the O_3 data reported in Table 8-14 demonstrate that concentrations of neither SO_2 or O_3 are elevated close to those standards and as such, the nature conservation receptors included in this assessment are not considered sensitive to the daily NO_X impacts reported.

[2] See Table 8.9 for habitat specific Critical Loads.

8.2.2 Industrial Emissions Directive

The installed aggregated thermal capacity of the Proposed Development will exceed 50 MW. As such, its operations will fall within the remit of the EU's Industrial Emissions Directive (2010/75/EU). The primary aims of the Industrial Emissions Directive are to prevent or reduce pollution from industrial activities, to reduce waste and to promote energy efficiency. The Directive applies to all large industrial installations and to power plants, which are above a certain size threshold. The Directive will apply to the applicable combustion plant associated with the Proposed Development site.

The Environmental Protection Agency (EPA) is the statutory body for the regulation of IE licences. Shannon Technology and Energy Park will be required to obtain an IE licence from the EPA for the proposed CCGT Power Plant. IE licences are determined having regard to the principle of Best Available Techniques (BAT), which, in turn, is based on the Best Available Techniques Reference Documents ('BREF' documents) developed and published by the European Commission. The EU has prepared a series of reference documents for different industrial activities, which define BAT for that activity.

A Best Available Technology (BAT) Assessment has been undertaken and is summarised in Chapter 01 – Introduction.

8.2.3 Relevant Environmental Legislation

Other national legislative measures that relate to air quality and are of relevance to this assessment are listed are follows:

- European Union (Environmental Impact Assessment) (Environmental Protection Agency Act 1992) (Amendment) Regulations 2020, S.I. No. 191 of 2020;
- European Communities (Birds and Natural Habitats) (Amendment) Regulations 2015, S.I. No. 355 of 2015;
- European Union (Industrial Emissions) Regulations 2013, S.I. 138 of 2013;
- Environmental Protection Agency (Industrial Emissions) (Licensing) Regulations 2013, S.I. 137 of 2013; and
- European Communities (Birds and Natural Habitats) Regulations 2011, S.I. No. 477 of 2011.

8.2.4 National Planning Policy

8.2.4.1 Project Ireland 2040

Project Ireland 2040 is the Government's long-term overarching strategy for future development and infrastructure in Ireland. It consists of several documents, including the National Planning Framework (Government of Ireland, 2018), which is the Government's high-level strategic plan for shaping the future growth and development of Ireland up to 2040.

The National Planning Framework includes the following overarching aim that is relevant to this assessment:

> '*Creating a Clean Environment for a Healthy Society:*
>
> *…Promoting Cleaner Air: Addressing air quality problems in urban and rural areas through better planning and design.*'

The National Planning Framework includes National Policy Objective 64, which stresses the importance of improving ambient air quality:

> '*National Policy Objective 64: Improve air quality and help prevent people being exposed to unacceptable levels of pollution in our urban and rural areas through integrated land use and spatial planning that supports public transport, walking and cycling as more favourable modes of transport to the private car, the promotion of energy efficient buildings and homes, heating systems with zero local emissions, green infrastructure planning and innovative design solutions.*'

Project Ireland 2040 also includes the Government's National Development Plan (Government of Ireland, 2018). This document is focused on Ireland's long-term economic, environmental and social progress up to 2027, and references improvements in air quality as an additional benefit to improving energy efficiency for the primary purpose of reducing carbon emissions.

The air quality assessment described in this chapter will demonstrate whether or not the emissions associated with the construction, operation and decommissioning of the Proposed Development contravene the relevant aims and objectives of Project Ireland 2040.

8.2.5 Local Planning Policy

8.2.5.1 Kerry County Development Plan 2015 – 2021

Planning decisions within Co. Kerry's administrative area are considered against the policies set out in the current County Development Plan (Kerry County Council, 2015). With regards to local air quality and amenity impacts, the following policies are of relevance:

- **Core Strategy CS11** - Support the National Climate Change Strategy and the National Climate Change Adaptation Framework, Building Resilience to Climate Change on an ongoing basis through implementation of supporting objectives in this Plan, particularly those supporting use of alternative and renewable energy sources, sustainable transport, air quality, coastal zone management, flood risk management, soil erosion and promotion of the retention of and planting of trees, hedgerows and afforestation subject to compatibility with environmental designations and legislative requirements.
- **Objective ES28** - Proposals for any economic development in rural areas must demonstrate… That there will be no adverse impact on the residential amenity of nearby residents, particularly in relation to noise, traffic, air quality odours or vermin.
- **Objective NR5** - Ensure all extractive development proposals comply with the objectives of this plan as they relate to development management standards, flood risk management requirements and the protection of landscape, biodiversity, infrastructure, water and air quality, built and cultural heritage and residential amenity.

The Kerry County Development Plan 2022 – 2028 should be published by the Council later this year, having gone through public consultation and review since 2020.

The air quality assessment described in this chapter will demonstrate whether or not the emissions associated with the construction, operation and decommission of the Proposed Development contravene the relevant strategies and aims of Kerry County Development Plan.

8.3 Methodology

8.3.1 Study Area

The air quality study area varies dependent on the source of emissions being considered. The construction phase dust assessment follows the industry standard guidance published by the Institute of Air Quality Management (IAQM) (2014) and considers construction dust impacts on amenity and human health at locations within 350 m of the construction site boundary, and at locations with 50 m of a public road used by construction traffic that is within 500 m of the egress point onto the public road. Construction dust impacts on ecologically sensitive areas within 50 m of the construction site boundary are considered.

The methodology for the assessment of road traffic emissions impacts follows guidance explicitly for that source (TII (NRA), 2011; Highways England (HE), 2019; Moorcroft and Barrowcliffe, et al., 2017) and considers impacts on selected representative receptors located within 200 m of a public road that experiences a defined change in traffic flows. Of the guidance available, that published by the IAQM (Moorcroft and Barrowcliffe, et al., 2017) provides the most stringent criteria with consideration recommended for roads that experience an increase in traffic flow, composition and/ or speed to the extent that it exceeds the criteria below:

- An increase in Light Duty Vehicles (weight <3.5t) of +500 two-way movements per average 24-hour day; and/ or
- An increase in Heavy Duty Vehicles (weight >3.5t) of +100 two-way movements per average 24-hour day.

The methodology for the assessment of industrial site emissions impacts is based on the EPA's Air Dispersion Modelling Guidance Note (AG4) (2020), with reference to UK Environment Agency's Air emissions risk assessment for your environmental permit guidance (2016), which considers locations to represent the worst-case impacts of such emissions from the Proposed Development site, as well as internationally designated nature conservation sites within 10 km of the Proposed Development site.

8.3.2 Impact Assessment

8.3.2.1 Construction Phase Dust and Particulate Matter Assessment

Overview

The movement and handling of soils and spoil during construction is likely to give rise to some short-term airborne dust. The occurrence and significance of dust generated by earth moving operations onsite depositing beyond the site boundary is difficult to estimate and depends upon the weather conditions, ground conditions and location of the work relative to receptors, and the nature of the actual activity being carried out.

Dust emissions and subsequent deposition and soiling at sensitive locations have the potential to harm the amenity of the users of that sensitive land use and or harm vegetation by affecting the rate of photosynthesis. Particulates emissions at sensitive locations is associated with increased risk of harm to human health.

At present, there are no statutory Irish or EU standards relating to the assessment or control of dust. The emphasis of the regulation and control of construction dust, therefore, is through the adoption of Best Practicable Means (BPM) when working onsite. It is intended that significant adverse environmental effects are avoided at the design stage and through embedded mitigation where possible, including the use of good working practices to minimise dust formation which is detailed further in Section 8.6.1.5 of this Chapter.

Assessment Approach

The IAQM provides guidance for good practice qualitative assessment of risk of dust emissions from construction and demolition activities (Holman et al., 2014). The guidance considers the risk of dust emissions from unmitigated activities to cause human health (PM_{10}) impacts, dust soiling impacts, and ecological impacts (such as physical smothering, and chemical impacts for example from deposition of alkaline materials). The appraisal of risk is based on the scale and nature of activities and on the sensitivity of receptors, and the outcome of the appraisal is used to determine the level of good practice mitigation required for adequate control of dust.

The assessment undertaken for this chapter is consistent with the overarching approach to the assessment of the impacts of construction, and the application of example descriptors of impact and risk set out in IAQM guidance. It considered the significance of effects from potential impacts with no mitigation and recommends mitigation measures appropriate to the identified risks to receptors. To encourage consistency with the wider EIA, some of the terminology used in the IAQM guidance has been adjusted to match common terminology used in EPA guidance (2017). The steps in the assessment are to:

- Identify receptors within the screening distance of the site boundary;
- Identify the magnitude of effect through consideration of the scale, duration and location of activities being carried out (including demolition, earthworks, construction and trackout, where construction vehicles could carry mud onto the public highway);
- Establish the sensitivity of the area through determination of the sensitivity and number of receptors and their distance from construction activities;
- Determine the risk of significant effects from impacts on receptors occurring as a result of the magnitude of impact and the sensitivity of the area, assuming no additional mitigation (beyond the identified development design and impact avoidance measures) is applied;
- Determine the level of mitigation required based on the level of risk, to reduce potential impacts at receptors to insignificant or negligible; and
- Summarise the potential residual effects of the mitigated works.

A detailed description of the IAQM construction dust assessment methodology is provided in Volume 4, Appendix A8-1 of this EIAR.

8.3.2.2 Construction Phase Site Plant and Non-Road Mobile Machinery Emissions Assessment

Overview

Combustion products will be emitted to air from onsite construction plant and/ or Non-Road Mobile Machinery (NRMM) operations during construction activities. This will affect air quality and give rise to impact in the form of exposure to increased concentrations of pollutants of sensitive receptors.

Assessment Approach

The IAQM guidance on the assessment of dust from demolition and construction (Holman et al., 2014) includes some discussion of onsite plant and NRMM emissions and states:

> '*Experience of assessing the exhaust emissions from onsite plant … and site traffic suggests that they are unlikely to make a significant impact on local air quality, and in the vast majority of cases they will not need to be quantitatively assessed. For site plant and onsite traffic, consideration should be given to the number of plant/ vehicles and their operating hours and locations to assess whether a significant effect is likely to occur.*'

In this instance, the closest human health sensitive receptor is over 300 m from the nearest point of the site boundary and whilst sections of the site boundary adjoin a Candidate Special Area of Conservation (cSAC) and Special Protection Area (SPA), the nearest habitat within the cSAC/ SPA that is considered sensitive to air quality impacts is over 2 km away.

The Highways England guidance (2019) suggests that a source of road traffic emissions that is in excess of 200 m from a receptor will not likely contribute to a significant effect and does not require quantification. For the purpose of this assessment it is considered that such conditions also apply to site plant and NRMM, due to the similar height of emissions release and the intermittent and transient nature of those emissions. As such, and due to the distance between the construction site boundary (and works within) and the nearest air quality sensitive receptors, it is considered that site plant and NRMM emissions impacts will not have a significant effect on local air quality. The impact of construction phase site plant and NRMM emissions has not been considered further.

8.3.2.3 Construction Phase Traffic Emissions Assessment

Overview

The incomplete combustion of fuel in vehicle engines results in the presence of combustion products of CO, PM_{10}, and $PM_{2.5}$ in exhaust emissions as well as hydrocarbons (HC) such as benzene and 1,3-butadiene. Similarly, but to a lesser extent, any sulphur in the fuel can be converted to SO_2 that is then released to atmosphere. In addition, at the high temperatures and pressures found within vehicle engines, some of the nitrogen in the air and the fuel is oxidised to form oxides of nitrogen, mainly in the form of nitric oxide (NO), which is then converted to NO_2 in the atmosphere. NO_2 is associated with adverse effects on human health. Better emission control technology and fuel specifications are expected to reduce emissions per vehicle in the long term.

Although SO_2, CO, benzene, and 1,3-butadiene are present in motor vehicle exhaust emissions, detailed consideration of the associated impacts on local air quality is not considered relevant in the context of this Proposed Development. This is because the released concentrations of these pollutants are low enough so as to not be likely to give rise to significant effects, either in isolation or in combination. In addition, no areas within the local area are considered to be at risk of exceeding the relevant objectives for these pollutants. Therefore, the risks to the attainment of the relevant air quality objectives in the vicinity of the Proposed Development are considered negligible. Emissions of SO_2, CO, benzene, and 1, 3-butadiene from road traffic are therefore not considered further within this assessment.

The exhaust emissions from road vehicles that do have the potential to affect the ambient concentrations of pollutants are NO_2, PM_{10} and $PM_{2.5}$. Therefore, these pollutants are the focus of the assessment of the significance of road traffic air quality impacts.

Assessment Approach

The Design Manual for Roads and Bridges (DMRB) LA105 guidance (Highways England, 2019) sets out criteria to establish the need for an air quality assessment from road traffic. The guidance considers the following changes in traffic anticipated as a result of a development, to identify the need for further evaluation or assessment:

- Annual Average Daily Traffic (AADT) flows of more than 1,000 vehicles;
- 200 Heavy Duty Vehicles (HDV, all vehicles greater than 3.5 tonnes gross weight, including buses);
- A change in the speed band; or
- A change in carriageway alignment by 5m or more.

Guidance published by the IAQM/ EPUK (Moorcroft & Barrowcliffe et al., 2017) sets out alternative and more stringent criteria with a change of 500 light duty vehicles (LDV) and/ or 100 HDV movements when outside of an area considered highly sensitive to changes in emissions (e.g. where an Air Quality Standard is being exceeded or at risk of being exceeded). For changes in traffic below these criteria, significant changes in air quality are not expected. That guidance also suggests that even where these criteria are exceeded, it does not necessarily mean there is potential for significant effect, but more detailed consideration may be required to confirm that.

Prior to any assessment, traffic movements are screened against appropriate criteria, to establish if there is the potential for a significant effect to occur. Where the criteria are exceeded on a given road link that has been considered as part of the Proposed Development Transport Assessment (Chapter 11 - Traffic and Transport), an assessment of air quality impacts will be undertaken.

Construction phase traffic data shared by the project transport consultant has demonstrated that the largest increase is traffic flow is anticipated to occur on the L1010, with 1086 additional two-way LDV movements and 73 additional two-way HDV movements (which equates to an AADT of 1159 two-way vehicle movements) in the year of peak construction. The construction of the Proposed Development is not expected to notably alter the daily average speed of vehicles using the roads, nor the alignment of the roads. Both the DMRB guidance and IAQM/ EPUK guidance suggest that such a change does have the potential to cause an effect of significance and further assessment is required.

Because of the temporary nature of impacts and pollutant concentrations associated with construction phase road traffic emissions from the Proposed Development, and the high standard of baseline air quality, the assessment is based on Highways England's DMRB simple assessment methodology, rather than a detailed assessment method using dispersion modelling software. This is considered to be a proportionate assessment for the consideration of such road traffic emissions contributions.

This approach makes use of a spreadsheet-based tool to predict annual mean NO_X and PM_{10} concentrations based on the relationship between traffic flow characteristics (annual daily average flows, composition of flows and speed) and the distance of a receptor from the road. The tool does not provide outputs for $PM_{2.5}$, so for this assessment, PM_{10} outputs are conservatively assumed to represent $PM_{2.5}$ also.

The annual mean NO_X and PM_{10} (and $PM_{2.5}$) road contribution output from the tool has been multiplied by a factor of 3 to simulate the adjustment of the model for model-bias. Professional experience suggests this is a precautionary approach. The factored road contribution NO_X is converted to NO_2 using a tool made available by the UK Governmental Department for the Environment, Food and Rural Affairs (DEFRA), which uses assumptions on ozone (O_3), NO_X and NO_2 at Local Planning Authority (LPA) level to estimate an appropriate conversion rate. Because the tool is based on conditions within UK LPAs, an assumption has been made to use the conversion rate estimated for Armagh, Banbridge and Craigavon, in Northern Ireland. This was selected as being a predominantly rural location, representative of the study area, on the same landmass and sharing a border with the Ireland.

The assessment of road traffic emissions has considered the following scenarios:

- 2019 Existing Baseline;
- 2024 Future Baseline; and
- 2024 Future Construction Phase.

Input data for the road traffic screening assessment spreadsheet is summarised in Table 8-11. The contribution of road traffic emissions to impacts and total pollutant concentrations has been quantified at receptors located within 200 m of the roads for which traffic data has been provided.

Table 8-2 Road Traffic Assessment Input Data – Construction Phase

Road Link	Traffic Flow Data						Traffic Speed (kph)[3]
	2019 Existing Baseline		2024 Future Baseline		2024 Future Construction		
	AADT[1]	%HDV[2]	AADT[1]	%HDV[2]	AADT[1]	%HDV[2]	
L1010 west of site entrance	352	0.4	372	0.4	372	0.4	- 45-80 on free-flowing sections - 20-45 at the approach to junctions
L1010 east of site entrance	352	0.4	372	0.4	1,458	5.1	
N67 north of Tarbert	1,607	2.6	1,671	2.6	1,715	2.5	
N69 Bridewell Street	5,261	2.4	5,473	2.4	6,515	3.1	
N69 east of Tarbert	5,838	3.6	6,073	3.6	6,825	4.1	
N69 south of Tarbert	4,883	2.8	5,079	2.8	5,329	2.9	
R551 southwest of Tarbert	2,909	2.5	3,026	2.5	3,026	2.5	

Notes:
1 24-hour Annual Average Daily Traffic (AADT) data (2-way flows)
2 Heavy Duty Vehicles (all vehicles >3.5t in weight)
3 Based on Highways England speed banding

It is noted that the contribution of road traffic emissions to impacts and total pollutant concentrations of pollutants associated with road traffic emissions can only be provided for pollutants with long-term (annual) averaging periods. This is because the traffic data used to inform the air quality assessment is based on average daily flows, and also because it is not standard practice to quantify short-term NO_2 contributions associated with vehicle movements. Instead, annual mean concentrations are compared against an annual mean proxy value of 60 µg/m^3 and 32 µg/m^3, values defined by research undertaken on the UK, to suggest potential for an exceedance of the hourly mean NO_2 and daily mean PM_{10} Air Quality Standards respectively (DEFRA, 2016).

8.3.2.4 Operational Phase Site Emissions Assessment

Overview

The operation of the Proposed Development will include a number of sources with emissions to air associated with combustion plant, to generate heat and power for onsite activity. Emissions to air associated with such plant vary with the type of plant and its purpose, the thermal capacity of the plant and the fuel used to enable combustion.

Natural gas will be the primary fuel source for all non-emergency plant at the Proposed Development site. Emissions from natural gas-fired plant predominantly include the pollutants NO_X and CO but may also include other pollutants to a lesser extent for some sources, including THC, some of which will comprise of VOC, including CH_2O.

Liquid fuel will also be utilised. Onshore, this fuel is limited to generators that will only ever be operational in the event of an emergency and for limited periods of testing and maintenance. Offshore, liquid fuel is required as the pilot fuel for the main power engines on the Floating Storage and Re-gasification Unit (FSRU) and the operational facility’s tug fleet. Liquid fuel is also likely to be the engine fuel for a proportion of the Liquified Natural Gas Carriers (LNGC) delivering to the operational facility. Emissions from liquid fuel-fired plant include the same pollutants associated with natural gas, plus PM_{10} and SO_2 (although SO_2 emissions are generally lessened by the use of low and ultra-low sulphur content fuels).

Assessment Method

The assessment of operational site emissions has been undertaken with detailed reference to the EPA’s Air Dispersion Modelling from Industrial Installations Guidance Note (AG4) (EPA, 2020). Detailed dispersion modelling has been undertaken using the atmospheric dispersion model system (ADMS) 5 (version 5.2.4), which is an advanced steady-state Gaussian type plume model that can simulate dispersion from multiple sources, and is a model authorised for use by the EPA. It has been used to calculate the contribution of site emissions to the total concentration of key pollutants at identified sensitive receptors. The contribution and total pollutant concentrations quantified have been compared with the defined National Air Quality Standards and Environmental Assessment Levels that are relevant to this assessment.

Modelled Scenarios

The main assessment considered in this chapter focuses on what is referred to in this assessment as the Normal Operational Scenario. This is based on the operation of plant at the Proposed Development site in the manner anticipated. However, a series of Sensitivity Scenarios have also been considered, based on alternative and/ or conservative assumptions on the operation of plant at the Proposed Development site. The Normal Operational Scenario and subsequent Sensitivity Scenarios are summarised in Table 8-2.

Table 8-2 Modelled Scenarios Description

Scenario	Operational Plant	Description of Operation
Normal Operational Scenario (Combined Loop Re-gasification[1])	4x main engines on the FSRU	Duel-fuelled – gas-fired for 95% of the year and liquid fuel-fired for 5% of the year
	3x re-gasification boilers on the FSRU	Gas-fired with 4,380 hours of operation/ year
	4x tugs	Liquid fuel-fired with 2x tugs operating for 2,310 hours/ year and 2x tugs operating for 1,155 hours/ year
	Main engine on LNGC delivering to the operational facility	Assumed 50% of LNGC visiting site are gas-fired and 50% are liquid fuel-fired, for 2,310 hours/ year[4]
	3x Water Bath Heaters (WBH)	Gas-fired with 8,760 hours of operation/ year
	4x (+1 spare) package boilers for the Above Ground Installation (AGI)	Gas-fired with 8,760 hours of operation/ year
	6x Combine Cycle Gas Turbines (CCGT)	Gas-fired with 8,760 hours of operation/ year[5]
	7x emergency/backup/auxiliary plant	Gas-fired and liquid fuel-fired with 52 hours/ year for testing and maintenance
Sensitivity Scenario 1: Operational Scenario (Combined Loop Re-gasification[1]) with Combustion Turbine Generator (CTG)	4x main engines on the FSRU	Duel-fuelled – gas-fired for 95% of the year and liquid fuel-fired for 5% of the year
	3x re-gasification boilers on the FSRU	Gas-fired with 4,380 hours of operation/ year
	4x tugs engines	Liquid fuel-fired with 2x tugs operating for 2,310 hours/ year and 2x tugs operating for 1,155 hours/ year
	Main engine on LNGC delivering to the operational facility	Assumed 50% of LNGC visiting site are gas-fired and 50% are liquid fuel-fired, for 2,310 hours/ year[4]
	3x Water Bath Heaters (WBH)	Gas-fired with 8,760 hours of operation/ year
	4x (+1 spare) package boilers for the Above Ground Installation (AGI)	Gas-fired with 8,760 hours of operation/ year
	2x (+1 spare) CTG plant	Gas-fired with 8,760 hours of operation/ year
	2x emergency plant	Liquid fuel-fired with 52 hours/ year for testing and maintenance
Sensitivity Scenario 2: Operational Scenario (Closed Loop Re-gasification[2])	4x main engines on the FSRU	Duel-fuelled – gas-fired for 95% of the year and liquid fuel-fired for 5% of the year
	3x re-gasification boilers on the FSRU	Gas-fired with 8,760 hours of operation/ year
	4x tugs	Liquid fuel-fired with 2x tugs operating for 2,310 hours/ year and 2x tugs operating for 1,155 hours/ year[4]

Scenario	Operational Plant	Description of Operation
	Main engine on LNGC delivering to the operational facility	Assumed 50% of LNGC visiting site are gas-fired and 50% are liquid fuel-fired, for 2,310 hours/ year
	3x Water Bath Heaters (WBH)	Gas-fired with 8,760 hours of operation/ year
	4x (+1 spare) package boilers for the Above Ground Installation (AGI)	Gas-fired with 8,760 hours of operation/ year
	6x Combine Cycle Gas Turbines (CCGT)	Gas-fired with 8,760 hours of operation/ year[4]
	7x emergency/ backup/ auxiliary plant	Gas-fired and liquid fuel-fired with 52 hours/ year for testing and maintenance
Sensitivity Scenario 3: Operational Scenario (Conservative[3])	4x main engines on the FSRU	Duel-fuelled – gas-fired and liquid fuel-fired for 50% of the year each
	3x re-gasification boilers on the FSRU	Gas-fired with 8,760 hours of operation/ year
	4x tugs	Liquid fuel-fired with 2x tugs operating for 4,620 hours/ year and 2x tugs operating for 2,310 hours/ year
	Main engine on LNGC delivering to the operational facility	Assumed 50% of LNGC visiting site are gas-fired and 50% are liquid fuel-fired, for 8760 hours/ year[4]
	3x Water Bath Heaters (WBH)	Gas-fired with 8,760 hours of operation/year
	4x (+1 spare) package boilers for the Above Ground Installation (AGI)	Gas-fired with 8,760 hours of operation/ year
	6x Combine Cycle Gas Turbines (CCGT)	Gas-fired with 8,760 hours of operation/ year[4]
	3x CTG plant	Gas-fired with 8,760 hours of operation/ year
	7x emergency/ backup/ auxiliary plant	Gas-fired and liquid fuel-fired with 52 hours/ year for testing and maintenance

Notes:

[1] Combined loop re-gasification requires the re-gasification boilers to be operational for half the year. During the warmer half of the year, heat is provided by seawater.

[2] Closed loop re-gasification requires the re-gasification boilers to be operational for the full year, without any use of seawater.

[3] Conservative scenario includes a number of unlikely and improbable assumptions, including a greater reliance on liquid fuel for the FSRU, increased frequency in LNGC presence and associated tug movements, and the operation of all 3 CTG plant alongside the CCGT plant.

[4] Whist the frequency of LNGCs accessing the operational facility is currently estimated at up to 60 visits per year, the type of LNGC, or specifically the nature of the visiting LNGC propulsion systems is unknown, beyond the knowledge that LNGC engines will have to comply with the emissions standards set by the MARPOL convention, when using liquid fuel. The International Gas Union (IGN) published a breakdown of the world's LNGC fleet as of the end of 2018 (IGN, 2019). The data demonstrated that the majority of LNGCs used either gas-fired propulsion, or multiple-fuel propulsion systems (with the emphasis on gas mode with Boil-off Gas being readily available). LNGCs that rely on liquid-fuel only propulsion systems account for approximately 10% of the operational LNGCs. The IGN document also reports the LNGC order book going forward, which suggests the proportion of LNGCs with liquid-only fuel propulsion systems is likely to decrease. The assumption made in this assessment on type of LNGC to visit the operation facility is considered to be suitably precautionary.

[5] In reality, CCGT plant will operate for less than 8760 hours per year and the number of hours of operation is expected to decrease year on year.

The scenarios described above include emissions associated with emergency/ backup/ auxiliary plant for testing and maintenance purposes only. The assessment does not consider a scenario for the operation of the emergency/ backup/ auxiliary plant in unison. Such an event when all such plant is in operation at any one time is considered highly unlikely, as is the operation of such plant for a duration of more than one hour. Emergency/ backup/ auxiliary plant operating in isolation for anything other than routine testing and maintenance is also considered unlikely.

Emissions Inventory

A list of individual sources of emissions to air at the Proposed Development site, as included in the dispersion modelling assessment, their emissions characteristics and emission rates are provided in Table 8-3. The table includes the source of data for each emissions point and describes any assumptions on emissions sources that have had to be made. Where assumptions have been made, the intention has been to be precautionary and err on the side of caution.

Table 8-4 provides the same details for the major cumulative sources of emissions to air in the vicinity of the Proposed Development – Moneypoint Power Station and Tarbert Power Station.

Table 8-3 Proposed Development Emissions Inventory

Source	Location		Operational Profile (hrs/yr)[1,2]	Emissions Release Height (m)[3]	Emissions Release Diameter. (m)	Emissions Exit Temp. (°C)	Emissions Volumetric Flow Rate (m^3/s)	Emissions Exit Velocity (m/s)	Mass Emission Rates (g/s)					
	X	Y							NO_X	CO	THC/VOC	CH_2O	SO_2	PM
FSRU Main Engine (Wärtsilä 6L50DF) (gas-fired)[4]	102932	149328	8760	50	1.07	303	15.4	17.1	1.95	1.46	0.80	0.37	-	0.10
FSRU Main Engine (Wärtsilä 6L50DF) (liquid fuel-fired)[4]	102931	149332	8760	50	1.07	284	11.1	9.98	5.13	1.43	0.50	-	0.40	0.15
FSRU Main Engine (Wärtsilä 8L50DF) (gas-fired)_1[4]	102931	149336	8760	50	1.13	319	19.0	18.9	2.60	1.95	1.06	0.50	-	0.14
FSRU Main Engine (Wärtsilä 8L50DF) (gas-fired)_2[4]	102930	149340	8760	50	1.13	319	19.0	18.9	2.60	1.95	1.06	0.50	-	0.14
FSRU Main Engine (Wärtsilä 8L50DF) (gas-fired)_3[4]	102932	149328	8760	50	1.13	319	19.0	18.9	2.60	1.95	1.06	0.50	-	0.14
FSRU Main Engine (Wärtsilä 8L50DF) (liquid fuel-fired)_1[4]	102931	149332	438	50	1.13	297	12.2	12.2	5.13	1.43	0.50	-	0.40	0.15
FSRU Main Engine (Wärtsilä 8L50DF) (liquid fuel-fired)_2[4]	102931	149336	438	50	1.13	297	12.2	12.2	5.13	1.43	0.50	-	0.40	0.15
FSRU Main Engine (Wärtsilä 8L50DF) (liquid fuel-fired)_3[4]	102930	149340	438	50	1.13	297	12.2	12.2	5.13	1.43	0.50	-	0.40	0.15
FSRU Re-gas Boiler (MAC-90BF Boiler)_1[4]	102922	149336	4380	50	1.47	450	36.4	21.4	2.86	2.41	0.16	0.07	-	0.21
FSRU Re-gas Boiler (MAC-90BF Boiler)_2[4]	102922	149333	4380	50	1.47	450	36.4	21.4	2.86	2.41	0.16	0.07	-	0.21
FSRU Re-gas Boiler (MAC-90BF Boiler)_3[4]	102923	149328	4380	50	1.47	450	36.4	21.4	2.86	2.41	0.16	0.07	-	0.21
Tug_1[5,6]	102774	149164	2310	7.25	0.46	500	7.78	47.1	0.46	0.57	-	-	0.01	0.23

Source	Location		Operational Profile (hrs/yr)[1,2]	Emissions Release Height (m)[3]	Emissions Release Diameter. (m)	Emissions Exit Temp. (°C)	Emissions Volumetric Flow Rate (m^3/s)	Emissions Exit Velocity (m/s)	Mass Emission Rates (g/s)					
	X	Y							NO_X	CO	THC/VOC	CH_2O	SO_2	PM
Tug_2[5,6]	102779	149182	2310	7.25	0.46	500	7.78	47.1	0.46	0.57	-	-	0.01	0.23
Tug_3[5,6]	102784	149203	1155	7.25	0.46	500	7.78	47.1	0.46	0.57	-	-	0.01	0.23
Tug_4[5,6]	102789	149223	1155	7.25	0.46	500	7.78	47.1	0.46	0.57	-	-	0.01	0.23
LNGC (gas-fired)[4,6]	102937	149392	1155	35	0.60	400	2.63	9.30	1.17	0.44	0.02	0.01	-	0.03
LNGC (liquid fuel-fired)[6,7]	102937	149392	1155	35	1.68	316	9.31	4.20	2.03	11.3	-	-	0.35	0.11
WBH_1[5]	102618	148765	8760	10	0.30	398	2.36	32.0	0.08	0.12	0.02	-	-	-
WBH_2[5]	102615	148770	8760	10	0.30	398	2.36	32.0	0.08	0.12	0.02	-	-	-
WBH_3[5]	102612	148775	8760	10	0.30	398	2.36	32.0	0.08	0.12	0.02	-	-	-
AGI Package Boiler_1[5]	102775	148628	8760	8	0.20	70	0.28	9.00	0.04	0.03	-	-	-	-
AGI Package Boiler_2[5]	102781	148626	8760	8	0.20	70	0.28	9.00	0.04	0.03	-	-	-	-
AGI Package Boiler_3[5]	102788	148624	8760	8	0.20	70	0.28	9.00	0.04	0.03	-	-	-	-
AGI Package Boiler_4[5]	102793	148623	8760	8	0.20	70	0.28	9.00	0.04	0.03	-	-	-	-
CTG_1[5]	102722	148766	0	9	2.40	532	110	25.0	1.10	1.10	0.70	-	-	-

Source	Location		Operational Profile (hrs/yr)[1,2]	Emissions Release Height (m)[3]	Emissions Release Diameter. (m)	Emissions Exit Temp. (°C)	Emissions Volumetric Flow Rate (m^3/s)	Emissions Exit Velocity (m/s)	Mass Emission Rates (g/s)					
	X	Y							NO_X	CO	THC/VOC	CH_2O	SO_2	PM
CTG_2[5]	102733	148773	0	9	2.40	532	110	25.0	1.10	1.10	0.70	-	-	-
CTG_3[5]	102744	148780	0	9	2.40	532	110	25.0	1.10	1.10	0.70	-	-	-
Black Start Generator[5]	102689	148769	52	5	0.25	523	1.98	39.1	2.40	0.12	0.01	-	0.07	0.01
Diesel Fire Water Pump_A[5]	102652	148694	52	3	0.20	499	1.23	38.0	1.53	0.08	0.01	-	0.05	0.01
CCGT_1a[5]	102263	148549	8760	35	3.00	76	143	19.0	5.63	11.3	2.50	-	-	-
CCGT_1b[5]	102282	148561	8760	35	3.00	76	143	19.0	5.63	11.3	2.50	-	-	-
CCGT_2a[5]	102348	148601	8760	35	3.00	76	143	19.0	5.63	11.3	2.50	-	-	-
CCGT_2b[5]	102368	148613	8760	35	3.00	76	143	19.0	5.63	11.3	2.50	-	-	-
CCGT_3a[5]	102434	148654	8760	35	3.00	76	143	19.0	5.63	11.3	2.50	-	-	-
CCGT_3b[5]	102453	148666	8760	35	3.00	76	143	19.0	5.63	11.3	2.50	-	-	-
Auxiliary Boiler[5]	102491	148570	52	32	0.80	150	9.44	17.8	0.45	0.65	0.20	-	-	-
Standby Diesel Generator_1[5]	102337	148544	52	17	0.25	523	1.98	39.1	2.40	0.12	0.01	-	0.07	0.01
Standby Diesel Generator_2[5]	102430	148601	52	17	0.25	523	1.98	39.1	2.40	0.12	0.01	-	0.07	0.01

Source	Location X	Location Y	Operational Profile (hrs/yr)[1,2]	Emissions Release Height (m)[3]	Emissions Release Diameter. (m)	Emissions Exit Temp. (°C)	Emissions Volumetric Flow Rate (m^3/s)	Emissions Exit Velocity (m/s)	Mass Emission Rates (g/s) NO_X	CO	THC/VOC	CH_2O	SO_2	PM
Standby Diesel Generator_3[5]	102516	148653	52	17	0.25	523	1.98	39.1	2.40	0.12	0.01	-	0.07	0.01
Diesel Fire Water Pump_B[5]	102588	148763	52	3	0.15	499	1.80	48.1	1.10	0.06	0.01	-	0.03	0.01

Notes:

[1] Profile based on normal operational scenario, as provided by the Proposed Development design team.

[2] In the normal operational scenario, the CCGT plant is the main source of power for the facility and the CTG plant will not be in operation. In sensitivity scenario 1, the CCGT plant is not in operation and instead, two of the three CTG plant are in operation for 8760 hours of the year.

[3] Emissions release height above ground level for onshore sources and sea level for Offshore sources.

[4] Emissions data sourced from the *Gas Import Jetty and Pipeline Project Environmental Effects Statement – Air Quality Impact Assessment* (AGL Wholesale Gas Limited and APA Transmission Pty Limited, 2020), which utilised the same FSRU technology as proposed and a near identical energy demand and provided data on a representative gas-fired LNGC.

[5] Emissions data provided by the Proposed Development design team.

[6] All emissions from tugs and LNGC are modelled at the location at which those sources are closest to the shore and the nearest air quality sensitive receptors.

[7] Emissions data sourced from the *Liquefaction Facility Air Quality Modelling Report Supporting Resource Report No. 9* (Alaska LNG, 2017), which contained a representative example of a liquid fuel-fired LNGC.

Table 8-4 Cumulative Sources Emissions Inventory Emissions Inventory

Source	Location X	Location Y	Operational Profile (hrs/yr)	Emissions Release Height (m)[5]	Emissions Release Diameter. (m)	Emissions Exit Temp. (°C)	Emissions Volumetric Flow Rate (m^3/s)	Emissions Exit Velocity (m/s)	Mass Emission Rates (g/s) NO_X	CO	THC/VOC	CH_2O	SO_2	PM
Moneypoint Power Station Stack 1[1,2]	103490	151683	8,760	220	6.89	145	1020.56	27.4	133	-	-	-	133	33.3
Moneypoint Power Station Stack 2[1,2]	103624	151634	8,760	220	6.89	145	510.28	13.7	66.7	-	-	-	66.7	16.7

Source	Location		Operational Profile (hrs/yr)	Emissions Release Height (m)[5]	Emissions Release Diameter. (m)	Emissions Exit Temp. (°C)	Emissions Volumetric Flow Rate (m^3/s)	Emissions Exit Velocity (m/s)	Mass Emission Rates (g/s)					
	X	Y							NO_X	CO	THC/VOC	CH_2O	SO_2	PM
Tarbert Power Station Stack 1[2,3]	107679	149489	794.2[4]	121	3.05	121	144.49	19.8	7.54	-	-	-	15.1	1.33
Tarbert Power Station Stack 2[2,3]	107616	149543	794.2[4]	152	5.4	152	523.25	22.8	12.9	-	-	-	12.9	1.61

Notes:

[1] Emissions information sourced from the air quality assessment reported in the *Environmental Impact Statement Shannon LNG CHP Plant* (Shannon LNG, 2012) and the Moneypoint Power Station Environmental Licence (Licence Reg No. P0605-04).

[2] Emissions data based on Moneypoint and Tarbert Power Stations operating at Licenced Emission Limits. In reality, they operate at levels well below Licenced Emission Limits (Moneypoint in particular). The cumulative assessment is therefore precautionary. Furthermore, coal burning at Moneypoint Power Station and oil burning at Tarbert Power Station is due to cease by 2025. Should the Power Stations be retrofitted with non-coal and non-oil burning plant, mass emissions of the pollutants of concern to this assessment are likely to lower than those reported in this table.

[3] Emissions information sourced from the air quality assessment reported in the *Environmental Impact Statement Shannon LNG CHP Plant* (Shannon LNG, 2012) and the Tarbert Power Station Environmental Licence (Licence Reg. No. 716).

[4] Tarbert Power Station is utilised as peaking plant to the Irish National Grid. The hours/year assumed in this assessment equates to the average hours of operation from 2015 and 2019.

[5] Emissions release height above ground level.

Meteorological Data

Actual measured hourly-sequential meteorological data is required for input into dispersion models, and it is important to select data as representative as possible for the site that will be modelled. This is usually achieved by selecting a meteorological station as close to the site as possible, although other stations may be used if the local terrain and conditions vary considerably, or if the station does not provide sufficient data.

The meteorological site that was selected for the assessment is Shannon Airport, located approximately 35 km east-northeast of the Proposed Development site, at a location close to the Shannon Estuary, on a flat airfield in a principally agricultural area. Therefore, the meteorological site is considered representative of the air quality study area and a surface roughness of 0.2 m (representative of an agricultural area) has been selected for the meteorological site.

The modelling for this assessment has utilised 5 years of meteorological data for the period 2016 – 2020. Wind roses for each of the years within this period are shown in Figure 8-1.

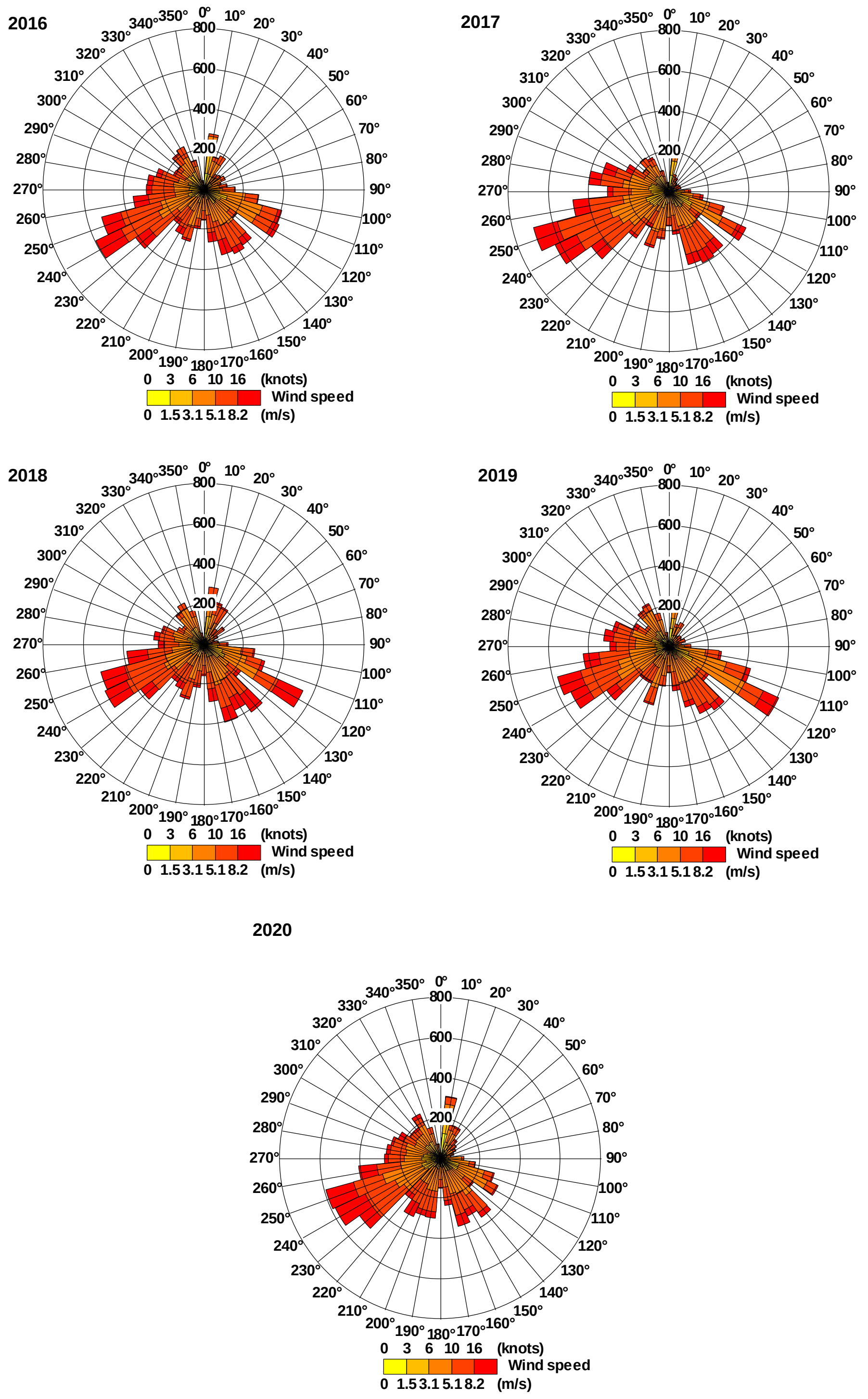

Figure 8-1 Wind Rose Plots for Shannon Airport

A sensitivity analysis of the use of meteorological data in the model is provided in Volume 4, Appendix A8-2 of this EIAR.

Building Data

The buildings and structures that make up the Proposed Development have the potential to affect the dispersion of emissions from the operational site sources. The ADMS 5 buildings effect module has therefore been used to incorporate building downwash effects as part of the modelling procedure. Nearby buildings and structures that are greater than one third of the range of stack heights modelled have the potential to affect the dispersion of emissions and have been included within the modelling assessment.

Buildings associated with the Proposed Development that have been considered to be of sufficient height and size to potentially impact on the dispersion of emission stacks are shown in Table 8-5. A plan showing the buildings layout used in the ADMS simulation is illustrated in Figure 8-2. A sensitivity analysis of the influence of building data in the model is provided in Volume 4, Appendix A8-2.

Table 8-5 Building Downwash Input Data

Building Name	Location		Height (m)	Length (m)	Width (m)	Orientation (º)	Diameter (m)
	X	y					
HRSG Building 1	102272	148559	28.8	46	28	238.5	-
HRSG Building 2	102359	148613	28.8	46	28	238.5	-
HRSG Building 3	102444	148665	28.8	46	28	238.5	-
Turbine Hall 1	102474	148661	13.8	96	66	238.5	-
Turbine Hall 2	102302	148556	13.8	96	66	238.5	-
Turbine Hall 3	102389	148609	13.8	96	66	238.5	-
Cooling Tower 1	102285	148631	25	57	50	238.5	-
Cooling Tower 2	102368	148682	25	57	50	238.5	-
Cooling Tower 3	102454	148734	25	57	50	238.5	-
CTG1	102721	148767	6	16	10	148.5	-
CTG2	102733	148774	6	16	10	148.5	-
CTG3	102744	148781	6	16	10	148.5	-
Auxiliary Boiler	102485	148580	15.5	15	15	148.5	-
GIS Substation	102346	148497	14.2	61	19	238.5	-
Canteen	102450	148559	7.5	52	14	238.5	-
Central Control	102507	148594	5.7	23	14	148.5	-
FG Regulating	102620	148773	4.8	17	16	148.5	-
Raw Water Tank B	102582	148746	24	-	-	-	21
Raw Water Tank A	102568	148770	24	-	-	-	21
Firewater Tank A	102657	148708	16	-	-	-	17
Firewater Tank B	102669	148688	16	-	-	-	17
FSRU Nav Deck	102883	149327	38.8	40	14	171.1	-
FSRU Engine Emissions	102922	149334	45	38	22	171.1	-
LNG Carrier	102931	149389	30	38	22	171.1	-

Terrain Data

Due to the limited variation in terrain across the study area, Shuttle Radar Topography Mission (SRTM) terrain data has been incorporated into the model with a resolution of 90 m. Figure 8-3 provides a visual representation of the terrain data across the air quality study area. A sensitivity analysis of the influence of terrain data in the model is provided in Volume 4, Appendix A8-2.

Surface Roughness Data

Due to the location of the site on and adjacent to the Shannon Estuary, the effect of surface roughness on turbulence and flow field has been accounted for with the inclusion of a variable surface roughness file in the dispersion model. Areas of the Shannon Estuary have a surface roughness value of 0.0001 m and areas on land 0.2 m. This is illustrated in Figure 8-4, with white representing areas with a surface roughness of 0.0001 m and purple representing areas with a surface roughness of 0.2 m. A sensitivity analysis of the influence of surface roughness data in the model is provided in Volume 4, Appendix A8-2.

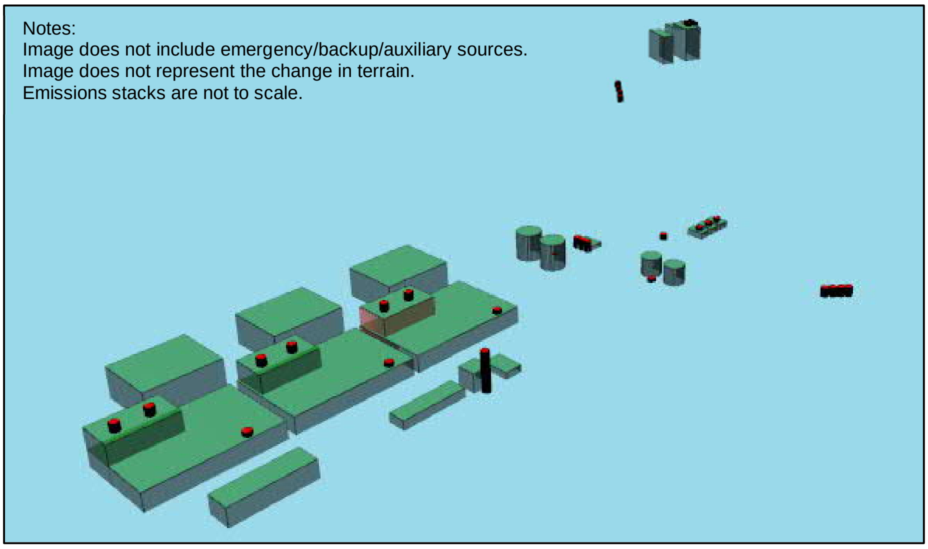

Figure 8-2 Visual Representation of Modelled Building in ADMS 5 Dispersion Model

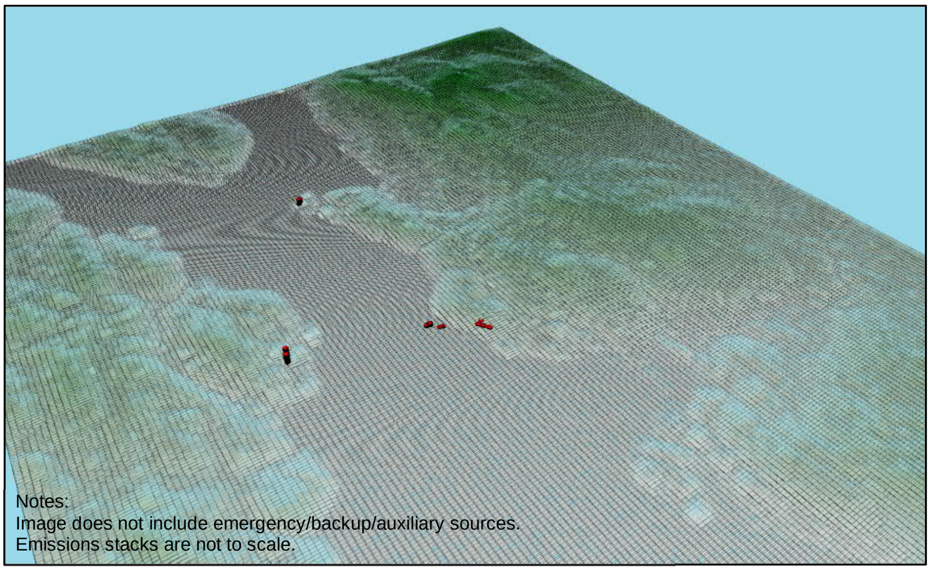

Figure 8-3 Visual Representation of Modelled Terrain Data in ADMS Dispersion Model

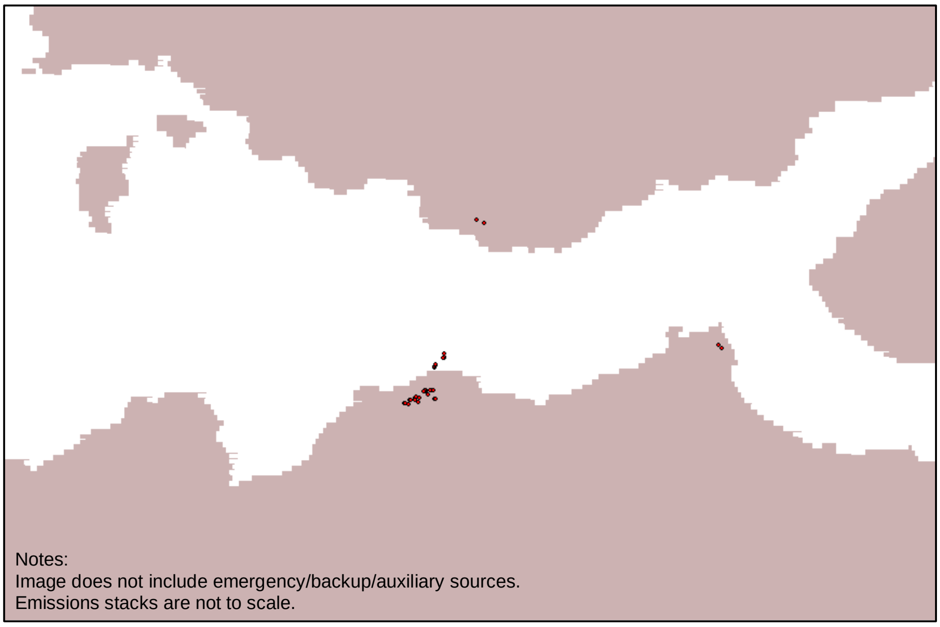

Figure 8-4 Visual Representation of Modelled Surface Roughness Data in ADMS Dispersion Model

Conversion of NO_X to NO_2

Emissions of nitrogen oxides from industrial point sources are typically dominated by nitric oxide (NO), with emissions from combustion sources typically in the ratio of nitric oxide to nitrogen dioxide of 9:1. However, it is nitrogen dioxide that has specified environmental standards due to its potential impact on human health. In the ambient air, nitric oxide is oxidised to nitrogen dioxide by the ozone present, and the rate of oxidation is dependent on the relative concentrations of nitric oxide and ozone in the ambient air.

For the purposes of detailed modelling, and in accordance with EPA technical guidance (2020), it is assumed that 100% of nitric oxide emitted from the stack is oxidised to nitrogen dioxide in the long term and 50% of the emitted nitric oxide is oxidised to nitrogen dioxide in the local vicinity of the site in the short-term.

Background Pollutant Concentration Data

The dispersion model predicts the contribution of pollutants from Proposed Development emissions sources at selected air quality sensitive receptors. To report total pollutant concentrations that can be compared to the relevant Air Quality Standards and Environmental Assessment Levels at the selected air quality sensitive receptors, this contribution needs to be added onto the background (or ambient) pollutant concentrations that are representative of those locations.

The background pollutant concentrations used to inform this assessment have been obtained from the most recent *Air Quality in Ireland* report published by the EPA (2020) and the Environmental Impact Assessment Report for the *Foynes to Limerick Road (including Adare Bypass)* (Roughan & O'Donovan – AECOM Alliance, 2019).

The background pollutant concentration data is listed in Table 8-6. For pollutants with averaging periods of less than the annual mean, it is standard practice to assume the background concentration is the annual mean (long-term) value doubled, which is in line with EPA guidance (2020). This is sometimes considered overly precautionary for pollutants that have an Air Quality Standard or Environmental Assessment Level averaged over 24-hours, and it is often more appropriate that the background for pollutants with daily mean Standards or Assessment Levels is the annual mean background x 1.5. In this instance, double the annual mean background has been used for all short-term (<annual mean) pollutants, due to the existing standard of air quality in the study area. Background nitrogen deposition values were sourced from EPA Research Report No. 323 (EPA, 2020). No ambient background data could be found for acid deposition rates and a proxy background value has been used as an alternative, as described in Table 8-6. Due to the use of this proxy value, there remains some uncertainty in the annual mean acid deposition rates reported in this chapter.

Table 8-6 Background Pollutant Concentration Data

Pollutant	Averaging Period	Rural Concentration (µg/m³ unless stated))	Urban Concentration (µg/m³ unless stated)
National Air Quality Standard Pollutant			
Nitrogen dioxide (NO_2)	Annual mean	4.3	4.7
	Hourly mean	8.7	9.4
Particulate matter (PM_{10})	Annual mean	9.0	14.3
	Daily mean	18.0	28.5
Fine particulate matter ($PM_{2.5}$)	Annual mean	4.0	9.3
Carbon monoxide (CO)	Rolling 8-hour mean	100	100
Sulphur dioxide (SO_2)	Daily mean	2.6	6.1
	Hourly mean	2.6	6.1
Benzene (C_6H_6)	Annual mean	0.2	0.2
Oxides of nitrogen (NO_X) – for the protection of ecosystems	Annual mean	6.2	7.8
Sulphur dioxide (SO_2) – for the protection of ecosystems	Annual mean	1.3	3.1
UK EA Environmental Assessment Levels			
Carbon monoxide (CO)	Hourly maximum	0.1	0.1
Sulphur dioxide (SO_2)	15-minute mean	2.6	6.1
Benzene (C_6H_6)	Hourly maximum	0.3	0.3
Formaldehyde (CH_2O)	Annual mean	No data available	
	Hourly maximum	No data available	
Oxides of nitrogen (NO_X) – for the protection of ecosystems	Daily mean	12.4	15.7
Sulphur dioxide (SO_2) – for the protection of ecosystems	Annual mean	1.3	3.1
Convention on Long-Range Transboundary Air Pollution Critical Loads			
Nitrogen deposition	Annual mean	12 kg N/ha/yr	
Acid deposition	Annual mean	0.5 (N: 0.4 / S: 0.1) keq/ha/yr[1]	

Notes:
[1] No acid deposition data for Ireland obtained. Instead, a representative value has been used and obtained from APIS, based on modelled acid deposition rates at a rural location in the west of Wales, at British National Grid reference 214675,325608. However, Predicted Environmental Concentrations of acid deposition reported in this chapter should be treated with caution.

Calculating Nitrogen and Acid Deposition

The deposition of nutrient nitrogen and acid at sensitive nature conservation receptors has been calculated, using the modelled Process Contribution predicted at the receptor points. The deposition rates are determined using conversion rates and factors contained within EPA guidance (2020), which account for various deposition mechanisms in different types of habitat. The conversion rates and factors used in the assessment are detailed in Table 8-7.

Table 8-7 Deposition Conversion Factors

Pollutant	Deposition velocity grassland (m/s)	Deposition velocity woodland (m/s)	Nutrient Nitrogen Conversion Factor (µg/m3/s to kg/ha/yr)	Acid Nitrogen Conversion Factor (µg/m3/s to keq/ha/yr)
NO_2	0.0015	0.003	96	0.071428
SO_2	0.012	0.024	157.7	0.0625

Determination of Air Quality Sensitive Receptors

The impact of operational site emissions has been predicted at a series of discrete receptors, which represent locations of human exposure to the pollutants of concern in the vicinity of the Proposed Development.

Air quality sensitive receptors typically include residential dwellings, schools and medical facilities. In this instance, they represent residential dwellings and are summarised in Table 8-8 and shown on Figure F8-1 of Volume 3. Discrete receptors have been selected from review of aerial photography and represent both worst-case impacts and the spatial variation in impacts across the area. Each selected receptor is considered to representative of other sensitive receptors in their vicinity.

Table 8-8 Human Health Sensitive Receptors

Receptor ID[1]	Location		Receptor ID[1]	Location		Receptor ID[1]	Location	
	x	Y		x	y		x	y
R1	99123	146816	R17	102452	147480	R33	104028	147867
R2	100485	146548	R18	102487	147709	R34	104232	148110
R3	100942	146667	R19	102666	148243	R35	104459	147372
R4	101122	147146	R20	102692	147715	R36	104539	147613
R5	101122	146825	R21	102766	146841	R37	104551	151739
R6	101500	148159	R22	102838	147819	R38	104600	147821
R7	101561	152352	R23	102996	147572	R39	104829	147623
R8	101576	147554	R24	103018	147337	R40	105292	147729
R9	101612	147192	R25	103150	147787	R41	105742	147799
R10	101776	147423	R26	103209	148311	R42	105774	149111
R11	101823	145949	R27	103407	147690	R43	105844	148323
R12	102061	152465	R28	103450	148059	R44	105889	147796
R13	102079	147620	R29	103460	148143	R45	105973	152137
R14	102144	147683	R30	103528	147333	R46	106177	147864
R15	102257	147666	R31	103577	147106	R47	107245	148435
R16	102264	147753	R32	103703	147307	R48	106736	147702

The impact of operational site emissions has also been predicted at a series of discrete nature conservation receptors to represent sensitive ecological exposure to the pollutants of concern in the vicinity of the Proposed Development. The EPA's Air Dispersion Modelling from Industrial Installations Guidance Note (AG4) (EPA 2020) does not provide guidance on what nature conservation sites should be included, beyond that they should be local and designated. The UK EA's air emissions risk assessment for your environmental permit guidance (Environment Agency, 2016) requires consideration of internationally designated sites within 10km of a facility and nationally designated sites within 2km of a facility. Nature conservation receptors that are within these distances from the Proposed Development are listed in Table 8-9 and shown on Figure F8-3 of Volume 3. Air quality impacts have the potential to harm flora within habitat that is sensitive to changes in loads of nitrogen and/or sulphur.

Fauna are not impacted directly, but indirectly as a consequence of the potential harm to the habitat they may rely on. Habitat information has been sourced from the National Parks and Wildlife Service Conservation Objectives report (2012). Critical Load data has been sourced from Air Pollution Information System (APIS) (Air Pollution Information System, 2016).

The closest nature conservation designations to the Proposed Development are the Lower River Shannon cSAC and the River Shannon and River Fergus Estuaries SPA. Whilst the cSAC and SPA cover the majority of the entire Shannon Estuary and a number of adjoining habitats, only some of the qualifying features that led to their designation are sensitive to the effects of air pollution and deposition. Discrete receptors have been selected to represent both worst-case impacts and the spatial variation in impacts across the habitats within the cSAC and SPA that are sensitive to air quality. Again, each selected receptor is considered to be representative of other sensitive receptors in their vicinity.

Table 8-9 Ecologically Sensitive Receptors

Receptor ID[1]	Location		Habitat ID	Habitat Description	Distance from Site (km)	Critical Loads	
	X	Y				Nitrogen Deposition (kg N/ha/yr)	Acid Deposition (keq/ha/yr)
River Shannon cSAC/SPA							
E1	100487	146450	1140	Mudflats	2.7	20 - 30[1]	Not sensitive
E2	100142	146783			2.8		
E3	99344	147393			3.1		
E4	99180	148139	1140 and 1330	Mudflats and Saltmarsh	3.1	20 - 30[1]	Not sensitive
E5	96324	154503	1140	Mudflats	8.3	20 - 30[1]	Not sensitive
E6	108374	152272			6.1		
E7	107535	149167			4.5		
E8	107597	148426			4.8		
E9	106810	147717			4.2		
E10	97494	152631	1150	Coastal lagoon	6.3	20-30[2]	Not sensitive
E11	95341	147141	1220	Perennial vegetation on stony banks	7.0	8-15	CLminN: 0.223 CLmaxN: 0.568 CLmaxS: 0.202
E12	102319	152410			3.1		
E13	106974	152264	1230	Vegetated sea cliffs	5.0	20-30[1]	Not sensitive
E14	100953	147779	1130, 1330 and 1410	Estuary and Saltmarsh	1.5	20-30[3]	Not sensitive
E15	100612	147428			2.0		
E16	100360	146849			2.5		
E17	100596	146344			2.8		
E18	99988	147121			2.7		
E19	98570	153207			5.8		
E20	97484	154407			7.4		
E21	106355	152093					
E22	108980	152786			6.9		
E23	107481	147597			4.8		

Receptor ID[1]	Location X	Location Y	Habitat ID	Habitat Description	Distance from Site (km)	Critical Loads: Nitrogen Deposition (kg N/ha/yr)	Critical Loads: Acid Deposition (keq/ha/yr)
Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA							
E24	111302	143099	4010	Northern wet heath	>10km	10-20	CLminN: 0.499 CLmaxN: 0.842 CLmaxS: 0.2
E25	111831	143906			>10km		
E26	114279	143179			>10km		
E27	115165	145362			>10km		
E28	110945	142293			>10km		
E29	110654	140480			>10km		
E30	110733	138787			>10km		
Bunnaruddee Bog NHA							
E31	104486	135648	7110	Active raised bogs	>10km	5-10	CLminN: 0.321 CLmaxN: 0.683 CLmaxS: 0.362

Notes:

[1] Habitat considered low sensitivity to nitrogen deposition, but no Critical Load estimate available from APIS because of limited data. Critical Load for Saltmarsh used as a proxy.

[2] APIS provides the Saltmarsh Critical Load as being representative sensitivity at this habitat.

[3] Whilst the Estuary habitat covers large sections of the cSAC and SPA, APIS states that only sections of Estuary habitat that are Saltmarsh are sensitive to air quality impacts.

In addition to the discrete receptors listed in Table 8-8 and Table 8-9 above, operational process emissions have also been modelled on a receptor grid of variable spacing, in order to determine the location and magnitude of maximum ground level impacts, and to enable the generation of key pollutant isopleth plots.

A nested grid has been used. The inner grid extends 1000 m from the centre of the Proposed Development site in each direction, at a resolution of 20 m x 20 m. The middle grid extends from 1,000 m to 3,000 m in each direction, at a resolution of 50 m x 50 m. The outer grid extends from 3,000 m to 6,000 m in each direction, at a resolution of 200 m x 200 m. Details of the receptor grid are summarised in Table 8-10.

Table 8-10 Modelled Nester Receptor Grid

Grid spacing (m)	Dimensions (km)	Number of nodes in each direction	National grid reference of south west corner
20	2 x 2	100	96368,142613
50	6 x 6	120	99368,145613
200	12 x 12	60	101368,147613

8.3.2.5 Operational Phase Traffic Emissions Assessment

The operational phase impact on traffic flows is less than that anticipated during the construction phase. As such operational traffic emissions impacts alone do not have the potential to cause a significant effect, in line with industry standard guidance (Moorcroft and Barrowcliffe et al., 2017). However, because the operational phase includes both site emissions and road traffic emissions, the contribution of road traffic emissions impacts has been quantified to allow for the reporting of combined site and road traffic emissions impacts.

Because of the limited contribution to impacts and pollutant concentrations associated with road traffic emissions from the Proposed Development, the assessment is based on HE's simple assessment methodology, rather than a detailed assessment method using dispersion modelling software. This is considered to be a proportionate assessment for the consideration of road traffic emissions contributions.

This approach makes use of a spreadsheet-based tool to predict annual mean NO_X and PM_{10} concentrations based on the relationship between traffic flow characteristics (annual daily average flows, composition of flows and speed) and the distance of a receptor from the road. The tool does not provide outputs for $PM_{2.5}$, so for this assessment, PM_{10} outputs are conservatively assumed to represent $PM_{2.5}$ also.

The annual mean NO_X and PM_{10} (and $PM_{2.5}$) road contribution output from the tool has been multiplied by a factor of 3 to simulate the adjustment of the model for model-bias. Professional experience suggests this is a precautionary approach. The factored road contribution NO_X is converted to NO_2 using a tool made available by the UK Governmental Department for the Environment, Food and Rural Affairs (DEFRA), which uses assumptions on ozone (O_3), NO_X and NO_2 at Local Planning Authority (LPA) level to estimate an appropriate conversion rate. Because the tool is based on conditions within UK LPAs, an assumption has been made to use the conversion rate estimated for Armagh, Banbridge and Craigavon, in Northern Ireland. This was selected as being a predominantly rural location, representative of the study area, on the same landmass and sharing a border with the Ireland.

The assessment of road traffic emissions has considered the following scenarios:

- 2019 Existing Baseline;
- 2025 Future Baseline; and
- 2025 Future Operational.

Input data for the road traffic screening assessment spreadsheet is summarised in Table 8-11. The contribution of road traffic emissions to impacts and total pollutant concentrations has been quantified at receptors located within 200 m of the roads for which traffic data has been provided.

Table 8-11 Road Traffic Assessment Input Data and Air Quality Sensitive Receptors

Road Link	Traffic Flow Data						Traffic Speed (kph)[3]
	2019 Existing Baseline		2025 Future Baseline		2025 Future Operational		
	AADT[1]	%HDV[2]	AADT[1]	%HDV[2]	AADT[1]	%HDV[2]	
L1010 west of site entrance	352	0.4	372	0.4	387	0.4	- 45-80 on free-flowing sections - 20-45 at the approach to junctions
L1010 east of site entrance	352	0.4	372	0.4	502	0.4	
N67 north of Tarbert	1,607	2.6	1,698	0.4	1,719	0.4	
N69 Bridewell Street	5,261	2.4	5,559	2.6	5,667	2.6	
N69 east of Tarbert	5,838	3.6	6,170	2.4	6,227	2.4	
N69 south of Tarbert	4,883	2.8	5,160	3.6	5,210	3.6	
R551 southwest of Tarbert	2,909	2.5	3,074	2.8	3,074	2.8	

Notes:
[1] 24-hour Annual Average Daily Traffic (AADT) data (2-way flows)
[2] Heavy Duty Vehicles (all vehicles >3.5t in weight)
[3] Based on Highways England speed banding

It is noted that the contribution of road traffic emissions to combined impacts and total pollutant concentrations of pollutants associated with road traffic emissions can only be provided for pollutants with long-term (annual) averaging periods. This is because the traffic data used to inform the air quality assessment is based on average daily flows, and also because it is not standard practice to quantify short-term NO_2 contributions associated with vehicle movements. Instead, annual mean concentrations are compared against an annual mean proxy value of 60 $\mu g/m^3$ and 32 $\mu g/m^3$, values defined by research undertaken on the UK, to suggest potential for an exceedance of the hourly mean NO_2 and daily mean PM_{10} Air Quality Standards respectively (DEFRA, 2016).

8.3.3 Describing Significant Effects

The EPA AG4 guidance document on dispersion modelling (EPA, 2020) does not include the means by which to describe the impact or significance of changes in pollutant concentrations as a result of new emissions. The EPA guidance document on Environmental Impact Assessment (EPA, 2017) does contain a method to determine and describe the effect of a development, but that approach is not wholly appropriate for air quality. This is because the relationship between magnitude of change in air quality conditions and receptor sensitivity is not linear. Receptor sensitivity to air quality impacts does not have a graded scale and instead, receptors are considered either sensitive to air quality impacts or not sensitive. Furthermore, the impact description of a change in pollutant concentration is not based on the magnitude of change alone, but that change relative to the pollutant concentration experienced at a receptor once the Proposed Development is in operation. The reason for this is to take account that smaller changes in air quality conditions can constitute a greater level of impact than a large change in conditions, where they occur at receptors that are predicted to experience pollutant concentrations close to or in excess of an Air Quality Standard or Environmental Assessment Level.

For this reason, the IAQM/ EPUK (Moorcroft & Barrowcliffe et al., 2017) and the UK EA (2016) have developed approaches to determine whether or not an air quality effect is considered significant or not, and these have been utilised in this assessment. Where possible, the approaches described in the air quality specific guidance have been reported in a manner that is compatible with the requirements of the EPA guidance (2017).

8.3.3.1 Construction Phase Dust and Particulate Matter Assessment

For amenity effects from dust and particulates associated with construction activities, the aim of the guidance document referred to (Holman et al., 2014) is to bring forward a scheme, including additional mitigation measures where necessary, that will control impacts so that they give rise to negligible or minor effects (at worst) at the closest sensitive receptors. Determination of whether an effect is likely to be significant or not is based on professional judgement (from experience of similar projects), taking account of whether effects are permanent or temporary, direct or indirect, constant or intermittent and whether any secondary effects are caused (in this instance, secondary effects refer to dust that is generated and deposited (primary impact) and then re-suspended and deposited again by further activity).

The classification of amenity impacts (from dust soiling) and health effects on receptors exposed to impacts has been assessed using the relationship between the magnitudes of effects identified, in combination with receptor sensitivity and other related factors where appropriate (as described in the relevant guidance (IAQM 2014), which results in a classification of effects as defined in Table 8-12.

Table 8-12 Definition in Significance of Fugitive Dust and PM_{10} Effects

Magnitude of Effect[1]	Change in dust deposition and short term PM_{10} Concentrations	Significance of Effects
High	Dust impact is likely to be intolerable for any more than a very brief period of time and is very likely to cause complaints from local people. Increase in PM_{10} concentrations at a location where concentrations are already elevated and to the extent that the short term PM_{10} air quality objective is likely to be exceeded.	**Significant to Profound:** A significant Impact that is likely to be a material consideration in its own right.
Medium	Dust impact is likely to cause annoyance and might cause complaints but can be tolerated if prior warning and explanation has been given. Increase in PM_{10} concentrations at a location where concentrations are already elevated and to the extent that the short term PM_{10} air quality objective is at risk of being exceeded.	**Moderate:** A significant effect that may be a material consideration in combination with other significant impacts but is unlikely to be a material consideration in its own right.
Slight	Dust impact may be perceptible, but of a magnitude or frequency that is unlikely to cause annoyance to a reasonable person or to cause complaints. Limited increase in PM_{10} concentrations.	**Not significant to Slight:** An impact that is not significant but that may be of local concern.

Magnitude of Effect[1]	Change in dust deposition and short term PM_{10} Concentrations	Significance of Effects
Negligible	Dust impact is unlikely to be noticed by and/ or have an effect on sensitive receptors. Negligible increase in PM_{10} concentrations.	**Imperceptible:** An impact that is not significant.

Notes:
[1] Terminology adapted to align with EPA Guideline (2017)

8.3.3.2 Operational Phase Emissions

The EPA's Air Dispersion Modelling from Industrial Installations Guidance Note (AG4) (EPA, 2020a), does not provide a criterion for determining significance from the predicted air quality impacts of industrial sources. Instead, this assessment uses guidance published by the UK EA (Environment Agency (UK) 2016) and IAQM (Moorcroft and Barrowcliffe et al., 2017) to determine whether the impact of the Proposed Development has an effect that is potentially significant or not. However, it should be noted that the UK EA guidance is intended for use in areas of the UK where pollutant concentrations are elevated close to or above the Air Quality Standards. For application in rural Ireland, it can be considered a conservative means of determining potential significance. It should also be noted that the IAQM guidance is predominantly for urban development projects where road traffic emissions are often the biggest contributor to air quality impacts, rather than industrial installations, although there is no reason why the significance criteria described within it cannot be adopted for industrial sites.

According to the UK EA guidance, an impact on human health sensitive receptors may be considered insignificant where:

- The short-term Process Contribution (PC – impact) is <=10% of the Air Quality Standard or Environmental Assessment Level; and
- The long-term Process Contribution (impact) is <=1% of the Air Quality Standard or Environmental Assessment Level.

Where an impact on human health sensitive receptors cannot be screened out at this stage, additional criteria are provided, including consideration of the Predicted Environmental Concentration (PEC – total pollutant concentration), where the PC is added to the background (or ambient) concentrations. The impact may be considered insignificant where:

- The short-term PC is <20% of the Air Quality Standard or Environmental Assessment Level minus the short-term background; and
- The long-term PEC is <70% of the Air Quality Standard or Environmental Assessment Level.

Where an impact on human health sensitive receptors still cannot be screened as insignificant at this stage, it does not necessarily mean that the effect is now significant. At this stage, model inputs are reviewed, and detail enhanced where it can be. The predicted PC and PEC are then reviewed relative to the appropriate Air Quality Standards and Environmental Assessment Levels and the headroom (gap between the PEC and the Standards and Assessment Levels) that remains once the Proposed Development is in operation – i.e. is there a risk of an exceedance of an Air Quality Standard and Environmental Assessment Level and/ or does the operation of the Proposed Development constrain future development of the area.

For this assessment, the 'insignificant' terminology used in the UK EA guidance applies to effects that can be described as 'Imperceptible' to 'Slight' in the EPA Guidelines on the information to be contained in Environmental Impact Assessment Reports (2017). It may also apply to effects that can be described as 'Moderate' in the EPA Guideline, where such effects relate to a limited number of sensitive receptors and/ or the Air Quality Standards and Environmental Assessment Levels remain not at risk of any exceedance.

Like the UK EA guidance, the IAQM approach does not define a graduating scale of human health receptor sensitivity. Instead, human health receptors are considered either sensitive or not, depending on the period of time for which they are exposed to emissions. The absolute magnitude of change in pollutant concentrations between the baseline and operational phase scenarios, in relation to the Air Quality Standards and Environmental Assessment Levels, is described and this is used to consider the risk of those Standards and Levels being exceeded.

For a change in annual mean concentrations of a given magnitude, IAQM have published recommendations for describing the impacts at individual receptors, as set out in Table 8-13. The description of impacts referred to in the IAQM guidance (Moorcroft and Barrowcliffe et al., 2017).

Table 8-13 IAQM Air Quality Impact Descriptors[1]

Long term average concentration at receptor in assessment year	% change in concentration relative to Air Quality Assessment Level (AQAL)[2]				
	<1 (Imperceptible)	1-2 (Very Low)	2-5 (Low)	6-10 (Medium)	>10 (Large)
75% or less of AQAL	Negligible	Negligible	Negligible	Slight	Moderate
76% - 94% of AQAL	Negligible	Negligible	Slight	Moderate	Moderate
95% - 102% of AQAL	Negligible	Slight	Moderate	Moderate	Significant
103% - 109% of AQAL	Negligible	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Negligible	Moderate	Substantial	Substantial	Substantial

Notes:

[1] For this assessment, IAQM effect descriptions are aligned with EPA Guidelines as follows:

Negligible = Imperceptible; Slight = Not Significant to Slight; Moderate = Moderate; and Substantial = Significant to Profound

[2] For this assessment, IAQM magnitude of change, descriptions are now aligned with EPA Guidelines as magnitude of effect as follows:

Imperceptible = Negligible; Very Low = Low; Low = Low; Medium = Medium; and Large = High.

The IAQM guidance states that the descriptors are for individual receptors only and that overall significance is determined using professional judgement. It also states that it is unwise to ascribe too much accuracy to incremental changes or background concentrations, and this is especially important when total concentrations are close to the objective value. For a given year in the future, it is impossible to define the new total concentration without recognising the inherent uncertainty, which is why there is a category that has a range around the objective value, rather than being exactly equal to it.

A change in predicted long-term (annual mean) concentrations of less than 0.5% of an Air Quality Standard or Environmental Assessment Level is considered to be 'imperceptible'. A PC (impact) that is 'Negligible', given normal bounds of variation, will not be capable of having a direct effect on local air quality that could be considered to be significant.

The guidance suggests the potential for 'Low' air quality impacts as a result of changes in pollutant concentrations between 2% and 5% of relevant Air Quality Standards and Environmental Assessment Levels. For example, for long-term NO_2 concentrations, this relates to changes in concentrations ranging from 0.6 – 2.1 µg/m^3. In practice, changes in concentration of this magnitude, and in particular changes at the lower end of this band are likely to be very difficult to distinguish due to the inter-annual effects of varying meteorological conditions. Therefore, in the overall evaluation of significance the potential for impacts to have significant air quality effect within this band will be considered in this context and will not be capable of having a direct effect on local air quality that can be considered to be significant.

Changes in concentration of more than 5% ('Medium' and 'High', the two highest bands) are considered to be of a magnitude which is far more likely to be discernible above the natural variation in baseline conditions and, as such, carry additional weight within the overall evaluation of significance for air quality. 'Moderate' impacts do not necessarily constitute a significant effect, where they do not contribute to an exceedance or risk of an exceedance of an Air Quality Standard or Environmental Assessment Level, particularly where such impacts relate to a small minority of receptors with the majority experiencing lesser impacts. A 'significant' to 'Profound' impact will almost certainly constitute a significant effect that will require additional mitigation to address.

The IAQM guidance (Moorcroft and Barrowcliffe et al., 2017) also provides thresholds for determining whether short-term impacts on human health sensitive receptors have the potential to cause a significant effect or not. Again, it is noted that the IAQM guidance is not specific to industrial facilities, but still provides a useful guide to scale the severity of impacts. This guidance deviates from the UK EA guidance in that the criteria it provides do not take account of background concentrations, although the guidance does state that this is not intended to play down the importance of total short-term concentrations; the IAQM guidance indicates that severity of peak short-term concentrations can be described without the need to reference background concentrations as the PC is used to measure impact, not the overall concentration at a receptor. The peak short-term PC from an elevated source has been adopted for this assessment as follows:

- PC <=10% of the Air Quality Standard or Environmental Assessment Level represents an impact that is 'Imperceptible' to 'Not significant';
- PC 11-20% of the Air Quality Standard or Environmental Assessment Level is small in magnitude representing a 'Slight' impact;
- PC 21-50% of the Air Quality Standard or Environmental Assessment Level is medium in magnitude representing a 'Moderate' impact; and
- PC >51% of the Air Quality Standard or Environmental Assessment Level is large in magnitude representing a 'Significant' to 'Profound' impact.

For impacts in nature conservation receptors, the UK EA guidance states that they may be considered insignificant ('not significant') where:

- The short-term PC is less than 10% of the short-term environmental standard for protected conservation areas; and
- The long-term PC is less than 1% of the long-term environmental standard for protected conservation areas.

Where the long-term process contribution exceeds this criteria, ecologically sensitive receptors may also be considered insignificant ('not significant') where:

- The long-term PEC is <70% of the Air Quality Standard, Environmental Assessment Level or Critical Load.

Where an impact on nature conservation sensitive receptors still cannot be screened as insignificant at this stage, again it does not necessarily mean that the effect is now significant. Model inputs and assumptions shall be reviewed, and detail enhanced where it can be. The predicted PC and PEC are then reviewed relative to the appropriate Air Quality Standards and Environmental Assessment Levels and the headroom that remains once the Proposed Development is in operation – i.e. is there a risk of an exceedance of an Air Quality Standard and Environmental Assessment Level and/ or does the operation of the Proposed Development constrain future development of the area.

Again, the 'insignificant' terminology used in the UK EA guidance applies to effects that can be described as 'Imperceptible' to 'Slight' in the EPA Guidelines on the information to be contained in Environmental Impact Assessment Reports (2017). It may also apply to effects that can be described as 'Moderate' in the EPA Guideline, where such effects relate to a limited number of sensitive receptors and/ or the Air Quality Standards and Environmental Assessment Levels remain not at risk of any exceedance. Ultimately, the significance of air quality impacts on nature conservation sites shall be determined by a professional ecologist.

8.3.3.3 Significance of Effects

Following the assessment of each individual air quality effect (construction dust, traffic and operational plant), the significance of all of the reported effects is then considered for the Proposed Development in overall terms. The potential for the Proposed Development to contribute to or interfere with the successful implementation of policies and strategies for the management of local air quality are considered if relevant, but the principal focus is any change to the likelihood of future achievement of the Air Quality Standards and Environmental Assessment Levels (which also relate to compliance with Council goals for local air quality management and objectives are set for the protection of human health).

In terms of the significance of the effects (consequences) of any adverse impacts, an effect is reported as being either significant or not. If the <u>overall</u> effect of the Proposed Development on local air quality or on amenity is found to be 'Moderate' (where a large proportion of sensitive receptors are affected and/ or there is risk of Air Quality Standards and Environmental Assessment Levels being exceeded) or 'Significant' to 'Profound', this is deemed to be significant for EIAR purposes. Effects found to be 'Moderate' (where limited sensitive receptors are affected and there is no risk of exceedance of an Air

Quality Standard or Environmental Assessment Level) to 'Imperceptible' are not considered to be significant.

8.3.4 Limitations and Assumptions

The air quality assessment has followed an industry standard approach, with reference to relevant guidance documents and methodologies, to provide the best possible means of predicting potential air quality impacts associated with the Proposed Development at Offsite receptors, and the determination of significance. However, it is inevitable that there are limitations associated with any approach, and those relevant to this assessment are summarised below:

- Inherent uncertainties with dispersion modelling:
  - The dispersion model can only be as accurate as the data inputted into it, including the source emissions data. To minimise the uncertainties associated with such data, the assessment has used emissions information provided directly from the design team that has fed into the current version of the Proposed Development design, and where design information is not available, data has been soured from published environmental LNG facility assessments with representative emissions sources.
  - The same can also be said of the meteorological data used to inform the assessment. Meteorological data has been sourced from Shannon Airport, the nearest meteorological station to the Proposed Development site with the complete dataset required for dispersion modelling. It is located approximately 35 km to the east-northeast of the Proposed Development site. To reduce the uncertainty in the representativeness of the meteorological data, the assessment has modelled five years of meteorological data and reported the worst impact for each pollutant and averaging period over the five-year period for each receptor. The assessment has also accounted for the influence in varying terrain and surface roughness, to better represent local conditions in the vicinity of the Proposed Development site.
- Uncertainties in baseline conditions:
  - The assessment refers to background air quality monitoring data reported by the EPA, in line with the approach set out in EPA guidance (2020). However, no current or recent air quality monitoring has been undertaken in the vicinity of the Proposed Development site and the data used and referred to is gathered by the EPA from rural locations across the country. There is some uncertainty into how representative this data is of background pollutant concentrations.
  - In line with EPA guidance (2020) the assessment quantifies the impact (Process Contribution) of emissions from the Proposed Development on acid deposition rates at nearby nature conservation sites that are sensitive to this pollutant. However, it has not been possible to source any baseline information on acid deposition rates in the vicinity of the Proposed Development site, or anywhere else in Ireland. In the absence of baseline data in the study area, a proxy acid deposition background has been sourced from the APIS website for a coastal location in the southwest of Wales. The use of this background acid deposition data should be treated with caution, as should the total acid deposition rates (Predicted Environmental Concentration) reported in this assessment.

The air quality assessment has also made a number of assumptions where precise information or data is not available. Where possible, assumptions are informed by relevant guidance. Assumptions based on operational characteristics are precautionary. Key assumptions are summarised below:

- It is assumed in the assessment that the CCGT plant will be operational for all hours of the year. This is precautionary as in reality it will operate for less than that and the hours of operation will decrease year on year.
- In line with EPA guidance (2020), in the absence of a species information for THC and VOC, all such emissions have been assumed to be as benzene, for comparison against the benzene Air Quality Standard. Again, this is precautionary as only a proportion of these compounds will actually be benzene.
- It has been assumed that the LNGCs accessing the Proposed Development will be an even split of gas and liquid fuel-fired vessels. This is precautionary as industry publication (IGN, 2019) suggests the LNGC fleet is now predominantly made up of gas-fired vessels and the number of liquid fuel-fired vessels is decreasing.

- Various precautionary assumptions have been made for the sensitivity scenarios to demonstrate compliance with the Air Quality Standards and Environmental Assessment Levels even with unlikely and/ or impossible operating conditions.
- The rate of conversion of NO_X to NO_2 from modelled emissions sources has been assumed to be 100% for annual mean NO_2 and 50% for hourly mean NO_2 across the study area, in the absence of NO_X, NO_2 and O_3 data. In reality, at locations close to the source, the conversion of NO_X to NO_2 is likely to be less efficient than that.

8.4 Baseline Environment

8.4.1 Monitored Baseline

The existing environment has been described with reference to the most recently published EPA Air Quality Report and supplementary data (EPA, 2020b).

The EPA manages the national ambient air quality network, which consists of 30 monitoring stations located across the country that monitor a range of pollutants, including some of those of relevance to this assessment. The most recent EPA Air Quality Report available was published in 2020 and refers to monitoring data gathered in 2019 and earlier.

EU legislation on air quality requires that Member States divide their territory into zones for the assessment and management of air quality. The zones in place in Ireland during the most recently available report of monitoring (EPA, 2020b) are:

- Zone A – Dublin conurbation;
- Zone B – Cork conurbation;
- Zone C – large towns with a population >15,000; and
- Zone D – the remaining area of Ireland.

The EPA operate a network of air quality monitoring across the country. Data gathered by the nearest air quality monitoring undertaken to the Proposed Development site is summarised in Table 8-14. Data is also presented as the average across the representative Zone D sites.

Table 8-14 Air Quality Monitoring Data

Monitoring Station	Distance and Orientation from Site	Pollutant	Reported Concentration ($\mu g/m^3$)[1]				Relevant Air Quality Standard ($\mu g/m^3$)
			2016	2017	2018	2019	
Tralee, Co. Kerry (Zone C)	39 km SW	PM_{10}	-	-	-	28[2]	40[3]
		$PM_{2.5}$	-	-	-	23[2]	25[3]
Ennis, Co. Clare (Zone C)	42 km NE	PM_{10}	17.2	15.8	16	18	40[3]
		$PM_{2.5}$	12	10.6	10	14	25[3]
		SO_2	3.7	3.4	3.2	3.6	20[4]
Valentia, Co. Kerry (Zone D)	83 km SW	O_3[5]	69.1 (1)	65.7 (0)	68 (6)	72 (0)	120[3,6]
		O_3[7]	4,116[7]	2,682[7]	3,240[7]	-	18,000[4,8]
People's Park. Limerick (Zone C)	55 km E	NO_2	-	-	-	13	40[3]
		PM_{10}	-	-	-	13	40[3]
		$PM_{2.5}$	-	-	-	9	25[3]
Zone D Average[9]		NO_2	6.3	4.4	4.7	5.7	40[3]
		NO_X	10.0	5.7	6.7	7.8	30_4
		PM_{10}	11.9	9.9	10.7	12.3	40[3]
		$PM_{2.5}$	9.0	7.4	7.5	9.3	25[3]
		O_3[5]	59.7 (1)	62.4 (2)	63.4 (6)	64.1 (0)	120[3]

Monitoring Station	Distance and Orientation from Site	Pollutant	Reported Concentration (μg/m^3)[1]				Relevant Air Quality Standard (μg/m^3)
			2016	2017	2018	2019	
			4,226[7]	2,400[7]	3,177[7]	-	18,000[4,8]
		SO_2	2.1	2.0	2.6	3.1	20[4]
		CO[5]	600 (0)	150 (0)[10]	400 (0)[10]	100 (0)	10,000[3]

Notes:

[1] Values as reported by the EPA in the Supplementary Tables to Support the annual Air Quality in Ireland reports.

[2] Poor data capture (<50%).

[3] For the protection of human health

[4] For the protection of ecosystems (nature conservation receptors)

[5] Rolling 8-hour average – number of exceedances of the rolling 8-hour maximum Air Quality Standard provided in parenthesis)

[6] Allowable on 25 days per year (averaged over 3 years))

[7] μg/m^3 x hr (AOT40)

[8] AOT40 target value for 2010 is 18,000 μg/m^3.h; long-term objective for 2020 is 6,000 μg/m^3.h. AOT40 is calculated 1st May – 31st July.

[9] Zone D average data discounts sites with data capture of <50%.

[10] Average for Zone C – no Zone D data available

The EPA data summarised in Table 8-14above demonstrates that the existing airshed in the vicinity of the Proposed Development is unlikely to be constrained and concentrations are generally well below the respective Air Quality Standards and Environmental Assessment Levels for the protection of human health and ecosystems.

Of the pollutants listed, 8-hour maximum O_3 concentrations have been monitored in above the Air Quality Standard value for human health (120 μg/m^3), but not to the frequency that actually constitutes an exceedance of that actual standard (25 days per year, averaged over 3 years).

Monitored annual mean NO_X and SO_2 concentrations and the O_3 AOT40 values (Accumulated exposure Over a Threshold of 40 parts per billion) reported by the EPA for Zone D suggest that nature conservation sites considered in this assessment are not currently constrained by the pollutants associated with harm to ecosystems.

In addition to the monitoring data made available by the EPA, there is also data available from other air quality assessments undertaken in the vicinity of the Proposed Development, including the EIAR for the Foynes to Limerick Road (including Adare Bypass) project. That report included NO_2 concentration data measured at several locations in Co. Limerick, to the east of the Proposed Development, over a period of 2 winter months. Whilst a 2-month survey of data cannot be directly comparable to the annual mean, measured roadside concentrations of 5.7 to 12.8 μg/m^3 and background concentrations of 1.9 to 6.7 μg/m^3 over winter months continue to demonstrate that existing local air quality in the vicinity of the Proposed Development is not constrained.

8.4.2 Modelled Baseline

The baseline data described above is based on measurement data that is considered representative of the study area. However, that data does not account for baseline road traffic emissions on nearby roads. Such emissions are likely to affect baseline air quality at locations up to 200 m from a road. To account for this source in the assessment, traffic data has been provided by the Proposed Development transport consultant and modelled to predict baseline and future baseline concentrations of the primary pollutants associated with road traffic. Predictions have been made at the selected human health and nature conservation site receptors located within 200 m of the roads most likely to be affected by Proposed Development traffic movements. The range of modelled baseline concentrations at selected roadside air quality sensitive receptors are provided in Table 8-15 and

Table 8-16. A full set of baseline results at all selected receptors considered in this assessment is provided in Volume 4, Appendix A8-3.

Table 8-15 Range in Modelled Combined Baseline Pollutant Concentrations at Human Health Sensitive Receptors

Pollutant	Averaging Period	Air Quality Standard (µg/m^3)	Range of Contribution from Road Sources (µg/m^3)	Ambient Background Contribution (µg/m^3)	Ambient Background + Road Source Contribution (µg/m^3)
2019 Existing Baseline					
Nitrogen dioxide (NO_2)	Annual mean	40	<0.1 – 8.5	4.3	4.4 – 12.8
Particulate matter (PM_{10})	Annual mean	40	<0.1 – 1.9	9.0	9.0 – 10.9
Fine particulate matter ($PM_{2.5}$)	Annual mean	25	<0.1 – 1.9	4.0	4.0 – 5.9
2025 Future Baseline					
Nitrogen dioxide (NO_2)	Annual mean	40	<0.1 – 5.3	4.3	4.4 – 9.6
Particulate matter (PM_{10})	Annual mean	40	<0.1 – 1.9	9.0	9.0 – 10.9
Fine particulate matter ($PM_{2.5}$)	Annual mean	25	<0.1 – 1.9	4.0	4.0 – 5.9

Table 8-16 Range in Modelled Combined Baseline Pollutant Concentrations at Nature Conservation Sensitive Receptors

Pollutant	Averaging Period	Air Quality Standard	Range of Contribution from Road Sources	Ambient Background Contribution	Ambient Background + Road Source Contribution
2019 Existing Baseline					
Oxides of nitrogen (NO_X)	Annual mean	30 µg/m^3	0.1 – 4.5 µg/m^3	6.2 µg/m^3	6.3 – 10.7 µg/m^3
Nitrogen deposition	Annual deposition rate	Various – see Table 8.8	<0.1 – 0.4 kg N/ha/yr	12.0 kg N/ha/yr	12.0 – 12.4 kg N/ha/yr
Acid deposition	Annual deposition rate	Various – see Table 8.8	<0.1 – 0.03 keq/ha/yr	0.50 keq/ha/yr	0.50 – 0.53 keq/ha/yr
2025 Future Baseline					
Oxides of nitrogen (NO_X)	Annual mean	30 µg/m^3	<0.1 – 2.8 µg/m^3	6.2 µg/m^3	6.2 – 9.0 µg/m^3
Nitrogen deposition	Annual deposition rate	Various – see Table 8.8	<0.1 – 0.2 kg N/ha/yr	12.0 kg N/ha/yr	12.0 – 12.2 kg N/ha/yr
Acid deposition	Annual deposition rate	Various – see Table 8.8	<0.1 – 0.02 keq/ha/yr	0.50 keq/ha/yr	0.50 – 0.52 keq/ha/yr

8.5 Embedded Mitigation

The Proposed Development includes a number of embedded mitigation measures that will likely reduce the impact of emissions on nearby air quality sensitive receptors. Some of these measures are designed with the specific purpose of controlling emissions to air, and others are included primarily for other purposes, but have an additional benefit of reducing air quality impacts. These measures are summarised below.

- Emission release heights for the largest and most frequent sources of emissions to air have been designed to encourage good dispersion, through height above ground level and height above nearby buildings and structures;
- The layout of the onshore site maximises distance between the main continuous sources of emissions to air and the nearest air quality sensitive receptors;
- The layout of the Offshore site also provides a good setback distance between sources of emissions to air and the nearest air quality sensitive receptors;
- Whilst the air quality assessment has assumed continuous operation of the Power Plant (CCGT) throughout the year, in reality the Power Plant will only operate for the energy demand required at the time;
- The majority of plant and all continuous and frequently operational plant will be fuelled by natural gas. Liquid fuel will only be used for start-up, maintenance and emergency purposes; and
- Start-up and emergency plant will only operate with use of low and ultra-low sulphur liquid fuel.

8.6 Assessment of Impact and Effect

8.6.1 Construction Phase Dust and Particulate Matter Assessment

As described in Section 8.3, the construction dust and particulate matter assessment follows the step by step approach set out in relevant IAQM guidance (2014). This process is summarised in the sub-sections below.

8.6.1.1 Identify Receptors within the Screening Distance of the Site Boundary

The screening distances set by the IAQM guidance are:

- Receptors sensitive to amenity and human health impacts within 350 m of the construction site boundary and/ or within 50 m of a public road used by construction traffic that is within 500 m of the site entrance; and
- Nature conservation receptors located within 50 m of the construction site boundary and/ or within 50 m of a public road used by construction traffic that is within 500 m of the site entrance.

There are a limited number of amenity and human health sensitive receptors within 350 m of the construction site boundary. These include the residential dwellings >300 m to the south and southeast of the Proposed Development site. There are also a number of amenity and human health sensitive receptors within 50 m of a public road used by construction traffic that is within 500 m of the site entrance, including residential dwellings adjacent to the L1010.

The Shannon Estuary cSAC/ SPA is also within 50 m of the construction site boundary, although the aquatic elements of the cSAC/ SPA are not considered sensitive to dust impacts.

8.6.1.2 Identify the Magnitude of Effects

The magnitude of effect is informed by the scale of works associated with the following activities: demolition; earthworks; construction (i.e. the building and erection of structures); and trackout (the deposition of dust and particulate matter onto public roads by construction vehicles). A detailed description of the construction works is provided in Chapter 02 – Project Description.

Demolition

The Proposed Development includes no/ minimal demolition and the emissions magnitude of effect from this activity is considered negligible.

Earthworks

The Proposed Development site is anticipated to require extensive earthworks associated with levelling and also regrading to mitigate visual and noise-related impacts. For the purposed of this assessment, the area of earthworks is considered to exceed 10,000 m^2 and require the handling of up to 100,000 t of material. As such, the dust emissions magnitude of effect for earthworks is High.

Construction

The Proposed Development includes a number of buildings and structures. For the purpose of this assessment, the combined volume of these is considered to be in excess of 100,000 m^3. It is also considered that onsite concrete batching maybe required. As such, the dust emissions magnitude of effect for construction is High.

Trackout

The peak number of daily HGV construction vehicle movements associated with the Proposed Development site is anticipated to be greater than 50. There is also anticipated to be periods when onsite haul routes are not surfaced, particularly during the earlier phases of construction. As such, the dust emissions magnitude of effect for trackout is High.

8.6.1.3 Establish the Sensitivity of the Area

The sensitivity of the area is determined by the sensitivity, number and proximity of amenity, human health and nature conservation receptors to the construction site boundary and access roads.

In this instance, there is a single High sensitivity amenity and human health receptor approximately 330 m from the construction site boundary, and 6 High sensitivity receptors within between 25 m and 50 m of a public road used by construction traffic that is with 500 m of the site access (off the L1010). There are no amenity and human health sensitive receptors of Medium or Low sensitivity. This equates to a Low sensitivity for amenity impacts. Coupled with low ambient background PM_{10} concentrations (<24 $\mu g/m^3$), this also equates to a Low sensitivity for human health impacts.

With regards to dust impacts on nature conservation receptors, the adjacent SPA/ cSAC is classed as a High sensitivity receptor, due to its international level of designation, and is located within 20 m of the construction site boundary. The sensitivity of the area to nature conservation impacts is classed as High.

8.6.1.4 Determine the Risk of Significant Effects

The risk of dust impacts occurring is determined by comparison of the potential dust emission magnitude effect and the sensitivity of the area. For dust soiling and human health impacts, the High dust emission magnitude of effect identified for earthworks, construction and trackout is offset by the Low sensitivity of the area and equates to a not significant to slight risk of dust impacts.

For dust impacts on ecology the High dust emission magnitude of effect combined with the sensitivity of the area equates to a **moderate** to **significant** risk of dust impacts. However, it is noted that the majority of the cSAC/ SPA within 50 m of the construction site boundary is tidal estuary and should dust deposit beyond the Proposed Development site boundary, it is likely to be washed away naturally.

8.6.1.5 Determine the Level of Mitigation Required

The classification of dust impact risk is then used to inform the level of mitigation required to ensure the impact risk identified can be sufficiently mitigated, to the extent that a significant effect does not occur. The IAQM guidance relevant to the construction dust assessment lists measures that should be applied, if practical, relative to the risk identified.

In this instance, a high risk of dust impacts was identified due the potential dust emission magnitude and the ecological sensitivity of the area. Therefore, the list of IAQM recommended mitigation measures provided below is proportionate to the risk identified. The final list of mitigation and monitoring measures to be taken forward during the construction works will be defined within the Proposed Development’s OCEMP application document.

IAQM recommended Dust (and particulate matter) mitigation measures for High risk sites are as follows:

- Develop and implement a stakeholder communications plan that includes community engagement before work commences onsite;
- Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary;
- Display the head or regional office contact information;
- Develop and implement a Dust Management Plan (DMP);
- Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken;

- Record any exceptional incidents that cause dust and/ or air emissions, either on- or off-site, and the action taken to resolve the situation in the logbook;
- Undertake daily onsite and offsite inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked;
- Carry out regular site inspections to monitor compliance with the DMP, record inspection results;
- Increase the frequency of site inspections by the person accountable for air quality and dust issues onsite when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions;
- Agree a proportionate level of site boundary dust monitoring, relative to the risk of offsite dust impacts occurring and the potential for harm to amenity, with the Planning Authority. This could include passive dust deposition monitoring at potential locations shown on Figure 8-5, the data gathered by which could be used to inform the effectiveness of dust control measures and substantiate potential complaints;
- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible;
- Erect solid screens/ barriers or enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period;
- Keep site fencing, barriers and scaffolding clean using wet methods;
- Cover, seed or fence long-term stockpiles to prevent wind whipping;
- Ensure all vehicles switch off engines when stationary - no idling vehicles;
- Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where practicable;
- Impose and signpost maximum-speed-limits on surfaced and unsurfaced haul roads and work areas;
- Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials;
- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression technique;
- Ensure an adequate water supply on the site for effective dust/ particulate matter suppression/ mitigation;
- Use enclosed chutes and conveyors and covered skips;
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment if it is fitted;
- Ensure equipment is readily available onsite to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods;
- Avoid bonfires and burning of waste materials;
- Re-vegetate earthworks and exposed areas/ soil stockpiles to stabilise surfaces as soon as practicable, or Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable;
- Only remove vegetation cover in small areas during work and not all at once;
- Avoid scabbling (roughening of concrete surfaces) if possible;
- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out;
- Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery;
- For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust;

- Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site;
- Avoid dry sweeping of large areas;
- Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport;
- Inspect onsite haul routes for integrity, make a record and instigate necessary repairs to the surface as soon as reasonably practicable;
- Install hard surfaced haul routes, which are regularly damped down;
- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable). Ensuring that there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits; and
- Access gates to be located at least 10 m from receptors where possible.

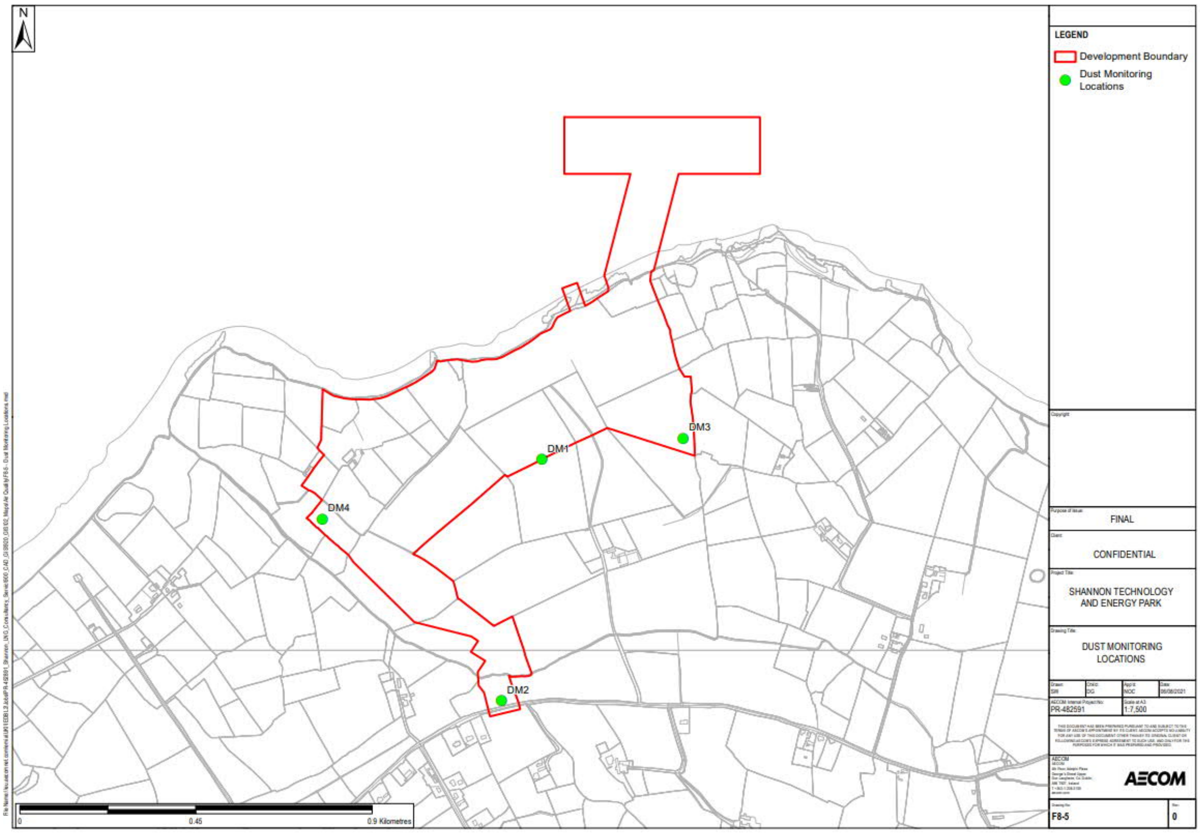

Figure 8-5 Dust Monitoring Locations

8.6.1.6 Summarise the Potential Residual Effects

In line with IAQM construction dust guidance, providing adequate dust mitigation measures are implemented onsite, all of which are common practice on all well managed construction sites across the country, then impacts can be adequately controlled to the extent that any effect is not significant (‘**Imperceptible’** to ‘**Slight’**).

8.6.2 Construction Phase Road Traffic Emissions Assessment

Annual mean concentrations of NO_2 and PM_{10} have been quantified at receptors located close to roads used by construction traffic for a 2024 future baseline scenario and a 2024 peak construction phase scenario. $PM_{2.5}$ contribution have been precautionarily assumed to be the same as the PM_{10} output from the DMRB spreadsheet. The results are presented in Table 8-17 for the worst affected receptors, which are located at roadside locations adjacent to the L1010 toward Tarbert and Bridewwll Street in Tarbert.

The results show that the temporary impact of construction phase traffic emissions at the worst affected receptor locations do not cause an exceedance of an air quality standard or Environmental Assessment Level, or put such a Standard or Level at Risk of an exceedance.

Table 8-17 Predicted Process Contribution of Road Traffic Emissions and Predicted Environmental Concentration at Selected Receptors –Construction Phase Scenario

Pollutant and Averaging Period	AQ Standard (µg/m³)	Road Traffic Emissions Process Cont. (µg/m³)	Road Process Cont. as proportion of AQ Standard (%)	Combined Background (Ambient) and Baseline Road Cont. (µg/m³)	Predicted Env. Conc. (µg/m³)	Predicted Env Conc. as a Proportion of AQ Standard (%)
Human Health Receptor – worst affected receptor located within 200m of a road used by Proposed Development construction traffic						
Annual Mean Nitrogen Dioxide (NO_2)	40	1.2	3.0	4.7	5.9	14.8
Annual Mean Particulate Matter (PM_{10})	40	<0.1	0.1	9.1	9.2	23.0
Annual Mean Fine Particulate Matter ($PM_{2.5}$)	25	<0.1	0.2	4.1	4.2	16.8
Nature Conservation Site Receptors – worst affected receptor located within 200m of a road used by Proposed Development traffic						
Annual Mean Oxides of Nitrogen (NO_X)	30	0.5	1.3	11.9	12.4	41.3
Nutrient Nitrogen Deposition[1]	20 (kg N/ha/yr)	<0.1	0.2	12.1 (kg N/ha/yr)	12.3 (kg N/ha/yr)	61.4
Acid Deposition[2]	N/A	N/A	N/A	N/A	N/A	N/A

Notes:

[1] Worst affected receptor is E09 – mudflats habitat.

[2] No nature conservation site receptor within 200m of a road that is sensitive to acid deposition.

Bold rows represent pollutants and averaging periods that cannot be screened as insignificant following UK EA guidance.

The data provided by Sisk Ltd in the OCEMP and Outline Construction Traffic Management Plan (OCTMP) is understood to be representative of the proposed combination of construction activities.

8.6.3 Operational Phase Site Emissions Assessment

8.6.3.1 Normal Operational Scenario (Combined Loop Re-gasification and CCGT)

The PC (impact) and PEC (total pollutant concentration with Proposed Development in operation) as a result of site emissions are presented in Table 8-17 for the worst affected human health and worst affected nature conservation receptors (for each pollutant and averaging period), for the Normal Operational Scenario (Combined Loop Re-gasification and CCGT). The PC and PEC for all receptors considered in the assessment are provided in Volume 4, Appendix A8-3. Contour plots showing the spatial variation of predicted impacts for key pollutants across the study area are provided in Volume 3 for annual mean NO_2 (Figure 8-1), hourly mean NO_2 (Figure 8-2), annual mean NO_X (Figure 8-3) and annual nitrogen deposition rates (Figure 8-4).

Table 8-17 Predicted Process Contribution and Predicted Environmental Concentration at Worst Affected Receptors – Normal Operational Scenario (Combined Loop Re-gasification and CCGT)

Pollutant and Averaging Period	AQ Standard (µg/m³)	Process Cont. (µg/m³)	Process Cont. as proportion of AQ Standard (%)	Background (Ambient) Cont. (µg/m³)	Predicted Env. Conc. (µg/m³)	Predicted Env Conc. as a Proportion of AQ Standard (%)
Human Health Receptors						
Annual Mean Nitrogen Dioxide (NO_2)	40	5.7	14.2	4.3	10.0	25.0
Hourly Mean Nitrogen Dioxide (NO_2)	**200**	**59.7**	**29.8**	**8.7**	**68.4**	**34.2**
Annual Mean Particulate Matter (PM_{10})	40	0.1	0.2	9.0	9.1	22.8
Daily Mean Particulate Matter (PM_{10})	50	0.6	1.3	18.0	18.6	37.2
Annual Mean Fine Particulate Matter ($PM_{2.5}$)	25	0.1	0.3	4.0	4.1	16.4
Rolling 8-hour Maximum Carbon Monoxide (CO)	10,000	239.8	2.4	100	339.8	3.4
Maximum Hourly Carbon Monoxide (CO)	30,000	261.1	0.9	100	361.1	1.2
Daily Mean Sulphur Dioxide (SO_2)	125	0.5	0.4	2.6	3.1	2.5
Hourly Mean Sulphur Dioxide (SO_2)	350	1.5	0.4	2.6	4.1	1.2
15-Minute Sulphur Dioxide (SO_2)	266	2.5	0.9	2.6	5.1	1.9
Annual Mean Benzene (C_6H_6)[1]	5	2.2	43.7	0.2	2.4	47.8
Hourly Maximum Benzene (C_6H_6)[1]	**195**	**58.0**	**29.8**	**0.2**	**58.2**	**29.8**
Annual Mean Formaldehyde (CH_2O)	5	0.1	2.6	No Data	0.1	2.6
Maximum Hourly Formaldehyde (CH_2O)	100	9.2	9.2	No Data	9.2	9.2
Nature Conservation Site Receptors						
Annual Mean Oxides of Nitrogen (NO_X)	30	1.1	3.6	6.2	7.3	24.3
Maximum Daily Oxides of Nitrogen (NO_X)[2]	**75**	**24.2**	**32.3**	**12.4**	**36.6**	**48.8**
Annual Mean Sulphur Dioxide (SO_2)	20	<0.1	<0.1	1.3	1.3	6.5
Nutrient Nitrogen Deposition[3]	20 kg N/ha/yr	0.2 (kg N/ha/yr)	0.8	12.0 (kg N/ha/yr)	12.2 (kg N/ha/yr)	61.0
Acid Deposition[4]	CLminN: 0.223 (keq/ha/yr) CLmaxN: 0.568 (keq/ha/yr) CLmaxS:	**<0.1 (keq/ha/yr)**	**1.8**	**0.5 (keq/ha/yr)[5]**	**0.51 (keq/ha/yr)**	**89.8**

Pollutant and Averaging Period	AQ Standard (µg/m³)	Process Cont. (µg/m³)	Process Cont. as proportion of AQ Standard (%)	Background (Ambient) Cont. (µg/m³)	Predicted Env. Conc. (µg/m³)	Predicted Env Conc. as a Proportion of AQ Standard (%)
	0.202 (keq/ha/yr)					

Notes:

[1] Assumed all THC and VOC emissions are as benzene (C_6H_6) (which is standard practice when THC/VOC composition is unknown). In reality, C_6H_6 is only likely to make up a proportion of total THC and VOC emissions amongst numerous other compounds. Where the conservative assumption that all THC and VOC emissions are C_6H_6 does not lead to an exceedance of the relevant Air Quality Standards for this pollutant, it is unlikely considered to represent a significant effect.

[2] Research cited in IAQM guidance (2020) states that the daily NO_X standard is of less importance than the annual NO_X standard at nature conservation sites. The daily NO_X standard is typically only of concern at a nature conservation site when SO_2 and O_3 concentrations are elevated close to or in excess of their Air Quality Standards for the protection of ecosystems. The SO_2 concentrations reported in this table and the O_3 data reported in Table 8.14 demonstrate that concentrations of neither SO_2 or O_3 are elevated close to those standards and as such, the nature conservation receptors included in this assessment are not considered sensitive to the daily NO_X impacts reported.

[3] Worst affected receptor is E09 – mudflats habitat.

[4] Worst affected receptor is E12 – perennial vegetation on stony banks habitat.

[5] In the absence of publicly available background acid deposition data for Ireland, a background acid deposition value reported by APIS for a rural location in the west of Wales (UK) has been used as a proxy. PEC of acid deposition reported in this chapter should be treated with caution and referred to as a guideline value only.

Bold rows represent pollutants and averaging periods that cannot be screened as insignificant following UK EA guidance.

Following UK EA guidance, the majority of pollutants and averaging periods at human health and nature conservation receptors reported for this scenario in Volume 4, Appendix A8-3 can be considered insignificant, due to the following reasons:

- PC to long-term (annual mean) pollutant concentrations at human health and nature conservation sensitive receptors being less than 1% of their Air Quality Standard and/ or Predicted Environmental Concentration being less than 70% of their Air Quality Standard;
- PC to short-term (<annual mean) pollutant concentrations at human health sensitive receptors being less than 10% of their Air Quality Standard and/ or PC being less than 20% of the Air Quality Standard minus the short-term background; and
- PC to short-term pollutant concentrations at nature conservation sensitive receptors being less than 10% of their Air Quality Standard.

Where pollutants and averaging periods cannot be screened as insignificant ('Imperceptible' to 'Slight' effects and 'Moderate' where those effects relate to a limited number of sensitive receptors and/ or the Air Quality Standards and Environmental Assessment Levels remain not at risk of any exceedance), the UK EA recommends that detailed modelling is undertaken to accurately reflect anticipated conditions at the site and further analysis of the Process Contribution and Predicted Environmental Concentrations is undertaken. This chapter already describes and reports the results of detailed modelling that is based on the current design information and precautionary assumptions where required. It is considered that the detail of the model is already fit for purpose and does not require any more detail than already included and described in this chapter. Instead, further analysis of the Process Contribution and Predicted Environmental Concentrations has been undertaken for these pollutants and averaging periods.

The footnotes provided for Table 8-17 describe why neither the hourly C_6H_6 PC nor the daily NO_X PC should be considered potentially significant. The C_6H_6 values reported are overly conservative in that it has been assumed that all THC and VOC emissions are as that pollutant, rather than the usual suite of various compounds that make up those pollutants. The daily NO_X Environmental Assessment Level is only considered to be a concern to nature conservation receptors where they are already under stress from elevated concentrations of SO_2 and O_3. In this instance, none of the nature conservation receptors experiences such conditions.

Hourly mean NO_2 PC and PEC at the worst affected human health sensitive receptor (R19) could not be screened as insignificant – with an impact (PC) that is in excess of 10% of the Air Quality Standard and of 20% of the Air Quality Standard minus the short-term background. The same was also the case for the next seven worst affected receptors (R8, R10, R13-R16 and R26 (see Volume 4, Appendix A8-3)), but not for the remaining 39 receptors considered, who experienced an hourly NO_2 impact (PC) of less than the criteria given in the UK EA guidance. Further review of the impact (PC) and total pollutant concentrations (PEC) at these worst affected receptors shows that with the Proposed Development in operation, there remains a headroom (the gap between the total pollutant concentration (PEC) and the Air Quality Standard) of between 68-79% of the Air Quality Standard for that pollutant. It can therefore be said with much confidence that the operation of the Proposed Development does not give rise to any risk of exceedance of the hourly mean NO_2 Air Quality Standard in the Normal Operational Scenario, nor is it likely to constrain any future development of the area.

The annual average acid deposition rate impact (PC) and total deposition rate (PEC) at the worst affected nature conservation site (receptor E12 - perennial vegetation on stony banks habitat) could not be screened as insignificant ('Imperceptible' to 'Slight' effects and 'Moderate' effects where those effects relate to a limited number of sensitive receptors and/ or the Air Quality Standards and Environmental Assessment Levels remain not at risk of any exceedance) – with an impact (PC) in excess of 1% of the Environmental Assessment Level and a total deposition rate (PEC) of more than 70%. No other nature conservation receptors sensitive to acid deposition considered in this assessment experience an impact (PC) of 1% or more of their respective Environmental Assessment Levels. At receptor E12, it is noted that the impact (PC) accounts for just 1.8% of the Air Quality Standard, and the elevated total deposition rate (PEC) is therefore primarily due to the ambient background contribution assumed in the assessment. That background contribution is a proxy obtained from what is considered to be a broadly representative location elsewhere (a location where acid deposition data is available), in the absence of site or region-specific data, and should be treated with caution and perhaps not primarily used for determining significance, due to its uncertainty. It should also be noted that the Air Quality Standard that the impact (PC) and total deposition rate (PEC) are being compared to is the lower end of a Critical Load Range and both will account for a smaller proportion of the upper Critical Load Range. Furthermore, background acid deposition rates in the study area are likely to fall in the near future, because of the cessation of coal burning and Heavy Fuel Oil burning at Moneypoint and Tarbert Power Stations respectively. In light of the above, it is determined that the operation of the Proposed Development will not give rise to an exceedance of the Air Quality Standard for annual mean acid deposition rates and that the impact will not cause a significant effect.

The impact (PC) and total pollutant concentrations (PEC) have also been evaluated against the IAQM guidance criteria (Morrow & Barrowcliffe, 2017). Whilst primarily intended for use with development planning for non-industrial sites, it still provides a useful gauge for estimating significance, as the criteria is based on the magnitude of impact and the risk of impacts causing an exceedance of an Air Quality Standard. In this instance and following this guidance, long-term (annual mean) impacts (PC) are described as slight-adverse to negligible for all pollutants and receptors (discounting the conservative C_6H_6 predictions) with the exception of annual mean NO_2 impacts at receptors R19 and R26, which are described as moderate adverse. In some circumstances, moderate adverse impacts (PC) can represent a significant effect, typically when there are numerous receptors predicted to experience such an impact and/ or the impact contributes to an Air Quality Standard being at risk of an exceedance. In this instance, the moderate adverse impact (PC) affects just 2 receptors, which, with the addition of the contribution from the Proposed Development, experience total annual mean NO_2 concentrations (PEC) that account for less than 50% of the Air Quality Standard. With reference to the IAQM guidance, the impacts on long-term pollutant concentrations, therefore, will not have a significant effect.

Following the IAQM guidance for short-term (<annual mean) impacts, potential significant effects are considered by the impact relative to the Air Quality Standard. The effect of short-term impacts are described as **imperceptible** to **slight adverse** at 45 of the 48 human health receptors considered for all pollutants, and **moderate adverse** at the remaining 3 receptors for hourly mean NO_2. However, even with this magnitude of effect, total hourly mean NO_2 concentrations remain well below the Air Quality Standard for that pollutant to the extent that the effect is not considered to be significant.

8.6.3.2 Sensitivity Scenario 1: Operational Scenario (Combined Loop Re-gasification and CTG)

The PC (impact) and PEC (total pollutant concentration with Proposed Development in operation) as a result of site emissions are presented in Table 8-18 for the worst affected human health and worst affected nature conservation receptors (for each pollutant and averaging period), for the Sensitivity Scenario 1: Operational Scenario (Combined Loop Re-gasification and CTG). The Process Contribution and Predicted Environmental Concentration for all receptors considered in the assessment are provided in Volume 4, Appendix A8-3.

Table 8-18 Predicted Process Contribution and Predicted Environmental Concentration at Worst Affected Receptors – Sensitivity Scenario 1: Operational Scenario (Combined Loop Re-gasification and CTG)

Pollutant and Averaging Period	AQ Standard (µg/m^3)	Process Cont. (µg/m^3)	Process Cont. as proportion of AQ Standard (%)	Background (Ambient) Cont. (µg/m^3)	Predicted Env. Conc. (µg/m^3)	Predicted Env Conc. as a Proportion of AQ Standard (%)
Human Health Receptors						
Annual Mean Nitrogen Dioxide (NO_2)	40	1.6	4.0	4.3	5.9	14.8
Hourly Mean Nitrogen Dioxide (NO_2)	200	30.9	15.4	8.7	39.6	19.8
Annual Mean Particulate Matter (PM_{10})	40	0.1	0.2	9.0	9.1	22.8
Daily Mean Particulate Matter (PM_{10})	50	0.6	1.3	18.0	18.6	37.2
Annual Mean Fine Particulate Matter ($PM_{2.5}$)	25	0.1	0.3	4.0	4.1	16.4
Rolling 8-hour Maximum Carbon Monoxide (CO)	10,000	76.6	0.8	100	176.6	1.8
Maximum Hourly Carbon Monoxide (CO)	30,000	125.2	0.4	100	225.2	0.8
Daily Mean Sulphur Dioxide (SO_2)	125	0.5	0.4	2.6	3.1	2.5
Hourly Mean Sulphur Dioxide (SO_2)	350	1.5	0.4	2.6	4.1	1.2
15-Minute Sulphur Dioxide (SO_2)	266	2.5	0.9	2.6	5.1	1.9
Annual Mean Benzene (C_6H_6)[1]	5	0.4	7.3	0.2	0.6	12.0
Hourly Maximum Benzene (C_6H_6)[1]	195	19.6	10.1	0.2	19.8	10.2
Annual Mean Formaldehyde (CH_2O)	5	0.1	2.6	No Data	0.1	2.0
Maximum Hourly Formaldehyde (CH_2O)	100	9.2	9.2	No Data	9.2	9.2
Nature Conservation Site Receptors						
Annual Mean Oxides of Nitrogen (NO_X)	30	0.5	1.6	6.2	6.7	22.3
Maximum Daily Oxides of Nitrogen (NO_X)[2]	75	9.5	12.7	12.4	21.9	29.2
Annual Mean Sulphur Dioxide (SO_2)	20	<0.1	<1	1.3	1.3	6.5

Pollutant and Averaging Period	AQ Standard (µg/m^3)	Process Cont. (µg/m^3)	Process Cont. as proportion of AQ Standard (%)	Background (Ambient) Cont. (µg/m^3)	Predicted Env. Conc. (µg/m^3)	Predicted Env Conc. as a Proportion of AQ Standard (%)
Nutrient Nitrogen Deposition[3]	20 kg N/ha/yr	0.1	0.4	12.0 (kg N/ha/yr)	12.1 (kg N/ha/yr)	60.5
Acid Deposition[3]	CLminN: 0.223 (keq/ha/yr) CLmaxN: 0.568 (keq/ha/yr) CLmaxS: 0.202 (keq/ha/yr)	**<0.1 (keq/ha/yr)**	**1.8**	**0.5 (keq/ha/yr)[3]**	**0.51 (keq/ha/yr)**	**89.8**

Notes:

[1] Assumed all THC and VOC emissions are as benzene (C_6H_6) (which is standard practice when THC/ VOC composition is unknown). In reality, C_6H_6 is only likely to make up a proportion of total THC and VOC emissions amongst numerous other compounds. Where the conservative assumption that all THC and VOC emissions are C_6H_6 does not lead to an exceedance of the relevant Air Quality Standards for this pollutant, it is unlikely considered to represent a significant effect.

[2] Research cited in IAQM guidance (2020) states that the daily NO_X standard is of less importance than the annual NO_X standard at nature conservation sites. The daily NO_X standard is typically only of concern at a nature conservation site when SO_2 and O_3 concentrations are elevated close to or in excess of their Air Quality Standards for the protection of ecosystems. The SO_2 concentrations reported in this table and the O_3 data reported in Table 8.14 demonstrate that concentrations of neither SO_2 or O_3 are elevated close to those standards and as such, the nature conservation receptors included in this assessment are not considered sensitive to the daily NO_X impacts reported.

[3] In the absence of publicly available background acid deposition data for Ireland, a background acid deposition value reported by APIS for a rural location in the west of Wales (UK) has been used as a proxy.

[3] Worst affected receptor is E09 – mudflats habitat.

[4] Worst affected receptor is E12 – perennial vegetation on stony banks habitat.

[5] In the absence of publicly available background acid deposition data for Ireland, a background acid deposition value reported by APIS for a rural location in the west of Wales (UK) has been used as a proxy. PEC of acid deposition reported in this chapter should be treated with caution and referred to as a guideline value only.

Bold rows represent pollutants and averaging periods that cannot be screened as insignificant following UK EA guidance.

Sensitivity Scenario 1: Operational Scenario (Combined Loop Re-gasification and CTG) will only occur should the LNG facility be operational without the presence of the Power Plant. The impact (PC) and total pollutant concentration (PEC) at the worst affected receptor for all pollutants and averaging periods are either less (NO_2, CO, THC and VOC, NO_X, nitrogen deposition and acid deposition) or no worse than (particulate matter, SO_2 and CH_2O) those reported for the Normal Operational Scenario (Combined Loop Re-gasification and CCGT). The impact of Sensitivity Scenario 1: Operational Scenario (Combined Loop Re-gasification and CTG) is such that effects are not considered significant.

8.6.3.3 Sensitivity Scenario 2: Operational Scenario (Closed Loop Re-gasification and CCGT)

The PC (impact) and PEC (total pollutant concentration with Proposed Development in operation) as a result of site emissions are presented in Table 8- for the worst affected human health and worst affected nature conservation receptors (for each pollutant and averaging period), for the Sensitivity Scenario 2: Operational Scenario (Closed Loop Re-gasification and CCGT). The Process Contribution and Predicted Environmental Concentration for all receptors considered in the assessment are provided in Volume 4, Appendix A8-3.

Table 8-20 Predicted Process Contribution and Predicted Environmental Concentration at Worst Affected Receptors – Sensitivity Scenario 2: Operational Scenario (Closed Loop Re-gasification and CCGT)

Pollutant and Averaging Period	AQ Standard (µg/m³)	Process Cont. (µg/m³)	Process Cont. as proportion of AQ Standard (%)	Background (Ambient) Cont. (µg/m³)	Predicted Env. Conc. (µg/m³)	Predicted Env Conc. as a Proportion of AQ Standard (%)
Human Health Receptors						
Annual Mean Nitrogen Dioxide (NO_2)	40	5.9	14.7	4.3	10.2	25.5
Hourly Mean Nitrogen Dioxide (NO_2)	**200**	**59.7**	**29.8**	**8.7**	**68.4**	**34.2**
Annual Mean Particulate Matter (PM_{10})	40	0.1	0.2	9.0	9.1	22.8
Daily Mean Particulate Matter (PM_{10})	50	0.6	1.3	18.0	18.6	37.2
Annual Mean Fine Particulate Matter ($PM_{2.5}$)	25	0.1	0.4	4.0	4.1	16.4
Rolling 8-hour Maximum Carbon Monoxide (CO)	10,000	239.8	2.4	100	339.8	3.4
Maximum Hourly Carbon Monoxide (CO)	30,000	261.1	0.9	100	361.1	1.2
Daily Mean Sulphur Dioxide (SO_2)	125	0.5	0.4	2.6	3.1	2.5
Hourly Mean Sulphur Dioxide (SO_2)	350	1.5	0.4	2.6	4.1	1.2
15-Minute Sulphur Dioxide (SO_2)	266	2.5	0.9	2.6	5.1	1.9
Annual Mean Benzene (C_6H_6)[1]	5	2.2	43.7	0.2	2.4	48.0
Hourly Maximum Benzene (C_6H_6)[1]	**195**	**58.0**	**29.8**	**0.2**	**58.2**	**29.8**
Annual Mean Formaldehyde (CH_2O)	5	0.1	2.6	No Data	0.1	2.6
Maximum Hourly Formaldehyde (CH_2O)	100	9.2	9.2	No Data	9.2	9.2
Nature Conservation Site Receptors						
Annual Mean Oxides of Nitrogen (NO_X)	30	1.2	3.9	6.2	7.4	24.7
Maximum Daily Oxides of Nitrogen (NO_X)[2]	**75**	**24.2**	**32.3**	**12.4**	**36.6**	**48.8**
Annual Mean Sulphur Dioxide (SO_2)	20	<0.1	<0.1	1.3	1.3	6.5
Nutrient Nitrogen Deposition	20 kg N/ha/yr	0.2 (kg N/ha/yr)	0.8	12.0 (kg N/ha/yr)	12.2 (kg N/ha/yr)	61.0
Acid Deposition	CLminN: 0.223 (keq/ha/yr) CLmaxN: 0.568 (keq/ha/yr)	**<0.1 (keq/ha/yr)**	**1.8**	**0.5 (keq/ha/yr)[3]**	**0.51 (keq/ha/yr)**	**89.8**

Pollutant and Averaging Period	AQ Standard (µg/m3)	Process Cont. (µg/m3)	Process Cont. as proportion of AQ Standard (%)	Background (Ambient) Cont. (µg/m3)	Predicted Env. Conc. (µg/m3)	Predicted Env Conc. as a Proportion of AQ Standard (%)
	CLmaxS: 0.202 (keq/ha/yr)					

Notes:

[1] Assumed all THC and VOC emissions are as benzene (C_6H_6) (which is standard practice when THC/ VOC composition is unknown). In reality, C_6H_6 is only likely to make up a proportion of total THC and VOC emissions amongst numerous other compounds. Where the conservative assumption that all THC and VOC emissions are C_6H_6 does not lead to an exceedance of the relevant Air Quality Standards for this pollutant, it is unlikely considered to represent a significant effect.

[2] Research cited in IAQM guidance (2020) states that the daily NO_X standard is of less importance than the annual NO_X standard at nature conservation sites. The daily NO_X standard is typically only of concern at a nature conservation site when SO_2 and O_3 concentrations are elevated close to or in excess of their Air Quality Standards for the protection of ecosystems. The SO_2 concentrations reported in this table and the O_3 data reported in Table 8.14 demonstrate that concentrations of neither SO_2 or O_3 are elevated close to those standards and as such, the nature conservation receptors included in this assessment are not considered sensitive to the daily NO_X impacts reported.

[3] In the absence of publicly available background acid deposition data for Ireland, a background acid deposition value reported by APIS for a rural location in the west of Wales (UK) has been used as a proxy.

[3] Worst affected receptor is E09 – mudflats habitat.

[4] Worst affected receptor is E12 – perennial vegetation on stony banks habitat.

[5] In the absence of publicly available background acid deposition data for Ireland, a background acid deposition value reported by APIS for a rural location in the west of Wales (UK) has been used as a proxy. PEC of acid deposition reported in this chapter should be treated with caution and referred to as a guideline value only.

Bold rows represent pollutants and averaging periods that cannot be screened as insignificant following UK EA guidance.

Sensitivity Scenario 2: Operational Scenario (closed Loop Re-gasification and CCGT) differs from the Normal Operational Scenario in that it is assumed the re-gasification boilers on the FSRU will be required to operate all year round, rather than for just 6 months per year. It is noted that such a scenario is not anticipated to occur, with the intention for seawater to be utilised for re-gasification for the 6 warmest months of the year. Nevertheless, the result of this unlikely scenario is an increase in impact (PC) from the Normal Operational Scenario, at the worst affected receptor, of <1% of the long-term (annual mean) Air Quality Standards for NO_2, particulate matter, THC and VOC, NO_X, nitrogen deposition and acid deposition. Short-term (<annual mean) impact (PC) remain unchanged from those reported in the Normal Operational Scenario. The limited change in impact (PC) and total pollutant concentration (PEC) from that reported in the Normal Operational Scenario (Combined Loop Re-gasification and CCGT) is such that the impact and associated effect of Sensitivity Scenario 2: Operational Scenario (Closed Loop Re-gasification and CCGT) are also not considered significant.

8.6.3.4 Sensitivity Scenario 3: Operational Scenario (Conservative)

The PC (impact) and PEC (total pollutant concentration with Proposed Development in operation) as a result of site emissions are presented in Table 8-19 for the worst affected human health and worst affected nature conservation receptors (for each pollutant and averaging period), for the Sensitivity Scenario 3: Operational Scenario (Conservative). The Process Contribution and Predicted Environmental Concentration for all receptors considered in the assessment are provided in Volume 4, Appendix A8-3.

Table 8-19 Predicted Process Contribution and Predicted Environmental Concentration at Worst Affected Receptors – Sensitivity Scenario 3: Operational Scenario (Conservative)

Pollutant and Averaging Period	AQ Standard (µg/m^3)	Process Cont. (µg/m^3)	Process Cont. as proportion of AQ Standard (%)	Background (Ambient) Cont. (µg/m^3)	Predicted Env. Conc. (µg/m^3)	Predicted Env Conc. as a Proportion of AQ Standard (%)
Human Health Receptors						
Annual Mean Nitrogen Dioxide (NO_2)	40	6.6	16.4	4.3	10.9	27.3
Hourly Mean Nitrogen Dioxide (NO_2)	**200**	**60.0**	**30.0**	**8.7**	**68.7**	**34.4**
Annual Mean Particulate Matter (PM_{10})	40	0.1	0.3	9.0	9.1	22.8
Daily Mean Particulate Matter (PM_{10})	50	0.7	1.4	18.0	18.7	37.4
Annual Mean Fine Particulate Matter ($PM_{2.5}$)	25	0.1	0.4	4.0	4.1	16.4
Rolling 8-hour Maximum Carbon Monoxide (CO)	10,000	223.2	2.2	100	323.2	3.2
Maximum Hourly Carbon Monoxide (CO)	30,000	261.1	0.9	100	361.1	1.2
Daily Mean Sulphur Dioxide (SO_2)	125	2.1	1.7	2.6	4.7	3.8
Hourly Mean Sulphur Dioxide (SO_2)	350	6.6	1.9	2.6	9.2	2.6
15-Minute Sulphur Dioxide (SO_2)	266	11.0	4.1	2.6	13.6	5.1
Annual Mean Benzene (C_6H_6)[1]	5	2.2	44.7	0.2	2.4	48.0
Hourly Maximum Benzene (C_6H_6)[1]	**195**	**58.0**	**29.8**	**0.2**	**58.2**	**29.8**
Annual Mean Formaldehyde (CH_2O)	5	0.1	1.6	No Data	0.1	2.0
Maximum Hourly Formaldehyde (CH_2O)	100	9.2	9.2	No Data	9.2	9.2
Nature Conservation Site Receptors						
Annual Mean Oxides of Nitrogen (NO_X)	30	1.4	4.7	6.2	7.6	25.3
Maximum Daily Oxides of Nitrogen (NO_X)[2]	**75**	**28.1**	**37.4**	**12.4**	**40.5**	**54.0**
Annual Mean Sulphur Dioxide (SO_2)	20	<0.1	0.2	1.3	1.3	6.5
Nutrient Nitrogen Deposition[3]	20 (kg N/ha/yr)	0.2	1.0	20 (kg N/ha/yr)	12.2	61
Acid Deposition[3]	CLminN: 0.223 (keq/ha/yr) CLmaxN: 0.568 (keq/ha/yr) CLmaxS:	**<0.1 (keq/ha/yr)**	**3.5**	**0.5 (keq/ha/yr)[3]**	**0.52 (keq/ha/yr)**	**91.5**

Pollutant and Averaging Period	AQ Standard (µg/m³)	Process Cont. (µg/m³)	Process Cont. as proportion of AQ Standard (%)	Background (Ambient) Cont. (µg/m³)	Predicted Env. Conc. (µg/m³)	Predicted Env Conc. as a Proportion of AQ Standard (%)
	0.202 (keq/ha/yr)					

Notes:

[1] Assumed all THC and VOC emissions are as benzene (C_6H_6) (which is standard practice when THC/ VOC composition is unknown). In reality, C_6H_6 is only likely to make up a proportion of total THC and VOC emissions amongst numerous other compounds. Where the conservative assumption that all THC and VOC emissions are C_6H_6 does not lead to an exceedance of the relevant Air Quality Standards for this pollutant, it is unlikely considered to represent a significant effect.

[2] Research cited in IAQM guidance (2020) states that the daily NO_X standard is of less importance than the annual NO_X standard at nature conservation sites. The daily NO_X standard is typically only of concern at a nature conservation site when SO_2 and O_3 concentrations are elevated close to or in excess of their Air Quality Standards for the protection of ecosystems. The SO_2 concentrations reported in this table and the O_3 data reported in Table 8.14 demonstrate that concentrations of neither SO_2 or O_3 are elevated close to those standards and as such, the nature conservation receptors included in this assessment are not considered sensitive to the daily NO_X impacts reported.

[3] Worst affected receptor is E09 – mudflats habitat.

[4] Worst affected receptor is E12 – perennial vegetation on stony banks habitat.

[5] In the absence of publicly available background acid deposition data for Ireland, a background acid deposition value reported by APIS for a rural location in the west of Wales (UK) has been used as a proxy. PEC of acid deposition reported in this chapter should be treated with caution and referred to as a guideline value only.

Bold rows represent pollutants and averaging periods that cannot be screened as insignificant following UK EA guidance.

Sensitivity Scenario 3: Operational Scenario (Conservative) is based on a number of assumptions that are considered unrealistic and, in all likelihood, will never occur. These assumptions are summarised as follows:

- The Power Plant and CTG plant in operation at the same time (in reality, the CTG plant will only ever operate when the Power Plant is not present);
- All 3 CTG plant are in operation (only 2 of 3 CTG plant are anticipated to be in operation at any one time);
- Closed-Loop re-gasification (re-gasification boiler operating for the full year, rather than 6 months of the year as anticipated);
- More reliance (50%) on liquid fuel for the FSRU main engine (in reality, liquid fuel is anticipated to be required for just 5% of operation); and
- Greater frequency of LNGC visits (8,760 hours of the year) and associated tug movements (LNGCs are anticipated to be berthed at the facility for 2,310 hours per year).

Table 8-19 demonstrates that the impact (PC) and total pollutant concentration with the Proposed Development in Operation (PEC) associated with Sensitivity Scenario 3: Operational Scenario (Conservative) are higher than those reported in the Normal Operational Scenario (Combined Loop re-gasification and CCGT). However, even with that greater impact (PC), pollutant concentrations (PEC) remain well below the Air Quality Standard for the majority of pollutants and averaging considered (<50% of the Air Quality Standard and Environmental Assessment Levels), with the exception of acid deposition. For that pollutant, the proxy ambient background contribution accounts for 96% of the Predicted Environmental Concentration reported.

8.6.4 Operational Phase Combined Emissions Assessment

Table 8-20 provides the combined PC (impact) of both site emissions and road traffic emissions contributions and resultant PEC (total pollutant concentration with Proposed Development in operation) at the following locations for the Normal Operational Scenario (Combined Loop Re-gasification and CCGT):

- Worst affected human health and nature conservation site receptors located within 200 m of a road used by Proposed Development traffic; and
- Human health and nature conservations receptors with the largest Process Contribution from road traffic emissions.

Combined PC and PEC for all receptors located with 200 m of a modelled road are provided in Volume 4, Appendix A8-3. Receptors located beyond 200 m of the road are unlikely to be affected by emissions from road traffic and concentrations are as reported in Table 8-17 and Volume 4, Appendix A8-3.

Table 8-20 Predicted Process Contribution of Site and Road Traffic Emissions Combined and Predicted Environmental Concentration at Selected Receptors – Normal Operational Scenario (Combined Loop and CCGT)

Pollutant and Averaging Period	AQ Standard (µg/m³)	Road Traffic Emissions Process Cont. (µg/m³)	Site Emissions Process Cont. (µg/m³)	Combined Process Cont. as proportion of AQ Standard (%)	Combined Background (Ambient) and Baseline Road Cont. (µg/m³)	Predicted Env. Conc. (µg/m³)	Predicted Env Conc. as a Proportion of AQ Standard (%)
Human Health Receptor – worst affected receptor located within 200m of a road used by Proposed Development traffic							
Annual Mean Nitrogen Dioxide (NO_2)	40	<0.1	3.0	7.5	4.4	7.4	18.5
Annual Mean Particulate Matter (PM_{10})	40	<0.1	0.1	0.3	9.1	9.2	23.0
Annual Mean Fine Particulate Matter ($PM_{2.5}$)	25	<0.1	0.1	0.4	4.1	4.2	16.8
Human Health Receptor – largest Process Contribution from road traffic emissions							
Annual Mean Nitrogen Dioxide (NO_2)	40	0.1	1.9	4.8	4.7	6.7	16.8
Annual Mean Particulate Matter (PM_{10})	40	<0.1	<0.1	0.3	9.1	9.2	23.0
Annual Mean Fine Particulate Matter ($PM_{2.5}$)	25	<0.1	<0.1	0.4	4.1	4.2	16.8
Nature Conservation Site Receptors – worst affected receptor located within 200m of a road used by Proposed Development traffic							
Annual Mean Oxides of Nitrogen (NO_X)	30	<0.1	1.1	3.7	7.4	8.5	28.3
Nutrient Nitrogen Deposition[1]	20 (kg N/ha/yr)	<0.1	0.2 (kg N/ha/yr)	0.8	12.1 (kg N/ha/yr)	12.3 (kg N/ha/yr)	61.5
Acid Deposition[2]	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nature Conservation Site Receptors – largest Process Contribution from road traffic emissions							
Annual Mean Oxides of Nitrogen (NO_X)	30	0.1	1.1	4.0	9	10.1	33.7
Nutrient Nitrogen Deposition[1]	20 (kg N/ha/yr)	<0.1	0.2 (kg N/ha/yr)	0.8	12.2 (kg N/ha/yr)	12.4 (kg N/ha/yr)	61.0
Acid Deposition[2]	Various – see Table 8.9	N/A	N/A	N/A	N/A	N/A	N/A

Notes:

[1] Worst affected receptor is E09 – mudflats habitat.

Pollutant and Averaging Period	AQ Standard (µg/m³)	Road Traffic Emissions Process Cont. (µg/m³)	Site Emissions Process Cont. (µg/m³)	Combined Process Cont. as proportion of AQ Standard (%)	Combined Background (Ambient) and Baseline Road Cont. (µg/m³)	Predicted Env. Conc. (µg/m³)	Predicted Env Conc. as a Proportion of AQ Standard (%)

[2] No nature conservation site receptor within 200m of a road that is sensitive to acid deposition.

Bold rows represent pollutants and averaging periods that cannot be screened as insignificant following UK EA guidance.

Table 8-20 demonstrates that for the Normal Operational Scenario (Combined Loop Re-gasification and CCGT), the addition of the contribution from Proposed Development road traffic emissions to the impact (PC) from the site emissions alone makes little to no difference to the assessment nor potential significance of effect.

8.7 Cumulative Impacts and Effects

8.7.1 Cumulative Baseline

The baseline data described in Section 8.4 is based on measurement data gathered and reported by the EPA that is considered representative of the study area. However, that data does not necessarily account for local sources, including emissions from nearby industrial facilities, such as Moneypoint Power Station and Tarbet Power Station. To account for these sources in the assessment, emissions data has been obtained and modelled to predict concentrations for a baseline (including road traffic emissions contributions) + cumulative sources scenario. The range of modelled baseline concentrations at selected air quality sensitive receptors are provided in Table 8-21 and Table 8-22, for the pollutants of which emissions data could be sought for the cumulative sites. A full set of cumulative baseline results at all selected receptors considered in this assessment is provided in Volume 4, Appendix A8-3.

The tables demonstrate that the contribution of cumulative sources is less than that associated with the ambient background (including road traffic emissions contributions) for long-term (annual mean) pollutants. The cumulative source is similar to or greater than the ambient background for short-term (<annual mean) pollutants. The range of cumulative contributions added to the ambient background contributions show that cumulative baseline concentrations are well below the respective Air Quality Standards, with the exception of the annual mean acid deposition rate, which at the Perennial vegetation on stony banks habitat of the SCA/ SPA, is already elevated close to the Critical Load for the habitat. However, it is again noted that there is much uncertainty in the ambient background acid deposition rate used to inform this assessment.

Table 8-21 Range in Modelled Cumulative Baseline Pollutant Concentrations at Human Health Sensitive Receptors

Pollutant	Air Quality Standard (µg/m³)	Range of Contribution from Road Sources (µg/m³)	Range of Contribution from Cumulative Sources (µg/m³)	Ambient Background Contribution (µg/m³)	Ambient Background + Road Source + Cumulative Contribution (µg/m³)
2019 Existing Baseline					
Annual mean Nitrogen dioxide (NO_2)	40	<0.1 – 8.5	0.1 – 0.5	4.3	4.4 – 12.9
Hourly mean Nitrogen dioxide (NO_2)	200	N/A[1]	2.9 – 8.6	8.7	11.6 – 17.3
Annual mean Particulate matter (PM_{10})	40	<0.1 – 1.9	<0.1 – 0.1	9.0	9.0 – 10.9
Daily mean Particulate matter (PM_{10})	50	N/A[1]	<0.1 – 0.2	18.0	18.0 – 18.2

Pollutant	Air Quality Standard (µg/m³)	Range of Contribution from Road Sources (µg/m³)	Range of Contribution from Cumulative Sources (µg/m³)	Ambient Background Contribution (µg/m³)	Ambient Background + Road Source + Cumulative Contribution (µg/m³)
Annual mean Fine particulate matter ($PM_{2.5}$)	25	<0.1 – 1.9	<0.1 – 0.1	4.0	4.0 – 5.9
Daily mean Sulphur dioxide (SO_2)	125	N/A[1,2]	1.7 – 3.8	2.6	4.3 – 6.4
Hourly mean Sulphur dioxide (SO_2)	350	N/A[1,2]	9.2 – 15.8	2.6	11.8 – 18.4
15-minute mean Sulphur dioxide (SO_2)	266	N/A[1,2]	12.3 – 22.5	2.6	14.9 – 25.1
2025 Future Baseline					
Annual mean Nitrogen dioxide (NO_2)	40	<0.1 – 5.4	0.1 – 0.5	4.3	4.4 – 9.7
Hourly mean Nitrogen dioxide (NO_2)	200	N/A[1,2]	2.9 – 8.6	8.7	11.6 – 17.3
Annual mean Particulate matter (PM_{10})	40	<0.1 – 1.9	<0.1 – 0.1	9.0	9.0 – 10.9
Daily mean Particulate matter (PM_{10})	50	N/A[1,2]	<0.1 – 0.2	18.0	18.0 – 18.2
Annual mean Fine particulate matter ($PM_{2.5}$)	25	<0.1 – 1.9	<0.1 – 0.1	4.0	4.0 – 5.9
Daily mean Sulphur dioxide (SO_2)	125	N/A[1,2]	1.7 – 3.8	2.6	4.3 – 6.4
Hourly mean Sulphur dioxide (SO_2)	350	N/A[1,2]	9.2 – 15.8	2.6	11.8 – 18.4
15-minute mean Sulphur dioxide (SO_2)	266	N/A[1,2]	12.3 – 22.5	2.6	14.9 – 25.1

Notes:
[1] Short-term (<annual average) contributions not predicted for road traffic emissions.
[2] SO_2 not considered a key pollutant from road traffic emissions.

Table 8-22 Range in Modelled Cumulative Baseline Pollutant Concentrations at Nature Conservation Sensitive Receptors

Pollutant	Air Quality Standard	Range of Contribution from Road Sources	Range of Contribution from Cumulative Sources (µg/m³)	Ambient Background Contribution (µg/m³)	Ambient Background + Road Source + Cumulative Contribution
2019 Existing Baseline					
Annual mean Oxides of nitrogen (NO_X)	30 µg/m³	0.1 – 4.5 µg/m³	<0.1 – 0.5 µg/m³	6.2 µg/m³	6.2 – 10.9 µg/m³
Daily mean Oxides of nitrogen (NO_X)	75 µg/m³	N/A[1]	1.8 – 7.5 µg/m³	12.4 µg/m³	14.2 – 19.9 µg/m³
Annual mean Sulphur dioxide (SO_2)	20 µg/m³	N/A[2]	0.1 – 1.0 µg/m³	1.3 µg/m³	1.4 – 1.9 µg/m³
Annual deposition Nitrogen rate	Various – see Table 8.9	<0.1 – 0.4 kg N/ha/yr	<0.1 – 0.1 kg N/ha/yr	12.0 kg N/ha/yr	12.0 – 12.4 kg N/ha/yr
Annual deposition Acid rate	Various – see Table 8.9	N/A[3]	0.01 – 0.07 keq/ha/yr	0.50 keq/ha/yr	0.51 – 0.57 keq/ha/yr

Pollutant	Air Quality Standard	Range of Contribution from Road Sources	Range of Contribution from Cumulative Sources ($\mu g/m^3$)	Ambient Background Contribution ($\mu g/m^3$)	Ambient Background + Road Source + Cumulative Contribution
2025 Future Baseline					
Annual mean Oxides of nitrogen (NO_X)	30 $\mu g/m^3$	<0.1 – 2.8 $\mu g/m^3$	<0.1 – 0.5 $\mu g/m^3$	6.2 $\mu g/m^3$	6.2 – 9.2 $\mu g/m^3$
Daily mean Oxides of nitrogen (NO_X)	75 $\mu g/m^3$	N/A[1]	1.8 – 7.5 $\mu g/m^3$	12.4 $\mu g/m^3$	14.2 – 19.9 $\mu g/m^3$
Annual mean Sulphur dioxide (SO_2)	20 $\mu g/m^3$	N/A[2]	0.1 – 1.0 $\mu g/m^3$	1.3 $\mu g/m^3$	1.4 – 1.9 $\mu g/m^3$
Annual deposition Nitrogen rate	Various – see Table 8.9	<0.1 – 0.2 kg N/ha/yr	<0.1 – 0.1 kg N/ha/yr	12.0 kg N/ha/yr	12.0 – 12.2 kg N/ha/yr
Annual deposition Acid rate	Various – see Table 8.9	N/A[3]	0.01 – 0.07 keq/ha/yr	0.50 keq/ha/yr[4]	0.51 – 0.57 keq/ha/yr

Notes:

[1] Short-term (<annual average) contributions not predicted for road traffic emissions.

[2] SO_2 not considered a key pollutant from road traffic emissions.

[3] Habitats within 200m of modelled roads not sensitive to acid deposition

[4] In the absence of publicly available background acid deposition data for Ireland, a background acid deposition value reported by APIS for a rural location in the west of Wales (UK) has been used as a proxy. PEC of acid deposition reported in this chapter should be treated with caution and referred to as a guideline value only.

8.7.2 Cumulative Impact and Effect

8.7.2.1 Construction Phase Dust and Particulate Matter Assessment

As described in Chapter 02 – Project Description, it is anticipated that the upgrade of the Coast Road (L1010) from Tarbert to the Proposed Development site, by Kerry Co. Council, will overlap with the earthworks and site preparation at the Proposed Development site, to allow the better vehicular access required for the main construction works to proceed.

With the exception of the Proposed Development construction site's access road, the construction site itself is located approximately 750 m away from the L1010, meaning that cumulative dust impacts from both sites impacting on the same receptor are extremely unlikely.

During earthworks and site preparation phase at the Proposed Development site, the traffic associated with the those works will largely be confined within the Proposed Development site boundary and will not involve the import or exportation of material to and from the Proposed Development site. Proposed Development traffic on the public road at this phase will largely consist of deliveries to the site, which will be co-ordinated with the road upgrade works. Any dust impact associated with the trackout of mud from vehicles leaving Proposed Development site is therefore considered unlikely.

All phases of the Proposed Development construction works will be undertaken in line with the project's OCEMP, including the implementation of standard good practice measures for the control of dust emissions. Such measures are standard practice on all well managed construction sites and there is no reason to believe that such measures will not be implemented by Kerry County Council (KCC) contractors working on the Coast Road. As such, the cumulative impact of construction dust emissions is not considered to have a significant effect.

Cumulative construction impacts are also possible where the construction of the Proposed Development coincides with the construction of any one of the 220 kV connection, medium voltage (10/ 20 kV) connection, Shannon Pipeline or potential data centre projects. Due to the distance of the limited number of receptors to the main construction activities associated with the Proposed Development, and the commitment of the Applicant to control dust emissions as far as reasonably practicable, the risk of the Proposed Development to contribute to cumulative dust effect is considered **low** and **not significant**.

8.7.2.2 Operational Phase Emissions Assessment

For the cumulative assessment of the Normal Operational Scenario (Combined Loop Re-gasification and CCGT), the PC (impact) from the Proposed Development is added to the cumulative baseline contribution (ambient background + emissions from Moneypoint and Tarbert Power Stations – see Section 8.7.1 above) to calculate the PEC (total pollutant concentration with Proposed Development in operation). As such, the actual PC from the Proposed Development remains unchanged to that reported in Section 8.6 for the Normal Operational Scenario. However, the PEC will be higher than that reported in Section 8.6, due to the additional contribution from those cumulative sources.

Table 8-23 provides a breakdown of the contributions associated with the Proposed Development (Normal Operational Scenario (Combined Loop Re-gasification and CCGT)) and the ambient background + cumulative sources, for the pollutants for which emissions data was available for those cumulative sources. The contributions and total pollutant concentrations are provided for the following selected receptors (cumulative impacts and concentrations for all receptors are provided in Volume 4, Appendix A8-3):

- Worst affected human health and nature conservation site receptors following the addition of the cumulative source contribution; and
- Human health and nature conservations receptors with the largest contribution from cumulative sources.

Table 8-23 Predicted Cumulative Operational Impacts – Normal Operational Scenario (Combined Loop Re-gasification and CCGT)

Pollutant and Averaging Period	AQ Standard (µg/m^3)	Combined (Site + Road Traffic Emissions) Process Cont. (µg/m^3)	Combined Process Cont. as proportion of AQ Standard (%)	Cumulative Source Cont. (µg/m^3)	Cumulative Baseline (Background (Ambient) + Baseline Road Cont.) (µg/m^3)	Cumulative Predicted Env. Conc. (µg/m^3)	Cumulative Predicted Env. Conc. as a Proportion of AQ Standard (%)
Human Health Receptor – largest contribution from Proposed Development							
Annual Mean Nitrogen Dioxide (NO_2)	40	5.7	14.2	0.1	4.4	10.1	25.4
Hourly Mean Nitrogen Dioxide (NO_2)	200	59.7	29.8	8.1	16.8	68.4[1]	34.2
Annual Mean Particulate Matter (PM_{10})	40	0.2	0.5	<0.1	9.1	9.3	23.3
Daily Mean Particulate Matter (PM_{10})	50	0.9	1.8	<0.1	18.0	19.1[1]	37.4
Annual Mean Fine Particulate Matter ($PM_{2.5}$)	25	0.2	0.4	<0.1	4.1	4.2	16.9
Daily Mean Sulphur Dioxide (SO_2)	125	0.5	0.4	3.6	6.2	6.4[1]	5.1
Hourly Mean Sulphur Dioxide (SO_2)	350	1.5	0.4	15.8	18.4	18.8[1]	5.4
15-minute Mean Sulphur Dioxide (SO_2)	266	2.5	0.9	20.8	23.4	23.8[1]	9.0

Pollutant and Averaging Period	AQ Standard (µg/m³)	Combined (Site + Road Traffic Emissions) Process Cont. (µg/m³)	Combined Process Cont. as proportion of AQ Standard (%)	Cumulative Source Cont. (µg/m³)	Cumulative Baseline (Background (Ambient) + Baseline Road Cont.) (µg/m³)	Cumulative Predicted Env. Conc. (µg/m³)	Cumulative Predicted Env. Conc. as a Proportion of AQ Standard (%)
Human Health Receptor – largest contribution from cumulative sources							
Annual Mean Nitrogen Dioxide (NO_2)	40	1.0	2.5	0.5	4.8	5.8	14.4
Hourly Mean Nitrogen Dioxide (NO_2)	200	48.4	24.2	8.6	17.3	57.1[1]	28.6
Annual Mean Particulate Matter (PM_{10})	40	<0.1	0.1	0.1	9.1	9.1	22.8
Daily Mean Particulate Matter (PM_{10})	50	0.2	0.5	0.2	18.4	18.5	36.9
Annual Mean Fine Particulate Matter ($PM_{2.5}$)	25	<0.1	0.1	0.1	4.1	4.1	16.6
Daily Mean Sulphur Dioxide (SO_2)	125	0.1	0.1	3.8	6.4	6.4[1]	5.1
Hourly Mean Sulphur Dioxide (SO_2)	350	1.5	0.4	15.8	18.4	18.8[1]	5.4
15-minute Mean Sulphur Dioxide (SO_2)	266	0.9	0.3	22.5	25.1	25.2[1]	9.5
Nature Conservation Receptor – largest contribution from Proposed Development							
Annual Mean Oxides of Nitrogen (NO_X)	30	1.1	3.8	0.1	9.2	10.3	34.4
Daily Maximum Oxides of Nitrogen (NO_X)	75	24.2	32.3	4.2	16.6	36.9[1]	49.2
Annual Mean Sulphur Dioxide (SO_2)	20	<0.1	<0.1	0.5	1.8	1.9	9.3
Nutrient Nitrogen Deposition[2]	20 (kg N/ha/yr)	0.2	0.8	<0.1	12.2	12.4	61.9
Acid Deposition[3]	CLminN: 0.223 (keq/ha/yr) CLmaxN: 0.568 (keq/ha/yr) CLmaxS: 0.202 (keq/ha/yr)	**0.01**	**1.8**	**0.03**	**0.53**	**0.54[4]**	**95.1**

Pollutant and Averaging Period	AQ Standard (µg/m³)	Combined (Site + Road Traffic Emissions) Process Cont. (µg/m³)	Combined Process Cont. as proportion of AQ Standard (%)	Cumulative Source Cont. (µg/m³)	Cumulative Baseline (Background (Ambient) + Baseline Road Cont.) (µg/m³)	Cumulative Predicted Env. Conc. (µg/m³)	Cumulative Predicted Env. Conc. as a Proportion of AQ Standard (%)
Nature Conservation Receptor – largest contribution from cumulative sources							
Annual Mean Oxides of Nitrogen (NO_X)	30	1.0	3.2	0.5	6.7	7.7	25.6
Daily Maximum Oxides of Nitrogen (NO_X)	75	9.2	12.3	7.5	19.9	21.6[1]	28.8
Annual Mean Sulphur Dioxide (SO_2)	20	<0.1	<0.1	0.5	1.8	1.9	9.3
Nutrient Nitrogen Deposition[2]	20 (kg N/ha/yr)	0.1	0.7	0.1	12.1	12.2	61.1
Acid Deposition[3]	CLminN: 0.223 (keq/ha/yr) CLmaxN: 0.568 (keq/ha/yr) CLmaxS: 0.202 (keq/ha/yr)	**0.01**	**1.8**	**0.03**	**0.50**	**0.54[4]**	**95.1**

Notes:

[1] The Predicted Cumulative Environmental Concentration for short-term pollutants is not the sum of all contributions. Short-term pollutant impacts are calculated based on conditions at a certain point in each meteorological year considered (i.e. the 19th worst hour of the year for hourly mean NO_2 at each receptor). When emissions from sources are modelled individually, the 19th worst hour at each receptor will almost most certainly be different for each source. Therefore, the Predicted Cumulative Environmental Concentration is based on a model run that includes both Proposed Development sources and cumulative sources together.

[2] Worst affected receptor is E09 – mudflats habitat.

[3] Worst affected receptor is E12 – perennial vegetation on stony banks habitat.

[4] In the absence of publicly available background acid deposition data for Ireland, a background acid deposition value reported by APIS for a rural location in the west of Wales (UK) has been used as a proxy. PEC of acid deposition reported in this chapter should be treated with caution and referred to as a guideline value only.

Bold rows represent pollutants and averaging periods that cannot be screened as insignificant following UK EA guidance.

Table 8-23 demonstrates that with the cumulative contribution the total pollutant concentrations (PEC) does increase at the worst affected human health and nature conservation receptors, but not to the extent that it alters the description of impact (PC) and effect described in Section 8.6.2 and 8.6.3. It also demonstrates that the cumulative sources have the greatest influence on the total pollutant concentration (PEC) for SO_2 (and SO_2-related acid deposition).

Hourly mean NO_2 impact (PC) and cumulative total Pollutant Concentration (PEC) at the worst affected human health sensitive receptor (R19) could not be screened as insignificant and the same was also the case for the next seven worst affected receptors (R8, R10, R13-R16 and R26 (see Volume 4, Appendix A8-3)). However, the remaining 39 receptors considered experienced an hourly NO_2 impact (PC) of less than the criteria given in the UK EA guidance. The cumulative total pollutant concentration (PEC) at these worst affected receptors shows that with the Proposed Development in operation, there remains a headroom (the gap between the total pollutant concentration (PEC) and the Air Quality Standard) of between 66-76% of the Air Quality Standard for that pollutant. It can therefore be said with much confidence that the operation of the Proposed Development does not give rise to any risk of exceedance of the hourly mean NO_2 Air Quality Standard in the Normal Operational Scenario, nor is it likely to constrain any future development of the area.

The annual average acid deposition rate impact (PC) and cumulative total deposition rate (PEC) at the worst affected nature conservation site (receptor E12 - perennial vegetation on stony banks habitat) could not be screened as insignificant, although no other nature conservation receptors sensitive to acid deposition considered in this assessment experience an impact (PC) of 1% or more of their respective Environmental Assessment Levels. At receptor E12, the elevated cumulative total deposition rate (PEC) is primarily due to the proxy ambient background contribution assumed in the assessment and should be treated with caution and perhaps not primarily used for determining significance, due to its uncertainty. As previously noted, background acid deposition rates in the study area are likely to fall in the near future, because of the cessation of coal burning and Heavy Fuel Oil burning at Moneypoint and Tarbert Power Stations respectively. In light of the above, it is determined that the operation of the Proposed Development will not give rise to an exceedance of the Air Quality Standard for annual mean acid deposition rates and that the impact will not cause a significant effect.

The impact (PC) and cumulative total pollutant concentration (PEC) has also been evaluated against the the IAQM guidance criteria (Moorcroft and Barrowcliffe, et al., 2017). Long-term (annual mean) impacts (PC) are described as slight-adverse to negligible for all pollutants and receptors in the cumulative assessment with the exception of annual mean NO_2 impacts (PC) at receptors R19 and R26, which are described as moderate adverse. In some circumstances, moderate adverse impacts can represent a significant effect, typically when there are numerous receptors predicted to experience such an impact (PC) and/ or the impact (PC) contributes to an Air Quality Standard being at risk of an exceedance. In this instance, the moderate adverse impact affects just 2 receptors, which, with the addition of the contribution from the Proposed Development, experience total annual mean NO_2 concentrations (PEC) that account for less than 50% of the Air Quality Standard. With reference to the IAQM guidance, the impacts on long-term pollutant concentrations, therefore, will not have a significant effect.

Following the IAQM guidance for short-term (<annual mean) impacts, the effects are described as ‘Imperceptible’ to ‘Slight’ adverse at 45 of the 48 human health receptors considered for all pollutants, and 'Moderate’ adverse at the remaining 3 receptors for hourly mean NO_2. However, even with this magnitude of effect, total hourly mean NO_2 concentrations remain well below the Air Quality Standard for that pollutant to the extent that the effect is not considered to be significant.

Cumulative operational phase impacts are also possible where the operation of the Proposed Development coincides with the operation of the potential Data Centre Campus. No operational emissions associated with the 220 kV connection, medium voltage (10/ 20 kV) connection and Shannon Pipeline are considered likely. The design of the potential Data Centre Campus is not advanced to the stage where the quantity of emissions and impact/ effect of those emissions is known. It is therefore not possible to confirm the cumulative effect of this source alongside the Proposed Development at this time. The cumulative effects of these two developments will therefore need to be accounted for in the assessment to accompany the Data Centre Campus planning application.

8.8 Do Nothing Scenario

In the Do-Nothing Scenario no development of the Shannon Technology and Energy Park will occur, i.e. neither the LNG facility or Power Plant will be developed. In such a scenario air quality will remain similar to that described in Section 8.4 and listed in Table 8-14 to

Table 8-16. Air quality concentrations for all pollutants and averaging periods of reference to this assessment will remain well below their respective Air Quality Standards and Environmental Assessment Levels, although there is some uncertainty in the annual mean deposition rates for acid. This will however, likely decrease is future years with the cessation of coal burning at Moneypoint Power Station and Heavy Fuel Oil burning at Tarbert Power Station.

8.9 Residual Impacts

8.9.1 Construction Phase Dust and Particulate Matter Assessment

In line with IAQM construction dust guidance, providing adequate dust mitigation measures are implemented onsite, all of which are common practice on all well managed construction sites across the country, then impacts can be adequately controlled to the extent that any effect is **not significant**.

In line with EPA guidance (2017), construction phase effects are described as **negative/ adverse**, **not significant** and limited to locations within 350 m of the construction site boundary. They are considered transient and intermittent in nature and unlikely, due to the distance from dust generating activities to the nearest receptors. They are also considered short-term – only having the potential to occur during the construction phase, only likely during working hours onsite, when construction activities are being undertaken within the site at locations closest to a receptor, and when the wind is blowing from the activity towards the receptors, at a speed that can transport the dust from the activity to the receptor.

8.9.2 Operational Phase Site Emissions Assessment

The assessment of operational phase emissions has identified that whilst the Proposed Development will have some impact on local air quality, the extent of that effect is either **slight** to **imperceptible**, or **moderate** at limited locations, where that impact does not put compliance with an Air Quality Standard or Environmental Assessment Level at risk.

In light of the above, no additional mitigation is suggested as being required beyond that inherent within the Proposed Development design (source release height) and compliance with the Emission Limits that will be set by the EPA within the facility's IE licence. Impacts and associated effects are as reported in Section 8.6 and Section 8.7.

In line with EPA guidance (2017), operational phase effects will be described as **negative/ adverse**, **not significant** at the majority of receptors, but with **significant** to **moderate** effects at limited individual receptors closest to the Proposed Development boundary. Overall, the effect is considered to be **slight**, **continuous**, **likely to occur** and **long-term**, for the duration of the Proposed Development's operation.

8.10 Decommissioning

As outlined in Chapter 02 – Project Description, in the event of decommissioning, measures will be undertaken by the Applicant to ensure that there will be no significant, negative environmental effects during the decommissioning phase. Examples of the measures that will be implemented are outlined in Section 2.11, Chapter 02 – Project Description. As a result, additional potential impacts and associated effects arising during the decommissioning phase are not anticipated above and beyond those already assessed during the construction phase.

8.11 Summary

Air quality dispersion modelling of emissions from the Proposed Development (LNG facility and Power Plant) has been undertaken. The Process Contribution (PC) (impact) and Predicted Environmental Concentration (PEC) (total pollutant concentrations) have been quantified at a number of receptors, including nearby (air quality sensitive) human health receptors (residential dwellings) and the nearest nature conservation habitats sensitive to air quality impacts (including habitats within the Shannon Estuary Special Area of Conservation and Special Protection Area).

Existing air quality has been reviewed and it is considered that the standard of baseline air quality is likely to be good with no risk of exceedance of than Air Quality Standard or Environmental Assessment Level (set for the protection of human health or sensitive habitat) for the vast majority of pollutants and averaging periods included in this assessment. It is considered that there is the potential for elevated baseline conditions for the annual mean rate of acid deposition. There is some uncertainty in the existing rate of acid deposition, due to an absence of site or even regional-specific baseline data. It is also noted that the annual mean rate of acid deposition is likely to fall within the study area over coming years, as will deposition rates and airborne concentrations of other pollutants, with the cessation of coal and Heavy Fuel Oil-fired operations at Moneypoint Power Station and Tarbert Power Station respectively.

A construction dust assessment has considered the risk of dust impacts occurring and has suggested a level of mitigation required to ensure any effect is not significant. The assessment is precautionary and likely over-estimates the level of mitigation required.

Dispersion modelling of operational emissions considered a number of scenarios based on various modes of operation of the Proposed Development, with the anticipated typical mode of operation forming the main assessment and subsequent sensitivity scenarios considering various alternative modes of operation and/ or precautionary assumptions.

The assessment of normal operation identified limited impacts at the vast majority of receptors considered for the majority of pollutants and averaging periods. Elevated impact (PC) were identified for hourly mean nitrogen dioxide, hourly maximum benzene and daily maximum oxides of nitrogen at the worst affected receptor locations. Of those, hourly maximum benzene impacts were screened out, due to the precautionary assumption that all total hydrocarbon and volatile organic compound emissions were released as that compound, when in reality, benzene will form only a proportion of such emissions and actual benzene impacts will likely be much lower. As was the daily maximum oxides of nitrogen impact, due to this pollutant and averaging period being of concern for nature conservation sites only where those sites are already constrained by other pollutants (sulphur dioxide and ozone), which in this instance, they were not.

At the limited receptor locations where hourly mean nitrogen dioxide impact (PC) was elevated, some receptors also experienced elevated total pollutant concentrations (PEC) above levels that air quality assessment guidance suggests can be screened as insignificant. However, review of hourly mean nitrogen dioxide impacts (PC) and total concentrations (PEC) at these locations, relative to the Air Quality Standard, identified that total concentrations (PEC) arising from the Proposed Development in operation were well below the relevant Air Quality Standard at the worst-affected receptor and, therefore, there was no risk of an exceedance and it will not constrain future development in the area.

The assessment of normal operation also identified an impact (PC) and total deposition rate (PEC) of concern for the annual mean rate of acid deposition at the worst affected nature conservation site receptor for that pollutant. Whilst the impact (PC) is relatively minor, the proportion of the total deposition rate (PEC) to the Environmental Assessment Level is elevated due to a particularly low Critical Load, accounting for the high sensitivity of that particular habitat to acid. However, the total deposition rate (PEC) is founded on an assumed ambient background rate of acid deposition, in the absence of site- or regional-specific data, which accounts for 88% of the Environmental Assessment Level alone. Ambient background rates of acid deposition are also likely to fall in the near future, due to changes in operation at nearby power stations. It is therefore suggested that the PEC reported for the rate of acid deposition is treated with caution, and greater weight is given to the PC predicted. In this instance, the PC accounts for just 1.8% of the Environmental Assessment Level at the worst affected nature conservation site receptor and less than 1% at all others.

The consideration of alternative modes of operation and precautionary assumptions in the sensitivity scenarios identified no additional issues and did not worsen the limited issues identified in the normal mode of operation to the extent that they become a constraint to the development.

The assessment has also considered the cumulative impact and effect of the Proposed Development alongside emissions from Moneypoint and Tarbert Power Stations, even though these facilities are due to cease current operations before or shortly after the Proposed Development is due to become operational. The cumulative assessment identified the same issues highlighted during the assessment of the normal mode of operation. Total pollutant concentrations (PEC) were slightly more elevated, but not to the extent that they became a constraint to the development.

Overall, it is considered that the Proposed Development will impact on local air quality in the study area and have an adverse effect. However, this will not contribute to an exceedance of an Air Quality Standard or Environmental Assessment Level, and pollutant concentrations will remain well below the limits set by the Government for the protection of human health. Concentrations are below the Air Quality Standards and Environmental Assessment Levels to the extent that the operation of the Proposed Development will not constrains future development of the area. The effect of the Proposed Development is not considered significant overall and is compliant with local and national planning policy.

Table 8-24 Summary

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance
Construction	Dust	High	Negligible	Slight	Standard practice dust mitigation measures as recommended by the Institute of Air Quality Management and listed in Section 8.6.1 (excluding those that are not practical for this site) and the section 9.2.9 of the OCEMP. These include, but are not limited to: • Production of and adherence to a site-specific dust minimisation control plan (AKA Dust Management Plan), setting out the control measures to implemented across the site and associated procedures; and • A proportionate level of dust monitoring relative to the risk of dust impacts, to ascertain the effectiveness of measures included with in the OCEMP and dust minimisation control plan. Dust deposition monitoring will be in place during construction. This could include passive dust deposition monitoring at potential locations shown on Figure 8-5.	Negligible
Operation	Site and road traffic emissions	High	Negligible to moderate	Negligible to slight adverse	Design embedded mitigation measures including: • Emission release heights for the largest and most frequent sources of emissions to air have been designed to encourage good dispersion, through height above ground level and height above nearby buildings and structures;	Negligible to slight adverse

- The layout of the onshore site maximises distance between the main continuous sources of emissions to air and the nearest air quality sensitive receptors;
- The layout of the offshore site also provides a good setback distance between sources of emissions to air and the nearest air quality sensitive receptors;
- Whilst the air quality assessment has assumed continuous operation of the Power Plant throughout the year, in reality the CCGT plant will only operate for the energy demand required at the time;
- The majority of plant and all continuous and frequently operational plant will be fuelled by natural gas. Liquid fuel will only be used for start-up, maintenance and emergency purposes; and
- Start-up and emergency plant will only operate with use of low and ultra-low sulphur liquid fuel.

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CHAPTER 09
Airborne Noise and Groundborne Vibration

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park
Environmental Impact Assessment Report

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Tables

9. Airborne Noise and Groundborne Vibration

9.1 Introduction

This chapter assesses the potential noise and vibration impacts associated with the Proposed Development. A full description of the Proposed Development is given in Chapter 02 – Project Description. Sound and vibration from Liquid Natural Gas Carriers (LNGC) used to refuel the Floating Storage and Regasification Unit (FSRU) and associated tugs are also considered.

This chapter does not cover underwater noise and vibration impacts. These are assessed in the appendix to Chapter 07. Noise and vibration impacts affecting ecological receptors are also not covered and instead are discussed in Chapter 07.

Noise and vibration emissions can potentially occur during the construction, operational and decommissioning phases of the Proposed Development.

Potential noise and vibration sources during the construction phase comprise mobile plant and construction processes such as earthworks and piling which can give rise to elevated sound and vibration levels.

Potential noise sources during the operational phase comprise plant and equipment associated with the operation of the power plant, Liquid Natural Gas (LNG) Terminal and Above Ground Installation (AGI). It also comprises plant associated with the FSRU and intermittent noise from LNGCs. No significant groundborne vibration sources are identified during the operational phase.

9.2 Competent Expert

The assessment has been carried out under the supervision of Chris Skinner. Chris Skinner has over 20 years' experience in Acoustics Consultancy and holds a MSci/ MA Physics from the University of Cambridge. He is a full corporate member of the Institute of Acoustics.

He has significant experience in modelling noise from a range of industrial facilities, including power generation plant. Chris Skinner works with a wide range of clients, from industrial site operators and developers to Local Authorities and provides expert technical advice to government departments on noise and nuisance.

Chris Skinner has strong experience in developing large complex acoustic models and undertaking predictions and has worked with many clients to use such models to understand noise impacts from industrial sites, design mitigation and provide acoustic design advice for site developments.

9.3 Methodology

9.3.1 Study Area

The study area for onsite construction and operational noise and vibration is defined as an area extending from the Proposed Development site up to and including the nearest sensitive receptor locations. If compliant levels of noise and vibration are predicted at the nearest sensitive receptor locations, it follows that compliant levels will be achieved at all other locations.

The study area for offsite traffic noise is the same as identified in the transport assessment, detailed in Chapter 11.

9.3.2 Determination of the Baseline Environment

The baseline acoustic environment has been determined via several long-term surveys conducted in and around the site. These surveys are discussed below.

9.3.3 Describing Potential Effects

The Environmental Protection Agency (EPA) Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2017) are draft Guidelines written to facilitate the implementation of Directive 2011/92/EU as amended by EU Directive 2014/52/EU in Ireland. This document covers the assessment and description of environmental impacts.

Effects are described under various headings, including Quality, Significance, Extent and Context, Probability, Duration and Frequency. Of particular relevance are the definitions of significance and duration, which are given in Table 9-1 and Table 9-2.

Table 9-1 Description of Significance of Effects

Aspect	Description
Imperceptible	An effect capable of measurement but without significant consequences
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences
Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends
Significant	An effect which, by its character, magnitude, duration or intensity, alters a sensitive aspect of the environment
Very Significant	An effect which, by its character, magnitude, duration or intensity, significantly alters most of a sensitive aspect of the environment
Profound	An effect which obliterates sensitive characteristics

Source: Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA 2017)

Table 9-2 Description of Duration of Effects

Aspect	Description
Momentary	Effects lasting from seconds to minutes
Brief	Effects lasting less than a day
Temporary	Effects lasting less than a year
Short-Term	Effects lasting from one to seven years
Medium-Term	Effects lasting from seven to 15 years
Long Term	Effects lasting from 15 to 60 years
Permanent	Effects lasting over 60 years
Reversible	Effects that can be undone, e.g. through remediation or restoration
Frequency	How often the effect will occur

Source: Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA 2017)

9.3.4 Significance of Effects Construction Phase

9.3.4.1 Introduction

To determine potential temporary noise and vibration impacts during the construction phase of the Proposed Development, the following matters have been considered:

- Noise and vibration caused by construction site activities; and
- Noise and vibration caused by increases in traffic on existing roads.

9.3.4.2 Criteria – Noise from Onsite Construction Activities

Transport Infrastructure Ireland (TII; formerly the National Roads Authority) is the only government body in Ireland to publish construction noise limits, which are presented in the document Guidelines for the Treatment of Noise and Vibration in National Road Schemes (NRA 2004) (NRA Guidelines).

It is acknowledged the limits presented relate to construction works for road schemes, however it is assumed that noise sensitive receptors are likely to be equally sensitive to construction noise from other project types.

The criteria presented in this document are given in Table 9-3.

Table 9-3 Maximum permissible noise levels at the façade of dwellings during construction

Period	$L_{Aeq,1hr}$ dB	$L_{p(max)\ slow}$ dB
Monday to Friday – 07:00 to 19:00	70	80
Monday to Friday – 19:00 to 22:00	60[1]	65[1]
Saturday – 08:00 to 16:30	65	75
Sundays and Bank Holidays – 08:00 to 16:30	60[1]	65[1]

[1] Construction activity at these times, other than that required in respect of emergency works, will normally require the
explicit permission of the relevant local authority

Source: Guidelines for the Treatment of Noise and Vibration in National Road Schemes *(NRA 2004)*

Potential construction noise impacts can also be assessed using BS 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites' (BS5228).

The 'ABC' method (detailed in BS5228 Section E.3.2) has been used to develop criteria . Using this method, the construction noise limit for the Proposed Development are determined by rounding the ambient noise levels to the nearest 5 dB and then comparing this level to the Category A, B and C values given in BS5228, detailed in Table 9-4.

Table 9-4 BS5228 Construction Noise Criteria

Assessment category and threshold value period	Threshold Value $L_{Aeq,T}$ dB		
	Category A (a)	Category B (b)	Category C (c)
Night-time (23:00 – 07:00)	45	50	55
Evenings and weekends (d)	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75

NOTE 1: A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.
NOTE 2 If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise.
NOTE 3: Applies to residential receptors only.

(a) Category A: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.
(b) Category B: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as Category A values.
(c) Category C: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than Category A values.

Assessment category and threshold value period	Threshold Value L_{Aeq},T dB		
	Category A (a)	Category B (b)	Category C (c)

(d) 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays, 07:00 – 23:00 Sundays.

For the purposes of this assessment, the criteria given in both the NRA Guidelines and BS5228 will be considered. Where the criteria differ, the more stringent of the two will be adopted.

9.3.4.3 Criteria – Vibration from Onsite Construction Activities

There are two types of construction vibration criteria: those dealing with human perception and those dealing with structural damage to buildings. Both criterion types are considered relevant to the Proposed Development.

Table B.1 in BS5228 presents vibration criteria with regards human perception. These are presented in Table 9-5 with descriptions of likely reactions.

Table 9-5 BS5228 Vibration Criteria - Human Perception

Peak Particle Velocity (PPV)	Description
>= 10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.
>1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
>0.3 mm/s	Vibration might be just perceptible in residential environments.
>0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.

Table 2 of the NRA guidelines provide construction vibration criteria identified to ensure there is no potential for vibration damage during construction. These criteria are presented in Table 9-6.

Table 9-6 NRA Guidelines Vibration Criteria – Structural Damage

Allowable vibration velocity (peak Particle Velocity) at the closest part of any sensitive property to the source of vibration, at a frequency of		
Less than 10Hz	10 to 50 Hz	50 to 100Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

9.3.4.4 Criteria – Blasting

It is expected that blasting would be required during the initial construction phases to excavate some of the rock, which cannot be removed by rock breaking equipment mounted on tracked excavators. Full details of the blasting process and methodology are given in Chapter 2 Section 2 Construction.

With regard blasting operations BS5228 states:

> *Whenever blasting is carried out, energy is transmitted from the blast site in the form of airborne pressure waves. These pressure waves comprise energy over a wide range of frequencies, some of which are higher than 20 Hz and therefore perceptible as sound, whereas the majority are below 20 Hz and hence inaudible but can be sensed as concussion. It is the combination of the sound and concussion that is known as air overpressure.*

With regard air overpressure criteria, BS5228 goes on to state:

> *As the airborne pressure waves pass any single point the pressure of the air rises rapidly to a value above atmospheric pressure, falls to below atmospheric pressure, then returns to normal pressure after a series of oscillations. The maximum value above atmospheric pressure is known as peak air overpressure and is measured in pressure terms and generally expressed in linear decibels (dB lin) (see I.4).*
>
> *Routine blasting can regularly generate air overpressure levels at adjacent premises of around 120 dB (lin). This level corresponds to an excess air pressure which is equivalent to that of a steady wind velocity of 5 m·s−1 (Beaufort force 3, gentle breeze) and is likely to be above the threshold of perception.*
>
> *Windows are generally the weakest parts of a structure and research by the United States Bureau of Mines [65] has shown that a poorly mounted window that is prestressed might crack at 150 dB (lin), with most windows cracking at around 170 dB (lin), whereas structural damage would not be expected at levels below 180 dB (lin).*

Criteria for vibration caused by blasting activities are presented in BS6472-2:2008 Guide to evaluation of human exposure to vibration in buildings, Part 2: Blast Induced Vibration (BSI Group, 2008) (BS6472). These criteria are presented in Table 9-7.

Table 9-7 BS6472 Vibration Criteria - Blasting

Place	Time	Satisfactory Magnitude[A] PPV (mm/s)
Residential	Day[D] Night[D] Other Times[D]	6.0 to 10.0[C] 2.0 4.5
Offices[B]	Any Time	14.0
Workshops[B]	Any Time	14.0

NOTE 1 This table recommends magnitudes of vibration below which the probability of adverse comment is low (noise caused by any structural vibration is not considered).

NOTE 2 Doubling the suggested vibration magnitudes could result in adverse comment and this will increase significantly if the magnitudes are quadrupled.

NOTE 3 For more than three occurrences of vibrations per day see the further multiplication factor in 5.2.

A) The satisfactory magnitudes are the same for the working day and the rest of the day unless stated otherwise.

B) Critical working areas where delicate tasks impose more stringent criteria than human comfort are outside the scope of this standard.

C) Within residential properties people exhibit a wide variation of tolerance to vibration. Specific values are dependent upon social and cultural factors, psychological attitudes and the expected degree of intrusion. In practice the lower satisfactory magnitude should be used with the higher magnitude being justified on a case-by-case basis.

D) For the purpose of blasting, daytime is considered to be 08h00 to 18h00 Monday to Friday and 08h00 to 13h00 Saturday. Routine blasting would not normally be considered on Sundays or Public Holidays. Other times cover the period outside of the working day but exclude night-time, which is defined as 23h00 to 07h00.

9.3.4.5 Criteria – Noise from Increased Traffic Flows on Existing Roads during the Construction Period

The potential increase in noise levels resulting from changes to road traffic flows during the construction period have been determined in accordance with the NRA Guidelines which refer to the Calculation of Road Traffic Noise (CRTN) methodology.

The CRTN methodology is not accurate for very low traffic flows (below 1000 AAWT,18hr). Where flows of this magnitude are predicted, the Noise Advisory Council (NAC) prediction method detailed in the document A Guide to Measurement and Prediction of the Equivalent Continuous Sound Level L_{eq} has been used.

No specific Irish guidance containing criteria for noise impacts from construction traffic has been published.

The impact of construction phase traffic has therefore been assessed in accordance with the short-term criteria provided in the Highways England document Design Manual for Roads and Bridges LA111 Noise and vibration (LA111). These criteria are given in terms of change in noise level and are presented in Table 9-8.

Table 9-8 Magnitude of Impact – Construction Phase Traffic

Change in Sound Level ($L_{A10,18hr}$ dB)	Magnitude of Impact (Short Term)
0	No Change
0.1 to 0.9	Negligible
1.0 to 2.9	Minor
3.0 to 4.9	Moderate
5+	Major

Source: Design Manual for Roads and Bridges LA111 Noise and vibration) Highways England, 2020)

9.3.4.6 Construction Phase – Candidate Special Area of Conservation (cSAC) and Other Ecological Receptors

The impact of construction phase noise and vibration emissions on the habitats and species of the cSAC and other ecological receptor positions are discussed in Chapter 07.

9.3.5 Significance of Effects Operational Phase

9.3.5.1 Introduction

To determine the potential noise and vibration impacts during the operational phase, the following matters have been considered:

- Sound and vibration caused by site operations; and
- Sound and vibration caused by increases in traffic on existing roads.

9.3.5.2 Criteria – Operational Phase Noise Emissions

The Proposed Development would be licensed by the Environmental Protection Agency (EPA) under an Industrial Emissions Directive (IED) Licence.

Guidance on permissible noise emission limits for licensed facilities is contained in the document Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (EPA,2016) (NG4). NG4 refers to Best Available Techniques as a form of noise mitigation which is defined in Section 7 of the Protection of the Environment Act (2003) as:

> '*The most effective and advanced stage in the development of an activity and its methods of operation, which indicate the practical suitability of particular techniques for providing, in principle, the basis for emission limit values designed to prevent or eliminate or, where that is not practicable, generally to reduce an emission and its impact on the environment as a whole.*'

NG4 states that:

> ' *All reasonably practicable measures should be adopted at licensed facilities to minimise the noise impact of the activity, and BAT should be used in the selection and implementation of appropriate noise mitigation measures and controls.*'

NG4 also provides criteria for use in noise assessments which vary depending on whether the location of the development is in a 'Quiet Area' or an 'Area of Low Background Noise'.

A 'Quiet Area' is defined as a location that meets the following criteria:

- At least 3 km from urban areas with a population >1,000 people;
- At least 10 km from any urban areas with a population >5,000 people;
- At least 15 km from any urban areas with a population >10,000 people;
- At least 3 km from any local industry;
- At least 10 km from any major industry centre;
- At least 5 km from any National Primary Route, and;
- At least 7.5 km from any Motorway or Dual Carriageway.

An 'Area of Low Background Noise' is a location that meets the following criteria:

- Average Daytime Background Noise Level ≤40dB L_{AF90}, and;
- Average Evening Background Noise Level ≤35dB L_{AF90}, and;
- Average Night-time Background Noise Level ≤30dB L_{AF90}.

The criteria presented in NG4 are detailed in Table 9-9.

Table 9-9 Recommended Noise Limit Criteria

Scenario	Daytime Noise Criterion dB $L_{ar,T}$ (0700 to 1900 hours)	Evening Noise Criterion dB $L_{ar,T}$ (1900 to 2300 hours)	Night-time Noise Criterion dB $L_{ar,T}$ (2300 to 10700 hours)
Quiet Area	Noise from the licensed site to be at least 10 dB below the average daytime background noise level measured during the baseline survey	Noise from the licensed site to be at least 10 dB below the average evening background noise level measured during the baseline survey	Noise from the licensed site to be at least 10 dB below the average night-time background noise level measured during the baseline survey
Areas of Low Background Noise	45 dB	40 dB	35 dB
All other Areas	55 dB	50 dB	45 dB

Source: Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (EPA,2016)

The criteria are given in terms of a Rated Noise Level ($L_{ar,T}$) which is defined in NG4 as:

> *The Rated Noise Level, equal to the LAeq during a specified time interval (T), plus specified adjustments for tonal character and/ or impulsiveness of the sound.*

The method for applying adjustments for tonal and/ or impulsive characteristics are described in NG4 and have been considered in this assessment.

The location of the Proposed Development does not meet the definition of a 'Quiet Area' due to its proximity to the N69 to the east and the Money Point Power Station to the north. However, the results of the baseline survey indicate that the site could be considered an 'Area of Low Background Noise' (this is discussed further below). Therefore, the criteria detailed for Areas of Low Background Noise' have been adopted for this assessment.

The acoustic character of this rural area may change in the future due to the area being zoned for marine-related industry as part of the Strategic Integrated Framework Plan for the Shannon Estuary which is supported by Kerry Co. Council as identified in the document 'Kerry County Development Plan 2015-2021' (adopted 16th March 2015). So, while the more stringent 'area of low background noise' criteria have been adopted in this assessment, it may be appropriate to review these criteria in due course.

9.3.5.3 Criteria – Noise from Increased Traffic Flows on Existing Roads during the Operational Period

The potential increase in noise levels resulting from changes to road traffic flows during the operational period have been determined in accordance with the NRA Guidelines which refer to the CRTN methodology.

The CRTN methodology is not accurate for very low traffic flows (below 1000 AAWT,18hr). Where flows of this magnitude are predicted, the NAC prediction method detailed in the document A Guide to Measurement and Prediction of the Equivalent Continuous Sound Level L_{eq} has been used.

The only Irish guidance which discusses criteria for road traffic noise is the NRA guidelines, which identifies a criterion of 60 dB L_{den}.

This guidance is identified as applicable to new road schemes only. However, it may be considered applicable to this scheme given the absence of other guidance and the fact that the impact of increased road traffic noise from existing roads may be considered subjectively similar to road traffic noise from a new road link.

The impact of operational phase traffic can also be assessed in accordance with the short-term and long-term criteria provided in the Highways England document Design Manual for Roads and Bridges LA111 Noise and vibration (LA111). This document does not cover Ireland; however, it has historically been used to assess this area.

LA111 presents criteria in terms of the change in noise level in the short term (year of opening) and long term (typically 15 years after opening) The criteria are given in Table 9-10 and Table 9-11.

Table 9-10 Magnitude of Impact – Operational Phase Traffic – Short Term

Change in Sound Level ($L_{A10,18hr}$ dB)	Magnitude of Impact (Short Term)
-0	No Change
0.1 to 0.9	Negligible
1.0 to 2.9	Minor
3.0 to 4.9	Moderate
5+	Major

Source: Design Manual for Roads and Bridges LA111 Noise and vibration (Highways England, 2020)

Table 9-11 Magnitude of Impact – Operational Phase Traffic – Long Term

Change in Sound Level ($L_{A10,18hr}$ dB)	Magnitude of Impact (Short Term)
-0	No Change
<3.0	Negligible
3.0 to 4.9	Minor
5.0 to 9.9	Moderate
10+	Major

Source: Design Manual for Roads and Bridges LA111 Noise and vibration (Highways England, 2020)

The assessment refers to both sources of criteria.

9.3.5.4 Operational Phase cSAC and other Ecological Receptors

The impacts of operational phase noise emissions on the cSAC and other ecological receptors are discussed in Chapter 07.

9.3.6 Limitations and Assumptions

The following limitations and assumptions apply to the assessment:

- The sound levels measured during the acoustic survey are representative of the baseline acoustic environment generally.
- Prior to construction start, a commercial tendering process will be held to supply the Power Plant and FSRU. The tendering process will result in a contract for a particular model of power plant and FSRU. Therefore, the precise size, configuration, performance, and layout of the equipment will be finalized following the award of the contract. For the purposes of this planning application and EIAR, consideration of environmental impacts is on the basis of the largest anticipated size of Power Plant and FSRU envisaged while accommodating equipment from the handful of major equipment suppliers capable of providing this type of generation equipment.
- The calculated sound levels presented in the report have been established using CadnaA 3D sound modelling software which adopts the calculation methodologies detailed in ISO 9613-2:1996 Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation, BS 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites and the Department of Transport Welsh Office document Calculation of Road Traffic Noise. The assessment is therefore subject to the assumptions and limitations detailed within these standards.

9.4 Baseline Environment

9.4.1 Baseline Measurements

Three long-term acoustic surveys were carried out in and around the site to determine baseline levels: between 14th and 18th February 2020, between 20th and 28th October 2020 and between 27th November and 11th December 2020. All surveys were conducted in accordance with BS 7445-1:2003 Description and measurement of environmental noise Guide to quantities and procedures.

The three surveys were conducted to ensure sufficient data was collected during weather conditions suitable for measurement. The measurement locations used during the surveys are shown in Figure F9-1, Vol. 3.

The existing acoustic environment is rural in nature. Sound sources identified included birdsong, farm animals and weather induced sound (e.g. the wind ‘rustling’ vegetation). Some intermittent road traffic sound was present, mainly from the L1010.

The results of the long-term measurement surveys, excluding measurements affected by adverse weather[1] are given in Table 9-12.

Table 9-12 Measured Baseline Levels

Date	Period	$L_{Aeq,T}$ (dB)	$L_{A90,15min}$ (modal) (dB)
04.02.20	Day	-	-
	Evening	32	23
	Night	30	23
05.02.20	Day	36	29
	Evening	31	22
	Night	25	23
20.10.20	Day	-	-
	Evening	-	-

[1] Defined as windspeeds greater than 5 m/s and/or precipitation. Weather data obtained from https://www.met.ie/climate/available-data/historical-data. Data for Shannon airport was used as this was the most representative location where hourly data was available. Only results where acceptable weather was present for the full period (i.e. day, evening or night) are presented and used in the assessment.

Date	Period	$L_{Aeq,T}$ (dB)	$L_{A90,15min}$ (modal) (dB)
	Night	42	34
21.10.20	Day	-	-
	Evening	44	41
	Night	43	40
22.10.20	Day	49	39
	Evening	-	-
	Night	-	-
27.11.20	Day	-	-
	Evening	33	29
	Night	41	38
28.11.20	Day	42	38
	Evening	40	36
	Night	36	29
29.11.20	Day	42	28
	Evening	27	21
	Night	43	35
30.11.20	Day	56	51
	Evening	43	43
	Night	-	-
01.12.20	Day	47	35
	Evening	52	45
	Night	-	-
02.12.20	Day	68	46
	Evening	-	-
	Night	-	-
03.12.20	Day	-	-
	Evening	37	34
	Night	-	-
06.12.20	Day	45	33
	Evening	37	35
	Night	41	39
07.12.20	Day	37	27
	Evening	42	34
	Night	-	-
08.12.20	Day	-	-
	Evening	48	41
	Night	32	30

In addition to the long-term survey, concurrent short term attended measurements were taken at three locations in proximity to nearby sensitive receptor positions during the February 2020 survey. The measurement locations are also shown in Figure F9-1, Vol. 3. The results of the measurements are given in Table 9-13.

Table 9-13 Short Term Attended Measurements

Location	Date	Period	Time	$L_{Aeq,T}$ (dB)	$L_{A90,15min}$ (dB)
ST1	04.02.20	Day	1500-1600	57	28 – 31
	04.02.20	Night-time	2300-2330	46	24-25
ST2	04.02.20	Day	1500-1600	57	26 – 30
	04.02.20	Night-time	2345-0015	46	24-25
ST3	05.02.20	Day	1015-1115	59	37-38
	05.02.20	Night-time	0040-0110	28	23

It can be seen from a comparison of the long term and short-term data that average sound levels ($L_{Aeq,T}$) are generally higher in proximity to the receptor positions than at the long-term monitoring location. This is likely due to the receptors being closer to the L1010 than the long-term monitoring location. Background sound levels ($L_{A90,T}$) are similar to or slightly lower than the background levels measured at the long-term monitoring location.

9.4.2 Existing Receptors

The location of the nearest noise sensitive receptor locations to the Proposed Development are shown in Figure F9-1, Vol. 3.

9.5 Characteristics of the Proposed Development

Sound and vibration emissions from the proposed development will occur in three distinct phases: construction operation and decommissioning.

The construction period is expected to last approximately 32 months. During this period sound ard vibration levels are expected to vary depending on the work being carried out.

Sound levels will be highest during the initial enabling period whilst louder activities such as earthworks and piling take place. As the construction phase develops, sound levels are expected to reduce as less noisy works (plant installation, internal works within structures) take over.

Vibration levels are expected to be highest during blasting operations, however these will be carefully managed. No more than three blasts are envisaged to occur in any given day and associated noise and vibration levels will be transient and very short lived. Some vibration may occur during piling works, however piling operations will take place around the jetty at significant distance from nearby receptors.

Sound levels during the operational phase will be caused principally by mechanical plant such as the open cycle gas turbines and gas processing equipment onshore and onboard the FSRU. Intermittent sound from movement and operation of LNGC's is also expected. Noise emissions during the operational phase will be subject to stringent limits, particularly during the night-time. Sound emissions are expected to be low level and present no distinctive characteristics such as tonality or impulsiveness. If these characteristics do occur, more stringent limits will apply.

Depending on the phasing of construction works, it is possible some noise sources associated with operation will occur concurrently with construction activities. This is discussed further below. If this does occur, no change to the outcomes of this assessment are expected. This is because the noise limits for operation phase noise are significantly more stringent than those applied to construction phase sources. As a result, any operational phase noise emissions that occur during the construction phase will not contribute to overall levels.

As outlined in Chapter 02 – Project Description, in the event of decommissioning, measures would be undertaken by the Applicant to ensure that there would be no significant, negative environmental effects during the decommissioning phase. Examples of the measures that would be implemented are outlined in Section 2.9, Chapter 02 – Project Description. As a result, additional potential impacts and associated effects arising during the decommissioning phase are not anticipated above and beyond those already assessed during the construction phase.

9.6 Embedded Mitigation

The proposed topographical changes which form part of the Proposed Development will give rise to a natural acoustic barrier, shielding existing sensitive receptors from sound emissions.

9.7 Assessment of Impact and Effect

9.7.1 Construction Phase – Site Operations

By comparison of the measured baseline levels presented in Table 9-12 and Table 9-13 and the threshold values presented in Table 9-4 this site is classified as ‘Category A’ with regard the ABC criteria presented in BS5228.

Category A BS5228 criteria are more stringent than the NRA guideline limits presented in Table 9-3 and therefore have been adopted for this assessment.

Details of the proposed construction programme have been provided by Sisk Ltd. The construction working hours are understood to be 0730-1800 Monday to Friday and 0800-1400 on Saturdays. Therefore, only the daytime and weekend noise limits apply. If construction works are required to take place outside of these times, this will be agreed in advance with the prior agreement of Kerry Co. Council, and subject to communication with the local community.

The criteria adopted for the assessment are presented in Table 9-14. The criteria apply at one metre from the façade of sensitive receptor positions.

Table 9-14 Construction Noise Criteria

Period	Time	Criteria
Monday to Friday	0730 – 1800	65 dB $L_{Aeq,10.5hr}$[1]
Saturday	0800 – 1300	65 dB $L_{Aeq,5hr}$[1]
Saturday	1300 - 1400	55 dB $L_{Aeq,1hr}$[1]

1. Criteria time periods chosen to align with working hours

The construction programme is understood to last approximately 32 months, comprising five sections as detailed in Table 9-15. The dates presented are understood to be indicative at this stage.

Table 9-15 Construction Programme

Area	Start Onsite	Duration (months)	Completion	Duration from Start Date (Months)
Enabling	Jan 2023	10	Oct 2022	10
LNG Terminal	+6 months	12	Jun 2023	18
Substation	+8 months	12	Sep 2023	21
CCGT - 2 Blocks	+9 months	21	Jun 2024	30
CCGT - 1 Block	+ 11 months	18	Aug 2024	32

Sisk Limited have advised that, with regard site operations, two ‘peak’ periods are expected to occur:

- ‘Peak 1’ around June/ July 2023 when site clearance, enabling works, piling and heavy civil engineering operations related to the LNG Terminal are expected to occur concurrently; and
- ‘Peak 2’ around May-September 2023 when CSA, mechanical and electrical works are to be carried out.

During Peak 1, night-time operations in and around the jetty will take place 24 hours a day.

These peaks represent the worst case (i.e. highest) construction phase noise emissions. Noise levels at all other times will be lower.

Details of mechanical plant operating onsite during these peak periods have been provided by Sisk Ltd. Sound power levels for each plant item present have subsequently been assigned from archive data presented in BS5228. The plant and associated sound levels for Peak One are presented in Table 9-16 and Table 9-17. The plant and associated sound levels for Peak Two are presented in Table 9-18.

Table 9-16 Peak 1 Plant and Associated Sound Pressure Levels – Main Construction and Access Road

Plant Item	No.	BS5228 reference	Octave Band Sound Pressure Levels (dB)								$L_{Aeq,T}$ 10m dBA	L_w dB(A)
			63	125	250	500	1k	2k	4k	8k		
Tracked Excavator w breaker	2	C.9.6	95	93	89	89	86	82	76	74	91	119
Tracked Excavator	2	C.2.16	72	71	74	73	69	66	63	58	75	103
Tracked Excavator w breaker	5	C.9.11	91	89	85	89	87	87	84	80	93	121
Semi Mobile Crusher	1	C.appendix4	91	91	88	87	85	83	78	68	90	118
Dump Trucks	8	C.2.31	86	79	79	79	79	84	69	60	87	115
Dozer	2	C.6.30	79	87	79	78	82	80	73	66	86	114
Dozer	1	C.6.28	80	84	76	77	79	81	69	59	85	113
Rollers	2	C.2.38	80	75	77	72	67	62	54	46	73	101
Loading Shovel	1	C.9.8	89	87	84	82	81	81	72	65	86	114
Road Grader (&Tipper)	1	C.6.31	88	87	83	79	84	78	74	65	86	114
Teleporter (Diesel)	1	C.2.35	85	79	69	67	64	62	56	47	71	99
Track Machine	1	C.2.25	77	65	67	67	63	61	57	47	69	97
Mobile Crane	1	C.5.37	85	73	67	71	72	69	63	56	76	104
Site Dumper	1	C.4.4	82	76	75	74	68	68	64	55	76	104
Fuel Tanker	1	C.4.16	75	70	67	67	69	66	60	53	72	100
Concrete Truck	1	C.4.28	79	80	73	72	69	68	59	53	75	103
Poker Vibrator	1	C.4.33	82	80	80	73	69	72	70	65	78	106

Plant Item	No.	BS5228 reference	Octave Band Sound Pressure Levels (dB)								$L_{Aeq,T}$ 10m dBA	L_w dB(A)
			63	125	250	500	1k	2k	4k	8k		
MEWP - Boom (Diesel)	1	C.4.57	78	76	62	63	60	59	58	49	67	95
Con Saw	2	C.4.70	72	89	81	80	80	82	86	85	91	119
Generator (Diesel)	1	C.4.82	64	61	59	53	49	47	42	35	56	84
Generator (Diesel)	3	C.4.85	69	69	67	60	59	60	56	53	66	94
Water Pump	1	C.4.88	70	65	66	64	64	63	56	46	68	96
Track machine w Breaker	1	C.5.2	79	75	73	74	77	77	75	70	83	111
Kango Hammer	2	C.5.3	82	75	73	68	63	67	80	69	82	110
Roller	1	C.5.27	85	70	62	62	61	59	53	45	67	95
Whacker Plate	1	C.5.29	76	78	74	77	77	77	73	70	82	110
Skilsaw	2	C.4.72	69	75	77	74	71	70	74	69	79	107
Drills	4	C.2.44	67	80	74	72	72	72	68	61	77	105

Table 9-17 Peak 1 Plant and Associated Sound Pressure Levels – Jetty and Jetty Access

Plant Item	No.	BS5228 reference	Octave Band Sound Pressure Levels (dB)								$L_{Aeq,T}$ 10m dBA	L_w dB(A)
			63	125	250	500	1k	2k	4k	8k		
400T Crawler Crane	1	C.4 38	80	79	73	74	73	73	64	55	78	106
70T Mobile Crane	1	C.3.30	80	72	71	67	65	62	57	49	70	98
Hydraulic Hammer	1	C.3.8	83	82	79	82	84	82	77	67	88	116
Drill Rig	1	C.6.35	85	93	78	79	80	79	76	74	86	114
Excavator	1	C4.17	81	72	68	68	66	64	60	55	67	95
Generator (for office)	1	C.4.78	64	67	68	65	57	54	49	42	66	94
Tug	4	Other[1]	88	83	75	67	59	57	55	-	-	105
Tracked Cranes[2]	4	C.3.28	81	77	66	62	59	57	51	46	67	95
Compressors[2]	4	C.5.5	84	73	64	59	57	55	58	47	65	93

1. *Based on AECOM archive data for tug with 2 x 2000kW diesel engines. This is understood to be an overestimate.*

Plant Item	No.	BS5228 reference	Octave Band Sound Pressure Levels (dB)								LAeq,T 10m dBA	Lw dB(A)
			63	125	250	500	1k	2k	4k	8k		

2. *Jetty Access area only*, *do not operate during the night time.*

Table 9-18 Peak 2 Plant and Associated Sound Pressure Levels

Plant Item	No.	BS5228 ref	Octave Band Sound Pressure Levels (dB)								LAeq,T 10m dBA	Lw dB(A)
			63	125	250	500	1k	2k	4k	8k		
Teleporter Diesel	6	C.4.54	79	73	66	65	78	66	54	47	79	107
Teleporter 360	2	C.4.54	79	73	66	65	78	66	54	47	79	107
Consaws	6	C.4.70	72	89	81	80	80	82	86	85	91	119
Poker Vibrators	6	C.4.33	82	80	80	73	69	72	70	65	78	106
Skilsaws	6	C.4.72	69	75	77	74	71	70	74	69	79	107
Concrete Trucks	10	C.4.28	79	80	73	72	69	68	59	53	75	103
Concrete Pumps	2	C.4.24	69	64	64	66	63	59	53	47	67	95
Tracked Excavator	4	C.10.2	82	75	72	73	71	70	66	58	76	104
Tracked Excavator	2	C.6.12	84	74	71	71	68	66	61	55	74	102
Tracked Excavator	4	C.4.67	87	79	76	70	68	64	57	48	74	102
Tracked Excavator	2	C.4.68	71	71	66	59	59	58	54	48	65	93
Site Dumpers	6	C.4.4	82	76	75	74	68	68	64	55	76	104
Mobile Crane	6	C.4.39	87	82	78	74	71	67	60	52	77	105
MEWP Booms	16	C.4.57	78	76	62	63	60	59	58	49	67	95
MEWP Scissor Lifts (Diesel)	8	C.4.59	80	77	74	74	74	71	65	63	78	106
Kango Hammers	6	C.5.6	90	79	75	78	78	83	91	92	95	123
Impact Guns	6	C.4.69	75	74	75	72	74	75	80	80	85	113
Generator Diesel	6	C.4.85	69	69	67	60	59	60	56	53	66	94
Water Pumps	2	C.4.88	70	65	66	64	64	63	56	46	68	96
Hilti Nail Guns	4	C.4.95	63	65	65	66	65	69	64	61	73	101

The Peak 1 construction plant is listed in two tables as some plant would operate within the access road, Power Plant and LNG Terminal footprint and some plant would operate around the jetty access and jetty. These sources are input differently into the associated noise model (discussed below) so are listed separately.

To determine the impact of construction noise on existing receptors in the area, a 3D sound model was constructed using CadnaA 2020 acoustic modelling software. The inputs to the model are as follows:

- Topographical Information for the site and surrounds from Ordnance Survey Ireland;
- Vector Mapping Data from Ordnance Survey Ireland;
- Site location and layout drawing provided by Black and Veatch; and
- Plant sound power data provided by Sisk Ltd.

The following assumptions were made:

- All plant is assumed to operate 100% of the time. This is a highly conservative assumption which is unlikely to ever occur in practice. However, in lieu of detailed information, this assumption is made to provide a robust assessment;

- Construction noise sources were input at a height 1.5 m from the existing ground level (ignoring the potential acoustic screening provided by proposed topographical changes);
- Construction noise sources input as a spatially averaged area source extending over the construction site;
- Ground absorption is assumed to be ‘acoustically soft’ as defined in BS5228. Water, the Proposed Development footprint, and roads are assumed to be acoustically hard/ reflective; and
- It is likely that a number of the Peak 2 sources would be used internally or in locations screened from nearby receptors by newly constructed structures. For robustness, no attenuation provided by this screening has been included in the predictions.

Full details of the sound modelling and associated noise maps are given in Appendix A9-2 , Vol. 4 and Figures F9-2 through to F9-4, Vol. 3. The results of the construction noise emission predictions are summarised in Table 9-19.

Table 9-19 Calculated Construction Noise Levels – Daytime

Receptor Position	Calculated Peak 1 Sound Pressure Level ($L_{Aeq,T}$)	Calculated Peak 1 Sound Pressure Level (Road) ($L_{Aeq,T}$)	Calculated Peak 2 Sound Pressure Level ($L_{Aeq,T}$)	Criteria	Below Criteria?
R1	56	53	52	65 dB $L_{Aeq,10.5hr}$ Mon-Fri 65 dB $L_{Aeq,5hr}$ Sat 0800-1300 55 dB $L_{Aeq,1hr}$ Sat 1300-1400	Y Y N
R2	53	50	49	65 dB $L_{Aeq,10.5hr}$ Mon-Fri 65 dB $L_{Aeq,5hr}$ Sat 0800-1300 55 dB $L_{Aeq,1hr}$ Sat 1300-1400	Y Y Y
R3	54	58	51	65 dB $L_{Aeq,10.5hr}$ Mon-Fri 65 dB $L_{Aeq,5hr}$ Sat 0800-1300 55 dB $L_{Aeq,1hr}$ Sat 1300-1400	Y Y N
R4	54	53	50	65 dB $L_{Aeq,10.5hr}$ Mon-Fri 65 dB $L_{Aeq,5hr}$ Sat 0800-1300 55 dB $L_{Aeq,1hr}$ Sat 1300-1400	Y Y Y
R5	58	45	54	65 dB $L_{Aeq,10.5hr}$ Mon-Fri 65 dB $L_{Aeq,5hr}$ Sat 0800-1300 55 dB $L_{Aeq,1hr}$ Sat 1300-1400	Y Y N
R6	50	45	47	65 dB $L_{Aeq,10.5hr}$ Mon-Fri 65 dB $L_{Aeq,5hr}$ Sat 0800-1300 55 dB $L_{Aeq,1hr}$ Sat 1300-1400	Y Y Y
R7	48	46	44	65 dB $L_{Aeq,10.5hr}$ Mon-Fri 65 dB $L_{Aeq,5hr}$ Sat 0800-1300 55 dB $L_{Aeq,1hr}$ Sat 1300-1400	Y Y Y

Table 9-20 Calculated Construction Noise Levels – Night-Time

Receptor Position	Calculated Peak 1 Night-Time Sound Pressure Level ($L_{Aeq,T}$)	Criteria	Below Criteria?
R1	39	45 dB $L_{Aeq,T}$	Y
R2	35	45 dB $L_{Aeq,T}$	Y
R3	35	45 dB $L_{Aeq,T}$	Y
R4	33	45 dB $L_{Aeq,T}$	Y
R5	42	45 dB $L_{Aeq,T}$	Y
R6	35	45 dB $L_{Aeq,T}$	Y
R7	30	45 dB $L_{Aeq,T}$	Y

It can be seen the above that construction sound levels are below the criteria at all identified receptors during all periods, except for receptors R1,R3 and R5 where there is a predicted exceedance between 1300 and 1400 on Saturdays. Exceedances during this period will be avoided through the careful scheduling of works.

No significant adverse impact is expected at residential receptor positions with regards construction phase sound levels generated by onsite activities.

9.7.2 Construction Phase – Vibration

The main sources of vibration associated with the construction of the Proposed Development (excluding blasting which is discussed below) are the piling rigs used in the construction of the jetty.

The transmission of ground-borne vibration is highly dependent on the nature of the intervening ground between the source and receiver and the activities being undertaken.

The principal potential source of vibration associated with the construction phase is the piling rig used in the construction of the jetty. It is not envisaged that any of the other proposed construction activities are likely to generate vibration levels, with the exception of blasting activities which are discussed separately in section 9.7.3.2.

The piling rig would be located on a jack up barge adjacent to the location of the proposed jetty and the distance between the proposed piling and nearest receptor position (R1) is approximately 600 m. It is understood the piling methodology would be a combination of bored and driven piles. To ensure the robustness of the assessment, driven piling has been assumed, being the piling method that gives rise to the highest vibration levels.

The bedrock geology of the area surrounding the proposed jetty location is soft becoming stiff gravelly clay above sandstone/ siltstone, as identified in the Halcrow document ‘Shannon LNG Offshore Geotechnical Investigation’ (2007).

To gain an indication of the potential vibration impact of the proposed piling, reference is made to the historical data presented in BS5228. The data covering piling activities in areas with similar ground conditions are presented in Table 9-21.

Table 9-21 Vibration Levels – Historical Data

BS5228 Table and Row	Soil Conditions	Piling Mode/ Dimensions	Mode	Distance (M, plan)	PPV mm/s
D.2.20	Fill/ soft material/ clay becoming stiff	450 mm diameter 10 m depth with enlarged base	Driving tube	4 20	8.4 5.0
			Expelling plug	4 20	6.1 4.8
			Enlarging base	4 20	4.0 4.4

BS5228 Table and Row	Soil Conditions	Piling Model/ Dimensions	Mode	Distance (M, plan)	PPV mm/s
D.2.22	Peaty, silty alluvia over shale and sandstone	350 mm diameter 7.5 m to 8 m depth	Driving tube	21	2.9
				28	2.7
				35	2.4
			Extracting tube	21	3.2
				28	3.9
				35	3.1

It can be seen from the above that the majority of the historical data presents vibration levels below the most stringent criterion of 8mm/s PPV presented in Table 9-6 (relating to building damage) but above the 0.14mm/s criterion presented in Table 9-5 (relating to human perception).

To estimate vibration levels at the closest receptor positions, these measured levels were used in conjunction with the Hillier and Crabb empirical predictor for percussive piling presented in Table E.1 of BS5228. These calculations indicate that vibration levels would be below the 0.14 mm/s criterion presented in Table 9-5 and significantly below the 8 mm/s criterion at receptor positions, even when basing predictions on these worst-case measured vibration levels from Table 9-21.

In summary, **no adverse impact** is predicted as a result of piling induced vibration.

9.7.3 Construction Phase – Blasting

9.7.3.1 Noise and Air Overpressure

It is expected that blasting would be required to excavate some of the rock, which cannot be removed by rock breaking equipment mounted on tracked excavators. It is understood that only single blasts will take place in each event. This will only take place during the enabling phase.

With regards the prediction of air overpressure, BS6472 states:

> *Accurate prediction of air overpressure is almost impossible due to the variable effects of the prevailing weather conditions and the large distances often involved.*
>
> *Control of air overpressure should always be by its minimization at source through appropriate blast design.*

In light of this, to mimimise the impact of air overpressure and blasting it is recommended that:

- Blasting is carried out in accordance with the principles set out in BS 5607:2017 Code of practice for the safe use of explosives in the construction industry;
- Ensuring appropriate burden to avoid over or under confinement of the charge;
- Accurate setting out and drilling;
- Appropriate charging;
- Appropriate stemming with appropriate material such as sized gravel or stone chippings;
- Using delay detonation to ensure smaller maximum instantaneous charges (mics);
- Using decked charges and in-hole delays;
- Blast monitoring to enable adjustment of subsequent charges;
- Designing each blast to maximize its efficiency and reduce the transmission of vibration;
- Avoiding the use of exposed detonating cord on the surface in order to minimize air overpressure – if detonating cord is to be used in those cases where down-the-hole initiation techniques are not possible, it should be covered with a reasonable thickness of selected overburden; and
- A protocol for community relations with regards blasting is adopted such that prior warning of blasting operations is given to members of the public.

Provided the above measures are adopted during the blasting stage of the construction phase, the impact of air overpressure would be minimised as far as practicable.

9.7.3.2 Vibration

It is expected that blasting would be required to excavate some of the rock, which cannot be removed by rock breaking equipment mounted on tracked excavators. Table 9-7 details appropriate criteria for blasting induced vibration. It is understood that no more than 3 blasts per day are envisaged (a prerequisite for the Table 9-7 criteria to apply).

The blasting vibration limits will be achieved by limiting the Maximum Instantaneous Charge (MIC) used in the blasting process.

To determine the MIC for the site, a number of trial blasts will be carried out such that a site-specific scaled distance graph can be developed. Using this graph, the MIC limit required to achieve the Table 9-7 criteria can be determined in accordance with the procedure detailed in BS6472.

No adverse impact is therefore expected because of blast induced vibration.

9.7.4 Construction Phase – Traffic on Existing Roads

The traffic flows on the surrounding road network with and without construction traffic are presented in Table 9-22.

Table 9-22 Construction Phase Traffic

Link Number	Link Name	2024 without Construction Traffic		2024 with Construction Traffic	
		AAWT,18hr	% HGV	AAWT,18hr	% HGV
1	L1010 – Site entrance to Ballylongford	357	0.4%	357	0.4%
2	L1010 – Site entrance to Tarbert	357	0.4%	1,055	0.4%
3	N67 (Ferry Port Road)	1,627	2.6%	1,657	2.6%
4	Bridewell Street	5,327	2.4%	5,995	2.4%
5	N69 (to Limerick)	5,912	3.6%	6,412	3.6%
6	N69 (to Listowell)	4,945	2.8%	5,113	2.8%
7	R551	2,946	2.5%	2,946	2.5%

Calculations have been carried out in accordance with the Basic Noise Level methodology presented in CRTN to determine the change in road traffic noise levels resulting from these changes in flows.

The CRTN methodology is not accurate for very low traffic flows (below 1000 AAWT,18hr). Where flows of this magnitude are predicted, the Noise Advisory Council method has been used.

The results of these calculations alongside the associated magnitude of impact are presented in Table 9-23.

Table 9-23 Change in Road Traffic Noise Level Resulting from Construction Traffic

Link	Change in Noise Level	Magnitude of Impact
1	0.0 dB	No Change
2	5.2 dB	Major
3	0.2 dB	Negligible
4	0.5 dB	Negligible
5	0.4 dB	Negligible
6	0.1 dB	Negligible
7	0.0 dB	No Change

Link	Change in Noise Level	Magnitude of Impact

It can be seen from the above that **no significant increase** in road traffic noise is expected on any link during the construction phase, except for Link 2 (L1010 – Site entrance to Tarbert) where a **major impact** is predicted.

This impact is limited to the relatively small number of noise sensitive properties located along this stretch of existing road.

The following contextual factors should be borne in mind when considering this impact:

- The absolute noise levels from Link 2 with and without construction traffic are low. Noise levels from this road, inclusive of construction traffic, are expected to be in the vicinity of 57 dB $L_{Aeq,16hr}$ at 10 metres from the road side. This is not a particularly high noise level and therefore the impact of the change in noise level may be less than indicated.
- It is understood that Link 2 would be resurfaced prior to the commencement of the Proposed Devleopment. This may assist in reducing noise levels (E.g. by removing potholes, roughness etc.). However, it is not possible to quantify this change.

9.7.5 Operational Phase – Site Operations

9.7.5.1 Criteria

The assessment evaluates potential adverse impact from sound emissions using criteria derived from existing baseline noise levels ($L_{A90,T}$) around the site.

Analysis of the measured baseline levels presented in Table 9-12 and Table 9-13 indicate there is variance in prevailing background sound levels; some survey periods indicate the site should be classed as an area of low background noise, whereas other periods indicate otherwise.

It is possible that the acoustic character of the area may change in the future due to the area being zoned for marine-related industry as part of the Strategic Integrated Framework Plan for the Shannon Estuary which is supported by Kerry Co. Council as identified in the document 'Kerry County Development Plan 2015-2021' (adopted 16th March 2015).

To assess the impact of the Proposed Development with regard to operational noise, the more stringent 'area of low background noise' criteria have been adopted. However, it may be appropriate to review these criteria in due course.

The adopted criteria are presented in Table 9-24.

Table 9-24 Operational Phase Noise Criteria

Location	Daytime Noise Criterion dB $L_{ar,T}$ (0700 to 1900 hours)	Evening Noise Criterion dB $L_{ar,T}$ (1900 to 2300 hours)	Night-time Noise Criterion dB $L_{ar,T}$ (2300 to 0700 hours)
Areas of Low Background Noise	45 dB	40 dB	35 dB

It is understood that operations are of a 24/7 nature i.e. the assessment is based on the LNG Terminal and Power Plant operating at any time throughout the day, evening or night. Therefore, the most stringent noise criterion of 35 dB $L_{ar,T}$ for the night-time at the nearest sensitive receptor location has been adopted. Compliance with this night-time criterion will therefore ensure compliance with the higher criteria for daytime and evening periods.

For the purposes of the noise assessment, the Proposed Development is considered in three parts:

- The Power Plant and LNG Terminal;
- The Pipeline Above Ground Installation; and
- The Floating Storage Regasification Unit (FSRU), Liquid Natural Gas Carrier (LNGC) and tugs.

These are discussed in turn below.

9.7.5.2 The Power Plant and LNG Terminal

Prior to construction start, a commercial tendering process will be held to supply the Power Plant and FSRU. The tendering process will result in a contract for a particular model of power plant and FSRU. Therefore, the precise size, configuration, performance, and layout of the equipment will be finalized following the award of the contract, however this will not affect the design of the buildings or emissions as described in this EIAR.

Indicative details of the noise generating mechanical plant associated with the Power Plant and LNG Terminal have been provided by Shannon LNG Limited and their Project Engineers Black and Veatch. They are detailed in Table 9-25.

Table 9-25 Power Plant and LNG Terminal Sound Levels

Plant	QTY	SPL/L_w	Sound Pressure/Power Levels dB(A)									
			31.5	63	125	250	500	1K	2K	4K	8K	Total
Air Intake Filter House	6	L_w	77	91	96	97	91	89	86	94	88	102
GT Enclosure Vent Outlet Fans	6	L_w	65	78	91	98	102	100	95	87	78	106
GT Enclosure Vent Outlet	6	L_w	64	57	55	55	51	44	38	31	18	66
Generator 2-p 50 Hz	6	L_w	-	65	100	106	107	106	103	100	90	112
Generator Cooling Inlet (air cooled)	6	L_w	70	82	90	94	99	98	99	96	88	105
Generator Cooling Outlet (air cooled)	6	L_w	66	75	91	83	86	85	88	84	78	95
Exhaust Duct	6	L_w	81	91	98	91	86	83	86	85	87	100
Oil Mist Outlet	9	L_w	45	59	68	72	78	79	72	64	56	83
Stack Outlet	6	L_w	83	89	105	106	109	116	110	99	79	118
HRSG Total (Duct + Body)	6	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 85
Steam Turbine	3	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 85
Air Cooled Condenser Fans (12 fans per unit)	3	SPL at 100 metres	19.7	33.8	40.6	41.5	44.8	45.3	38.1	32.6	23.6	50
ST Gland Steam Condenser	3	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 85
Duct Burner Skid	6	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 85

Plant	QTY	SPL/L_w	Sound Pressure/Power Levels dB(A)									
			31.5	63	125	250	500	1K	2K	4K	8K	Total
CT GSU Transformer	3	SPL at 2 metre	-	37.1	66.5	51.4	56.5	59.8	55.6	55.5	52.2	70
BESS Step Up transformer	1	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 85
CT Auxiliary Transformer	6	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 85
Boiler feed pumps & motors	12	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 92
LP Recirculation Pumps	6	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 85
Closed Cycle Cooling Water Pumps	6	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 85
Closed Cycle Cooling Water Fin-Fan Coolers (24 per unit)	3	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 85
Steam Jet Air Ejectors units	3	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 85
Vacuum Pumps	3	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 85
Condensate Pumps	9	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 85
Aux Boiler Components	1	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 85
Aux Boiler Stack Discharge	1	L_w	-	-	-	-	-	-	-	-	-	110
Other pumps, valves, blowers, etc.	--	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 85
Sewage Treatment Package	1[1]	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 85
Instrument Air Package	2[1]	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 85
Nitrogen Generation Package	2[1]	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 85
Nitrogen Compressors	3[1]	SPL at 1 metre	-	-	-	-	-	-	-	-	-	≤ 110

Plant	QTY	SPL/L_W	Sound Pressure/Power Levels dB(A)									
			31.5	63	125	250	500	1K	2K	4K	8K	Total

[1.] *Does not include standby units present.*

A number of the plant items listed above are to be housed within the proposed turbine halls which are to be constructed from ~100 mm vertical profiled modular steel cladding. This cladding is assumed to be similar to the Kingspan KS1000RW cladding panels and will be lined with 18 mm cement board (or similar) if/ where required to reduce noise emissions. This will be determined via prediction once details of the specific plant items to be installed are known.

The facade sound insulation performance used for the assessment is detailed in Table 9-26.

Table 9-26 Sound Insulation Performance of Turbine Hall Facades

Source	R,w (dB)								
	63	125	250	500	1K	2K	4K	8K	Total (dB Rw)
Facade Sound Insulation	22	26	30	33	29	32	47	-	32

Three combustion turbine power generators (CTG) are to be installed within the LNG Terminal (two operational and one back up). The purpose of these CTGs is to provide energy to the LNG Terminal prior to the Power Plant being constructed and/ or as a back-up power for the LNG Terminal if grid connection is lost. These CTGs will not be operated (except for test purposes) when the Power Plant is operating. Noise sources associated with these CTGs are presented Table 9-27.

Table 9-27 LNG Terminal CTG Sound Levels

Source	Sound Power Levels dBA									
	31.5	63	125	250	500	1K	2K	4K	8K	Total (dBA)
Driver Enclosure	-	84	91	90	87	93	90	87	75	98
Combustion Exhaust	-	111	105	101	97	94	89	97	102	113
Combustion Intake		83	83	76	69	67	69	79	77	88
Vent Intake	-	72	74	77	70	66	63	76	78	83
Vent Exhaust	-	79	83	81	77	77	78	90	84	93
Alternator Vent Intake (each)	-	60	73	79	78	82	85	79	72	89
Alternator Vent Exhaust	-	54	67	74	79	86	89	87	82	93
Oil Cooler Inlet[1]	-	58	71	77	76	80	83	77	70	87
Oil Cooler Outlet[1]	-	58	71	77	76	80	83	77	70	87
CT Breather Outlet[1]	-	82	82	78	72	69	72	78	78	87
PT Breather Outlet[1]	-	76	75	74	72	70	76	78	68	84
Oil Mist Coalescer Exhaust[1]	-	61	68	70	80	66	60	61	51	81

Indicative data based on a Centrax CX400 CTG
1. Sound power levels calculated from sound pressure levels given in the associated datasheet assuming hemispherical point source propagation.

Source	Sound Power Levels dBA									
	31.5	63	125	250	500	1K	2K	4K	8K	Total (dBA)

The locations of these plant items are indicated on drawing reference198291-1GSU-G2001-r0 and 198291-1GSU-G2002-r0.

In addition, there are noise sources which would operate intermittently. These intermittent sources are:

- Firewater Pumps: 85 dB $L_{Aeq,T}$ at 1 metre;
- Firewater Jockey Pumps: 85 dB $L_{Aeq,T}$ at 1 metre; and
- Black Start Diesel Generators: 85 dB $L_{Aeq,T}$ at 7 metres.

These sources only operate during emergency conditions and for testing. The Black Start diesel generators will be run every two weeks for 30 minutes and for maintenance outside of emergency conditions. The pumps will be tested once a day for approximately 30 minutes. This will only occur during the daytime. They have not been included in the assessment.

9.7.5.3 Above Ground Installation

It is understood that noise generating plant associated with the Above Ground Installation (AGI) comprises the following:

- Odorant New Blend Pump Unit;
- Package Boiler Units;
- Gas Fired Generator; and
- Pressure Regulating Stream.

9.7.5.4 The Floating Storage Regasification Unit, Liquid Natural Gas Carrier and Tugs

Information regarding sound emissions from the FSRU and LNGC have been provided by Shannon LNG Limited. The sound levels used in the assessment are presented in Table 9-28.

Table 9-28 FSRU and LNGC Sound Levels

Source	Number per Ship	Sound Power Levels dB								
		63	125	250	500	1K	2K	4K	8K	Total (dB)
Engine Room Exhaust Stacks	4	130	130	130	119	122	110	95	-	135
Regas Boiler Exhaust	2	101	96	90	89	87	85	85	-	103
Engine Room Internal Level	-	94	99	102	104	101	100	100	89	109
Engine Room Ventilation Fans	2	89	93	92	87	79	79	79	82	97
Control Valves	14	52	60	68	76	84	89	88	-	92
Bosun Store Fan	1	-	-	-	-	-	-	-	-	109

It is understood that the LNGC and FSRU are similar, with the FSRU simply being a modified LNGC which also houses regassification equipment. Sound sources from both vessels has been modelled to include all noise sources listed in Table 9-28, apart from the Regas boiler exhaust which is only present on the FSRU.

Noise transmission to the environment from the engine room would be attenuated by the ship's hull. At its thinnest, the hull is understood to be constructed from 12 mm steel. The attenuation provided by 12 mm steel has been calculated using Marshall Day Acoustic's partition modelling software package INSUL v9.0 and is presented in Table 9-29.

Table 9-29 Sound Insulation Performance of Ship Hull

Source	Sound Reduction Index, R (dB)								
	63	125	250	500	1K	2K	4K	8K	Total (dB Rw)
12 mm Steel	31	35	39	43	39	44	53	53	43

It is also understood that the engine room exhaust stacks for both the FSRU and LNGC would be fitted with attenuators. The assumed performance is presented in Table 9-30 based on indicative data provided by potential suppliers[2].

Table 9-30 Engine Room Exhaust Stack Attenuator

Source	Insertion Loss (dB)							
	63	125	250	500	1K	2K	4K	8K
Stack Attenuator	28	44	53	66	61	59	54	51

A notable noise source onboard the vessel would be high velocity gas flowing through the control valves. Control valves regulate flow by increasing or decreasing the fluid pressure drop across an element. Pressure drop adjustments are usually accompanied by noise generation.

In is understood from liaison with GOLAR LNG that there would typically be approximately fourteen such control valves on each vessel and that these valves would be distributed along the full length of the ships. Noise emissions from these valves would be at or below the noise limits set out in the International Maritime Organization IMO Code of Noise Levels On Board Ships[3] which states that noise levels should not exceed 85 dB $L_{Aeq,T}$ in open deck work spaces. It has been assumed that each valve would be at least one metre from an open deck workspace and therefore subject to a noise limit of 85 dB $L_{Aeq,T}$ at one metre.

The operation of the Proposed Development requires the use of four tugs used for FSRU and LNGC mooring operations. Noise emissions data for the tugs has been obtained from AECOM archive data and is presented Table 9-31. The data used has been cross referenced with other similar assessments and has been confirmed as a conservative estimate.

Table 9-31 Tug Sound Levels

Source	Number	Sound Power Levels dB								
		63	125	250	500	1K	2K	4K	8K	Total (dB)
Tugs	4	116	111	103	95	87	85	83	-	117

9.7.5.5 Assessment

To determine the potential noise impact of the Proposed Development on the noise sensitive receptor locations identified, all of the noise sources identified above were input into the 3D sound model

[2] This data has been provided by one of the major FSRU providers.
[3] The Code on noise levels on board ships has been developed to provide international standards for protection against noise regulated by regulation II-1/3-12 of the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended. Although the Code is legally treated as a mandatory instrument under the SOLAS Convention, certain provisions of the Code remain recommendatory or informative.

discussed in section 9-16. Details of the sound modelling methodology is given in Appendix A9-2, Vol. 4 with noise maps given in Figures F9-5 through F9-9, Vol. 3.

The locations of the various noise sources were taken from drawing reference 98291-1GSU-G2001-r0, 198291-1GSU-G2002-r0, the Moffat and Nichol drawing ‘Shannon LNG – FSRU Analysis’ and through direct input from the Project Engineers Black and Veatch and from GOLAR LNG.

The following modelling approaches were adopted:

- Ground absorption is assumed to be ‘acoustically soft’ as defined in ISO 9613-2:1996 Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation. Areas of water, the Proposed Development footprint and roads assumed to be acoustically hard/ reflective.
- As a conservative approach, it is assumed that all sound sources identified as not exceeding a given sound pressure/ power level would emit a level equal to the defined limit.
- Where spectral data was not available for certain sources, the sound power/ pressure level has been input in the 500 Hz band.
- It is assumed that sound pressure levels within the turbine hall would not exceed 85 dB $L_{Aeq,T}$ at the internal perimeter (i.e. incident on the inner face of the façade walls). It was confirmed with Black and Veatch that this limit would be adopted at the detailed design stage and, if this limit proves unachievable in certain areas, the façade walls of the turbine halls could be acoustically upgraded (above the levels presented in Table 9-26) such that the external emissions remain the same.
- Where sound pressure level input data has been provided for external sources of small dimension (condensate pumps, vacuum pumps, steam jet air injectors, closed cycle cooling water pumps, oil mist outlet and control valves), the sound power levels have been calculated assuming hemispherical propagation over a reflective plane. The same approach has been applied to the various exhausts and intake/ discharge points associated with the Proposed Development. These sources have been input as point sources within the 3D model.
- Where sound pressure level input data has been provided for larger external sound sources (e.g. Transformers, Nitrogen Compressors), sound power levels have been calculated in accordance with the methodology detailed in BS EN ISO 3746:2010 Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane (ISO 3746:2010). It is assumed that the sound pressure level provided is representative of all measurement positions. These sources have been input as area sources within the 3D model.
- Sound sources within the AGI are to be designed to not exceed 45 dB $L_{Aeq,T}$ at the boundary. Sound sources from this area of the Proposed Development were input as an area source at a height of two metres set one metre in from the boundary of the AGI and calibrated within the model to result in a sound level of 45 dB $L_{Aeq,T}$ at the boundary.

Section 5 of NG4 details the assessment of noise sources with tonal or impulsive elements and the appropriate penalties/ corrections to apply where sources present these characteristics. In this instance, it is assumed that all sources can be designed such that they do not present tonal or impulsive characteristics at the location of nearby receptor positions. Therefore, no corrections have been applied. This has been discussed with Black and Veatch and it was confirmed this was a reasonable assumption.

The 3D sound model was used to calculate operational phase sound pressure levels at the various receptor locations identified. Calculations were carried out in two scenarios: with the CTG operational but without sources associated with the Power Plant (Scenario 1); and with the Power Plant operational but without the sources associated with the CTGs (Scenario 2). The results of the modelling calculations are presented in Table 9-32.

Table 9-32 Operational Sound Levels - Unmitigated

Receptor	Criterion ($L_{Ar,T}$)	Predicted Level – Scenario 1 ($L_{Ar,T}$)	Compliant? (Y/ N)	Predicted Level – Scenario 2 ($L_{Ar,T}$)	Compliant? (Y/ N)
R1	35 dB	42	N	53	N
R2	35 dB	40	N	53	N
R3	35 dB	39	N	54	N
R4	35 dB	37	N	53	N
R5	35 dB	43	N	53	N
R6	35 dB	40	N	50	N
R7	35 dB	34	Y	46	N

It can be seen from the above that, unmitigated, noise emissions from the Proposed Development do not comply with the relevant criteria.

This was discussed with the wider design team and the following mitigation requirements were identified.

Table 9-33 Proposed Noise Mitigation Measures

Plant Item	Reduction Required	Form of Mitigation
Air Intake Filter House	13 dB	Silencers
Stack Outlet	35 dB	Silencers/ attenuators
CT GSU Transformer	10 dB	Re-specification to a quieter model. An acoustic barrier around the units may also be required.
Closed Cycle Cooling Water Pumps	10 dB	Re-specification to a quieter model.
Closed Cycle Cooling Water Fin-Fan Coolers (24 per unit)	8 dB	Re-specification to larger units allowing the fans to run at lower speeds. An acoustic barrier around the units may also be required.
Aux Boiler Stack Discharge	25 dB	Re-specification to a quieter model and inclusion of an attenuator.
Sewage Treatment Package	5 dB	Re-specification to a quieter model.
Nitrogen Compressors	44 dB	Unit to be housed in a masonry construction
CTG Combustion Exhaust	15 dB	Re-specification to a quieter model and inclusion of an attenuator.
Bosun Store Fan	10 dB	Silencers/ attenuators

The above requirements were discussed and confirmed as technically achievable with Black and Veatch and GOLAR LNG.

It is not clear at this stage whether acoustic barriers and/ or enclosures would be required to mitigate noise emissions. To retain flexibility, a seven-metre-high barrier around the Closed Cycle Cooling Water Fin-Fan Coolers, a six-metre-high barrier around the CT GSU Transformer and an enclosure around the nitrogen compressors have been included in the 3D sound model and associated planning drawings. Whether these barriers are required and their specific dimensions should be confirmed at the detailed design stage.

The 3D sound model was used to calculate operational phase sound pressure levels at the various receptor positions including the mitigation measures identified in Table 9-33. The results of these calculations are presented in Table 9-34.

Table 9-34 Operational Sound Levels – Mitigated – Residential Receptors

Receptor	Criterion ($L_{Ar,T}$)	Predicted Level – Scenario 1 ($L_{Ar,T}$)	Compliant? (Y/ N)	Predicted Level – Scenario 2 ($L_{Ar,T}$)	Compliant? (Y/ N)
R1	35 dB	35	Y	37	N
R2	35 dB	30	Y	32	Y
R3	35 dB	28	Y	33	Y
R4	35 dB	27	Y	32	Y
R5	35 dB	33	Y	34	Y
R6	35 dB	30	Y	29	Y
R7	35 dB	23	Y	26	Y

It can be seen from Table 9-34 that, including the mitigation measured detailed in Table 9-33, operational phase noise emissions comply with the most stringent criteria at all residential receptor positions, with the exception of a 2 dB exceedance at receptor R1 during the night time.

However, there are various contextual factors which indicate that this exceedance may not give rise to a significant impact. They are:

- The predicted sound levels are readily compliant with the NG4 daytime and evening criteria at all receptor locations. The predicted levels also comply with the night-time criteria at all other receptors apart from R1.
- A 2 dB exceedance is relatively small. It is often considered difficult to detect a change in sound level of less than 3 dB outside of laboratory conditions. Therefore, the levels predicted at R1 are likely to be subjectively no different from compliant levels.
- A sound level of 37 dB $L_{Ar,T}$ is relatively low, identified in NG4 as comparable to the ambient levels you would expect in an empty bedroom or in a rural setting with no wind.
- The Power Plant is only expected to operate approximately 5820 hours per year initially and is expected to drop to 3354 hours per year by 2050. Therefore, sound emissions will not be constantly present.
- BS 8233:2014 Guidance on sound insulation and noise reduction for buildings defines acceptable internal levels within bedrooms as being 30 dB $L_{Aeq,T}$ during the night-time. It also states that a façade with an open window will provide approximately 15 dB of sound attenuation. Oh this basis, sound levels from the Proposed Development within the bedrooms of R1 will be 22 dB $L_{Ar,T}$ with windows open and even lower with windows shut.
- With windows shut it is highly likely that sound from the proposed development will be inaudible within bedrooms at R1. With windows open sound levels from the Proposed Development will be 8 dB below the BS8233 criterion. It is noted that the BS8233 criterion is applicable to anonymous sources only, however it is used in this context for reference.
- The criteria used are derived from sound level measurements taken in accordance with the weather condition requirements detailed in NG4 (i.e. low wind speeds and no rain). However, weather conditions during the survey periods indicate that these weather conditions are not typical for the area. Significantly higher ambient sound levels were measured during periods of wind and/ or rain. If sound levels during periods of wind and rain were factored into baseline levels, a different category of NG4 criteria would apply and the predicted levels would be readily compliant.
- There is indication that the acoustic character of the area may change due to surrounding area being zoned for marine-related industry as part of the Strategic Integrated Framework Plan for the Shannon Estuary which is supported by Kerry Co. Council as identified in the document ‘Kerry County Development Plan 2015-2021’ (adopted 16th March 2015). If this were to happen, the criteria adopted for the assessment may need further consideration.
- NG4 makes significant reference to the application of Best Available Techniques (BAT). Significant work has been undertaken to reduce noise emissions from the Proposed Development. The

mitigation measures and attenuation levels detailed in Table 9-33 are costly and, in some cases, are at the limit of what is achievable with current technology. The noise mitigation strategy as currently proposed is considered to be an application of BAT.

- Prior to construction start, a commercial tendering process will be held to supply the Power Plant and FSRU. The tendering process will result in a contract for a particular model of power plant and FSRU. Therefore, the precise size, configuration, performance, and layout of the equipment will be finalized following the award of the contract, however this will not affect the design of the buildings or emissions as described in this EIAR. The assessment assumes the largest anticipated size of Power Plant and FSRU. It is therefore possible that sound levels from the Proposed Development, once specified in detail, will be quieter than indicated in this assessment.

Considering these contextual factors, **no significant impact** associated with operational phase noise levels resulting is expected.

9.7.6 Operational Phase – Traffic on Existing Roads

The traffic flows on the surrounding road network with and without construction traffic are presented in Table 9-35.

Table 9-35 Operational Phase Traffic Flows

Link No	Link Name	2025 Without Development		2025 With Development		2040 With Development	
		AAWT,18hr	% HGV	AAWT,18hr	% HGV	AAWT,18hr	% HGV
1	L1010 – Site entrance to Ballylongford	361	0.4%	375	0.4%	399	0.4%
2	L1010 – Site entrance to Tarbert	361	0.4%	490	0.4%	514	0.3%
3	N67 (Ferry Port Road)	1,645	0.4%	1,667	0.4%	1,775	0.4%
4	Bridewell Street	5,387	2.6%	5,495	2.6%	5,851	2.6%
5	N69 (to Limerick)	5,978	2.4%	6,035	2.4%	6,431	2.4%
6	N69 (to Listowell)	4,999	3.6%	5,050	3.6%	5,381	3.6%
7	R551	2,978	2.8%	2,978	2.8%	3,175	2.8%

Calculations have been carried out in accordance with the Basic Noise Level methodology presented in CRTN to determine the change in road traffic noise levels resulting from changes in flows. The results of these calculations alongside the associated magnitude of impact are presented in Table 9-36.

Table 9-36 Change in Road Traffic Noise Level Resulting from Operational Traffic

Link	Short Term Change in Noise Level	Short Term Magnitude of Impact	Long Term Change in Noise Level	Long Term Magnitude of Impact
1	0.2 dB	Negligible	0.4 dB	Negligible
2	1.3 dB	Minor	1.5 dB	Negligible
3	0.1 dB	Negligible	0.5 dB	Negligible
4	0.1 dB	Negligible	0.4 dB	Negligible
5	0.0 dB	No Change	0.3 dB	Negligible
6	0.0 dB	No Change	0.3 dB	Negligible
7	0.0 dB	No Change	0.3 dB	Negligible

It can be seen from the above that all increases in road traffic noise during the operational phase are negligible, except for Link 2 (L1010 – Site entrance to Tarbert) where a minor impact is predicted in the short term. LA111[4] defines a minor impact as not significant.

Traffic noise from Link 2 was calculated to be 53 dB $L_{A10,18hr}$ at a distance of 10m from the carriageway, and is expected to be below the NRA guidelines of 60 dB L_{den} at all receptors.

In light of the above, **no significant impact** associated with change in road traffic noise levels resulting from operational traffic is expected.

9.8 Mitigation and Monitoring Measures

9.8.1 Construction Phase

The assessment of construction noise and vibration detailed above indicates no adverse effects. Nonetheless, to ensure sound and vibration levels are kept to a minimum and to reduce the risk of cumulative impacts, it is recommended that the following measures are adopted during the construction phase:

- Good community relations shall be established and maintained throughout the construction process. This shall include informing residents on progress and ensuring measures are put in place to minimise noise and vibration impacts.
- Fixed and semi-fixed ancillary plant such as generators, compressors and pumps shall be located away from sensitive receptors wherever possible.
- All plant used onsite shall be regularly maintained, paying attention to the integrity of silencers and acoustic enclosures.
- All noise generating construction plant shall be shut down when not in use.
- The loading and unloading of materials shall take place away from residential properties, ideally in locations which are acoustically screened.
- Materials shall be handled with care and placed rather than dropped where possible. Drop heights of materials from lorries and other plant shall be kept to a minimum.
- Modern plant shall be selected which complies with the latest European Commission noise emission requirements. Electrical plant items (as opposed to diesel powered plant items) shall be used wherever practicable. All major compressors shall be low noise models fitted with properly lined and sealed acoustic covers. All ancillary pneumatic percussive tools would be fitted with mufflers or silencers of the type recommended by the manufacturers.
- Site operations and vehicle routes shall be organised to minimise the need for reversing movements, and to take advantage of any natural acoustic screening present in the surrounding topography.
- No employees, subcontractors and persons employed on the site shall cause unnecessary noise from their activities e.g. excessive 'revving' of vehicle engines, music from radios, shouting and general behaviour etc. All staff inductions at the site shall include information on minimising noise and reminding them to be considerate of the nearby residents.
- As far as practicable, noisier activities shall be planned to take place during periods of the day which are generally considered to be less noise sensitive i.e. not particularly early or late in the day.
- Measures shall be put in place to ensure that employees know that minimisation of noise will be important at the site; and
- Blasting vibration limits will be achieved by limiting the Maximum Instantaneous Charge (MIC) based on the results of trial blasts carried out in accordance with the procedure detailed in BS6472. It is noted there may be blasting charge limits imposed as a result of the underwater acoustic assessment. If these limits differ, the more stringent limit of the two will be adopted.

[4] Highways England (2020) Design Manual for Roads and Bridges LA111 Noise and vibration

- A commitment is made to ensure construction traffic from this and other concurrent development (i.e. Pipeline and Grid Connections, see below for details) will be coordinated to minimise traffic and site noise impacts where possible.

In addition to the above measures, a regime of noise and vibration monitoring will be undertaken during the construction phase to determine compliance with the nominated criteria and to provide a feedback mechanism so that corrective action can be taken in the event of exceedances.

Approximately three to four long term noise monitoring stations and one to two long term vibration monitors will be set up on the construction site boundary. The exact location of these stations will be determined in due course and will be chosen to best represent noise and/ or vibration emissions in the direction of nearby receptor positions. Monitoring will continue throughout the entire construction phase.

Long term noise monitoring stations will be equipped with an SMS and/ or email alert system so that site staff can be informed of potential exceedances. The results of the monitoring will be recorded and reported to relevant stakeholders in an appropriate manner and frequency, to be agreed in due course.

Any noise complaints received during the construction phase will be investigated thoroughly. The results of the investigation, including measured noise and vibration levels at the time of the complaint, onsite activities and any corrective action taken, will also be reported to relevant stakeholders.

9.8.2 Operational Phase

A commitment is made to adopt the operational noise limits detailed in this assessment as requirements in final design, including the need to address distinctive acoustic characteristics and/ or adjust the noise limits accordingly. Mitigation measures are anticipated to include the following:

- Silencers;
- Attenuators;
- Specification of low noise plant wherever possible; and
- Inclusion of acoustic barriers where required.

Furthermore, compliance with the nominated criteria will be confirmed via long term noise monitoring.

Long term monitoring will be undertaken for a period of at least 12 months from the commencement of site operations and again following any subsequent substantive change in site operations. After 12 months the need for long term monitoring will be reviewed with the relevant authority. Indicative monitoring locations are shown in Figure F9-1, Vol. 3 but may change as more detailed information becomes available.

In addition to the above, short-term attended noise measurements will be taken at or near to the receptor locations identified in this chapter. Measurements will be taken and reported in accordance with the guidance provided in NG4. Short term measurements will take place at the commencement of site operations and again following any subsequent substantive change in site operations. They will then be repeated no less than once a year. As a minimum, measurements will comprise a 30-minute measurement at each location during the daytime, evening and night time (as defined in NG4).

If exceedances of the predicted levels are identified by either the long term or short-term monitoring, the causes will be thoroughly investigated, and corrective action will be taken.

The Proposed Development would be licensed by the Environmental Protection Agency (EPA) under an Industrial Emissions (IE) licence, the terms and conditions of which are anticipated to be requiring a noise monitoring protocol to be adopted.

9.9 Cumulative Impacts

The developments considered with regard to cumulative impacts are listed in Table 9-37. Committed developments further away than 5 km from the site have not been considered with regard to noise and vibration.

Table 9-37 Developments Considered for Cumulative Impacts

Planning Reference	Location	Received Date	Decision Date	Decision	Description
13138	Kilpaddoge, Tarbert, Co. Kerry	13.03.2013	17.09.2013	Granted	Construct an electricity peaker power generating plant.
PL08.GA0003	Townlands of Ralappane, Carhoonakineely,	14.8.2008	17.2.2009	Granted	Permission approved for a gas pipeline to connect Shannon LNG Terminal to the existing natural gas network at Leahy's Co. Limerick.
13477	Tarbert Island, Tarbert, Co. Kerry	31.07.2013	23.09.2013	Granted	Alter existing 220 kV station consisting of new single storey control building, new diesel generator building, 3 no. single storey modular buildings, 6 no. gantry support structures, 8 no. control and protection kiosks, 6 no. surge arrestors, 6 no. cable sealing ends, existing compound chain link fence and gates to be replaced with new palisade fence and gates, new holding tank.
14816	Gurteenavallig, Tarbert, Co. Kerry	28.11.2014	28.04.2015	Granted	The extension of a portion of the permitted access road, the provision of a new substation compound with a single storey substation building and associated underground services.
155	Kilpaddoge, Tarbert, Co. Kerry	08.01.2015	03.03.2015	Granted	Alterations to the existing station consisting of 1 no. 110/ 20 kV transformer, 3 no. 110 kV surge arrestor, 3 no. 110 kV cable sealing ends, 1 no. neutral earth resistor, 1 no. lightning mast, new retaining wall with handrail, new single story mv switchgear building and associated drainage and site works.
17466	Meelcon and Gurteenavallig, Ballylongford, Co. Kerry	22.05.2017	14.07.2017	Granted	The modification of the permitted northern access, junction to Leanamore wind farm.
18392	Tarbert Island, Tarbert, Co. Kerry	27.04.2018	15.01.2019	Granted	For a 10 year permission to construct a battery storage facility within a total site area of up to 2.278ha.
18878	Kilpaddoge, Tarbert, Co. Kerry	10.09.2018	23.09.2019	Granted	For a 10 year permission to construct a battery energy storage system (bess) facility on a total site area of up to 0.6ha that will provide gird balancing services to the Irish electrical grid. Third Party Appeal to Appeal to ABP (305739-19). ABP granted permission.
19115	Kilpaddoge, Tarbert, Co. Kerry	12.02.2019	07.02.2020	Granted	For a 10 year permission for a grid stabilisation facility comprising of: the construction up to 4 no. rotating stabilisers, 5 no. battery storage containers, 1 no. control room, 2 transformers and ancillary equipment within a site area of approximately 1.46 hectares.
304807-19	Townlands of Aghanagran Middle, Aghanagran Lower, Ballyline West, Tullahennell South,	02.07.2019	06.01.2020	Granted	Construction of a Windfarm consisting of up to 6 Wind Turbines. Previously refused by Kerry Co. Council (19381)

Planning Reference	Location	Received Date	Decision Date	Decision	Description
	Ballylongford, Co. Kerry				
20850	Kilpaddoge, Tarbert, Co. Kerry	18.09.2020	12.11.2020	Granted	For changes to the previously permitted peaker power plant development (planning ref. 13/138). It is proposed to change the energy source for the charging of the battery energy storage system (bess) containers from diesel to charging off the national grid and to change the permitted layout for electrical equipment.
11457	Carrowdotia South, Co. Clare	24.06.2011	03.08.2011	Granted	Permission for the development of electrical transmission infrastructure and associated works at the existing Moneypoint Power Station complex.
PL 03.241624 (1274)	Carrowdotia North and, Carrowdotia South, Killimer, Co Clare	19.02.2013	12.12.2013	Granted	10-year planning permission for a Wind Farm Project (5 wind turbines) at Moneypoint Generating Station refused by Clare Co. Council but granted by An Bord Pleanála following a first party appeal.
14190	Moneypoint Power Station, Carrowdotia South, Co. Clare	10.04.2014	28.05.2014	Granted	A new indoor Gas Insulated Switchgear (GIS) 400 kV substation building (3463 m^2), 17m high, two new 400/ 220 kV transformers with associated Switchgear, three new 30 m high lightning masts, and associated drainage and site works. The application relates to previous grant of planning permission reg. ref. P11-457.
PL 03.243842 (14373)	Carrowdotia North, and South, Killimer, Co. Clare	15.09.2014	29.01.2015	Granted	20-year planning permission for works to the existing 32 ha ash repository site located within the Moneypoint generating station complex granted by Clare Co. Council and granted by An Bord Pleanála following a first party appeal relating to a condition regarding a development contribution.
1581	Carrowdotia North & South, Killimer, Co. Clare	18.02.2015	10.04.2015	Granted	10-year permission primarily for an electrical transformer station. The proposed development is an amendment to the previously approved electrical transformer station at Moneypoint Wind Farm (CCC Ref: 12-74 APB Ref: PL03.241624)
161011	Moneypoint, Co.Clare	22.12.2016	24.08.2017	Granted	Refurbishment of the Moneypoint – Oldstreet 400 kV overhead line.
19746	Moneypoint Generating Station, Carrowdotia North, Kilimer , Co Clare	26.09.2019	20.11.2019	Granted	10-year planning permission for a synchronous condenser and supporting items of plant, with the largest building being approximately 962 sq.m. and standing approximately 15m high.

None of the above developments are considered likely to give rise to cumulative impacts with regard to noise and/ or vibration due to the distance between them and the Proposed Development site, with the exception of planning reference PL08.GA0003 which relates to the natural gas pipeline from the Proposed Development and the existing Bord Gáis Éireann national gas transmission network near Foynes, Co. Limerick.

No cumulative impacts are expected to arise from the Proposed Development, either during the construction or operational phases for the following reasons:

- Noise emissions from construction works for the pipeline were assessed in The Shannon Pipeline Environmental Impact Statement. No adverse impact from construction noise was predicted for receptors within the study area for the Proposed Development and construction sound levels were predicted to exceed 50 dB $L_{Aeq,T}$ for no longer than eight days. Due to the short time period and relatively low predicted levels, no construction phase cumulative impact is considered likely.
- No quantitative assessment has been carried out with regards the proposed pipeline, However, no significant operational phase sound sources are proposed as part of the pipeline application in the vicinity of the proposed development, except for the AGI which is covered and assessed quantitatively in the above assessment.

The pipeline development is not expected to generate significant traffic during its operational phase, however there is the potential that, if construction phases overlap, there will be a cumulative impact arising from construction phase traffic.

It is expected that there will be a forthcoming application for a 220 kV grid connection and medium voltage (10/ 20 kV) connection in relation to the Proposed Development. No cumulative noise or vibration impacts are expected to arise from this development in combination with the Proposed Development for the following reasons:

- Construction works for the grid connections will progress relatively quickly along a linear corridor, any noise emitted will be localised and temporary and would not be expected to be of sufficient magnitude to create any disturbance or displacement impacts outside of areas contiguous or adjacent to the corridor. Site activity will be limited, involving between 5 and 15 site workers and less than 4 peak construction movements.
- Mitigation measures, such as timing of works and the implementation of a Construction Environmental Management Plan (CEMP) and Construction Traffic Management Plan (CTMP) will ensure that construction activities, so far as is practical, do not occur concurrently with the peak construction periods for the Proposed development. An Outline Construction Environmental Management Plan (OCEMP) and Outline Traffic Management Plan (OCTMP) have been prepared for this application.

The development is not expected to generate significant traffic during its operational phase, however there is the potential that, if construction phases overlap, there will be a cumulative impact arising from construction phase traffic. A commitment is made to ensure construction traffic from all developments (i.e. the Proposed Development, Pipeline and grid connections) will be coordinated to minimise noise impacts.

9.10 Do Nothing Scenario

If the Proposed Development were to not go ahead, the temporary and long-term noise and/ or vibration sources would not be introduced into the area.

However, the Tarbert-Ballylongford land bank is zoned for marine-related industry as part of the Strategic Integrated Framework Plan for the Shannon Estuary with support from Kerry Co. Council as identified in the document 'Kerry County Development Plan 2015-2021' (adopted 16th March 2015).

It is therefore possible that, in the absence of the Proposed Development, a different industrial development could be forthcoming which could contain its own array of noise and/ or vibration sources.

Nonetheless, any other development proposed in this location would be subject to the same noise and vibration criteria and therefore, its emissions and impact on existing receptors would need to be addressed in a similar manner to those described above.

Alternatively, no development could be forthcoming and as a result the existing acoustic environment (as quantified during the baseline survey and described above) would be expected to continue with little change.

9.11 Residual Impacts and Effects

Post mitigation, the only residual impacts are those arising from changes in traffic flows on existing roads during the construction phase.

The impact is short term and the spatial extent is small, being restricted to one road link. Furthermore, although the change in noise from this road is sufficient to constitute an impact, absolute levels are not high and as such the impact may be less than indicated by the assessment methodology.

9.12 Decommissioning

As outlined in Chapter 02 – Project Description, in the event of decommissioning, measures would be undertaken by the Applicant to ensure that there would be no significant, negative environmental effects during the decommissioning phase. Examples of the measures that would be implemented are outlined in Section 2.9, Chapter 02 – Project Description. As a result, additional potential impacts and associated effects arising during the decommissioning phase are not anticipated above and beyond those already assessed during the construction phase.

9.13 Summary

The Proposed Development has been assessed with regard to the following areas:

- Short term impacts during the construction phase, including:
  - Noise and vibration generated by onsite construction activities;
  - Noise, vibration and air overpressure generated by blasting activities; and
  - Noise generated by changes to traffic flows on existing roads.
- Long term impacts during the operational phase, including:
  - Noise generated by the Proposed Development once complete;
  - Noise generated by changes to traffic flows on existing roads.

Subject to the adoption of the mitigation measures detailed in this chapter, **no adverse impacts** are predicted in any of these areas, with the exception of **one likely short-term significant impact** with regard to increased traffic flows during the construction phase on the L1010 between the site entrance and Tarbert.

A regime of noise and vibration monitoring will be undertaken during the construction phase to determine compliance with the nominated criteria and provide a feedback mechanism so that corrective action can be taken in the event of exceedances.

Approximately three to four long term noise monitoring stations and one to two long term vibration monitors will be set up on the construction site boundary. The exact location of these stations will be determined in due course and will be chosen to best represent noise and/ or vibration emissions in the direction of nearby receptor positions. Monitoring will continue throughout the entire construction phase.

Long term noise monitoring stations will be equipped with an SMS and/ or email alert system so that site staff can be informed of potential exceedances. The results of the monitoring will be recorded and reported to relevant stakeholders in an appropriate manner and frequency, to be agreed in due course.

Any noise complaints received during the construction phase will be investigated thoroughly. The results of the investigation, including measured noise and vibration levels at the time of the complaint, onsite activities and any corrective action taken, will also be reported to relevant stakeholders.

Long term monitoring will be undertaken for a period of at least 12 months from the commencement of site operations and again following any subsequent substantive change in site operations. After 12 months the need for long term monitoring will be reviewed with the relevant authority. Indicative monitoring locations are shown in Figure F9-1, Vol. 3 but may change as more detailed information becomes available.

In addition to the above, short-term attended noise measurements will be taken at or near to the receptor locations identified in this chapter. Measurements will be taken and reported in accordance with the guidance provided in NG4. Short term measurements will take place at the commencement of site operations and again following any subsequent substantive change in site operations. They will then be repeated no less than once a year. As a minimum, measurements will comprise a 30-minute measurement at each location during the daytime, evening and night-time (as defined in NG4).

If exceedances of the predicted levels are identified by either the long term or short-term monitoring, the causes will be thoroughly investigated, and corrective action will be taken.

Table 9-38 Summary

Proposed Development Stage	Aspect/Impact Assessed	Existing Environment/Receptor Sensitivity	Effect/Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance
Construction	Construction Noise	Sensitive	Negative	Significant	Scheduling of works such that noisy activities do not occur between 1300- and 1400 on Saturdays, and to comply with noise limits and criteria set out in Chapter 09 during weekdays. Fixed and semi-fixed ancillary plant will be located away from sensitive receptors wherever possible. All plant shall be regularly maintained and shut down when not in use. Approximately three to four long term noise monitoring stations and one to two long term vibration monitors will be set up on the construction site boundary.	Not Significant
	Construction Vibration	Sensitive	Neutral	Imperceptible	None required. See below for mitigation measures associated with blasting.	Imperceptible
	Construction Traffic Noise on Existing Roads	Sensitive	Negative	Significant	Construction traffic from this and other concurrent development will be coordinated to minimise traffic and site noise impacts where possible.	Significant
	Blasting Induced Noise/Air Overpressure	Sensitive	Negative	Significant	Process management and community liaison including a dedicated Public Liaison Officer. A protocol for community relations with regards to blasting will be adopted such that prior warning of blasting operations is given to members of the public. All noise complaints will be logged and followed up in a prompt fashion by the Liaison Officer. Only single blasts will take place in each event and monitoring will be in place as described in Chapter 09.	Not Significant
	Blasting Induced Vibration	Sensitive	Negative	Significant	Limiting of Maximum Instantaneous Charge (MIC). It is noted there may be blasting charge limits imposed as a result of the underwater acoustic assessment. If these limits differ, the more stringent limit of the two will be adopted.	Not Significant
Operational	Operational Noise	Sensitive	Negative	Significant	Various forms of mitigation (inc. silencers, plant selection, relocation,	Not Significant

					barriers enclosures) as detailed in the relevant chapter. Long term monitoring will be undertaken for a period of at least 12 months from the commencement of site operations and again following any subsequent substantive change in site operations. After 12 months the need for long term monitoring will be reviewed with the relevant authority. Indicative monitoring locations are provided in Figure F91-, Volume 3. In addition to the above, short-term attended noise measurements will be taken at or near to the receptor locations identified in Chapter 09 at the commencement of site operations and again following any subsequent substantive change in site operations. The Proposed Development will comply with the conditions of the Industrial Emissions licence, which will be required to operate the site.	
	Operational Traffic Noise on Existing Roads	Sensitive	Negative	Not Significant	Best practice measures will be adhered to during operation, including avoiding vehicle idling and adhering to speed limits on internal roads.	Not Significant

9.14 References

ARUP Consulting Engineers (2008) Shannon LNG Shannon Pipeline Environmental Impact Statement

BSI Group, (2003) BS 7445-1:2003 Description and measurement of environmental noise. Guide to quantities and procedures.

BSI Group, (2008) BS6472-2:2008 Guide to evaluation of human exposure to vibration in buildings, Part 2: Blast Induced Vibration

BSI Group (2014) BS 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites')

BSI Group (2014) BS 8233:2014 Guidance on sound insulation and noise reduction for buildings

Department of Transport Welsh Office (1988) Calculation of Road Traffic Noise

Environmental Protection Agency (2016) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities

Environmental Protection Agency (2017) Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports

European Parliament, Council of the European Union (2014) EU Directive 2014/52/EU

Halcrow (2007) 'Shannon LNG Offshore Geotechnical Investigation'

Highways England (2020) Design Manual for Roads and Bridges LA111 Noise and vibration

International Maritime Organization (2012) Cod of Noise Levels On Board Ships

International Standards Organisation (1996) ISO 9613-2:1996 Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation

International Standards Organisation (2010) BS EN ISO 3746:2010 Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane

Kerry County Council (2015) 'Kerry County Development Plan 2015-2021'

Moffat and Nichol drawing (2020) 'Shannon LNG – FSRU Analysis'

National Roads Authority (2004) Guidelines for the Treatment of Noise and Vibration in National Road Schemes

Noise Advisory Council, (1978); A Guide to Measurement and Prediction of the Equivalent Continuous Sound Level Leq,

Sunbo Industries (2012) SB-S2056ESM351300.

TRL Abbott P., Nelson P. (2002) 'Converting the UK traffic noise index LA10,18hr to EU noise indices for noise mapping'.

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CHAPTER 10
Landscape and Visual

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park
Environmental Impact Assessment Report

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Tables

10. Introduction

This chapter identifies and assesses the likely significant effects of the Proposed Development (as presented in Chapter 02 – Project Description) on the landscape and visual resource of the study area. It identifies mitigation and compensation measures that will be implemented to prevent, reduce, or offset potential adverse landscape and visual effects or enhance potential beneficial effects, where possible.

The Landscape and Visual Impact Assessment (herein referred to as LVIA) considers how:

- Landscape effects associated with the Proposed Development relate to changes to the fabric, character, and quality of the landscape resource and how it is experienced; and
- Visual effects relate closely to landscape effects, but concern changes in existing views.

Landscape and visual effects are interrelated with other environmental effects but are assessed separately. Whilst elements of the built heritage such as Listed Buildings and Conservation Areas are important elements of the landscape and contribute to its character and influence its quality and value, effects on the significance of these designated features and their setting do not form part of this assessment. Those are the subject of assessment in Chapter 12 – Cultural Heritage.

The LVIA is supported by the following technical documents, which are enclosed in the following documents:

- Figure F10-1, Vol. 3 – Landscape Designations;
- Figure F10-2, Vol. 3 – Seascape Character Areas; and
- Appendix A10-1, Vol. 4 – Booklet of 15 Photomontages.

10.1 Competent Expert

Joerg Schulze has over 16 years' professional experience working for clients in the private and public sectors. He has a comprehensive track record in developing and managing landscape and visual impact assessments of large industrial, commercial, residential, infrastructural, renewable energy, tourism and civic developments throughout the island of Ireland. He has extensive experience in all stages of the planning, design, tender and implementation process, contract management and as consultant for Part 8 applications for road schemes and EIA processes. He has prepared residential visual impact assessments, manages the production of photomontages and the preparation of zones of theoretical visibility and theoretical visual intensity mapping.

10.2 Relevant Legislation, Planning Policies and Guidance

10.2.1 International

The Council of Europe Landscape Convention (Treaty No. 176) (as amended) provides guidelines for managing landscapes/ landscapes. The Convention is not an EU Directive. Countries that sign and ratify the Convention make a commitment to upholding the principles it contains within the context of their own domestic legal and policy frameworks. The convention was ratified by Ireland in March 2002 and came into effects in Ireland in 2004. The European Landscape Convention requires '*landscape to be integrated into regional and town planning policies and in cultural, environmental, agricultural, social and economic policies, as well as any other policies with possible direct or indirect impacts on Landscape*'.

10.2.2 National

10.2.2.1 National Landscape Strategy

The National Landscape Strategy (NLS) for Ireland 2015-2025 was launched in May 2015 and is to be implemented by the Government in the future. The NLS promotes the sustainable protection, management and planning for the landscape/ landscape. The NLS states that the '*National Landscape Strategy will be used to ensure compliance with the European Landscape Convention and to establish principles for protecting and enhancing the landscape* (landscape) *while positively managing its change.*

It will provide a high-level policy framework to achieve balance between the protection, management and planning of the landscape by way of supporting actions.' It also states that '*The Strategy sets out Ireland's high-level objectives and actions with regard to landscape* (landscape)*. It also positions landscape in the context of existing Irish and European strategies, policies and objectives, and outlines methods of ensuring co-operation at a sectoral and at a European level by the State.*'

10.2.2.2 Regional Seascape Character Assessment for Ireland

The Regional Seascape Character Assessment for Ireland 2020, Draft Consultation Report has been prepared for the Marine Institute.

10.2.2.3 National Marine Planning Framework (NMPF)

The NMPF is a national plan how to use Ireland's seas over a 20-year horizon. The NMPF sits at the top of the hierarchy of plans and sectoral policies for the marine area. The plan has been informed by existing sectoral plans and will, in turn, be used to inform future cycles of those plans in an ongoing feedback loop. It provides a coherent framework in which those sectoral policies and objectives can be realised. It will become the key decision-making tool for regulatory authorities and policy makers into the future in a number of ways, including decisions on individual authorisation applications, which will have to secure the objectives of the plan, similar to the way that terrestrial plans form part of the decision-making tool-kit in the on-land planning process.

10.2.2.4 Strategic Integrated Framework Plan for the Shannon Estuary

This plan has been developed by an interjurisdictional steering group to produce a land and marine based framework to guide the future development and management of the Shannon Estuary.

In terms of Marine Related Industry, the Tarbert-Ballylongford Land Bank, Co. Kerry has been considered as an areas of interest for a wide range of small scale commercial to major commercial developments. This area is already designated as a strategic zone for development. The framework plan provides a range of guidance including guiding principles, objectives and mitigation measures for development in this zone.

In terms of landscape and visual impact mitigation measures it states the following:

'***L MM 5****: To mitigate the minimal impact, any construction should be designed to minimise visual impacts during the detailed design phase, perhaps including landscape screening elements*'.

10.2.3 Regional

10.2.3.1 Kerry County Development Plan 2015- 2021 (KCDP) / Draft Kerry County Development Plan 2022-2028

This is the main strategic planning policy document which guides the future renewal and development of Co. Kerry to 2021 and beyond. The Proposed Development is located within the jurisdiction of the KCDP.

The Proposed Development is located within the Tarbert / Ballylongford Landbank area, which is zoned for 'Industry'. Relevant landscape designations are illustrated in Figure 11.1, which is included in the Appendix.

The review of the current County Development Plan has commenced and is at Stage 1: Pre-Draft at the time of writing this LVIA (July 2021). The release and consultation period for the Draft County Development Plan is planned at Stage 2: Draft Development Plan, and anticipated for later in 2021.

10.2.3.2 Clare County Development Plan 2017- 2023 (CCDP)

This is the main strategic planning policy document which guides the future renewal and development of Co. to 2023 and beyond. The Proposed Development is not located in Co. Clare, however, given its prominent location along the River Shannon Estuary, the Proposed Development will result in landscape and visual effects when seen from the viewpoints located in Co. Clare. Relevant landscape designations are illustrated in Figure F10-1, which is included in Volume 3.

10.2.3.3 Limerick County Development Plan 2010-2016/ Draft Limerick Development Plan 2022-2028

In accordance with a decision made in 2014, the Limerick County & City Development Plans will not be reviewed and therefore continue to have effect until a new Development Plan for Limerick City and

County is prepared in accordance with the requirements of section 10B of the Planning and Development Acts 2000, as amended.

At the time of writing this assessment (July 2021), the Limerick County Development Plan 2010-2016 is still valid. A Draft Limerick County Development Plan 2022-2028 has been prepared but the review and approval process has not been completed yet. Changes between the current and the draft county development plan will be stated in the assessment herein where required.

10.3 Methodology

10.3.1 Guidance and Other Information used in the Landscape and Visual Impact Assessment

The following sources and guidelines were used in the assessment:

- European Commission Guidance on the preparation of the Environmental Impact Assessment Report, 2017;
- EPA "Guidelines on the information to be contained in Environmental Impact Assessment Reports", Draft, August 2017;
- EPA "Guidelines on the information to be contained in Environmental Impact Statements", 2002
- EPA "Advice Notes on Current Practice (in the preparation of EIS)", 2003
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment, Government of Ireland, 2018
- 'Guidelines for Landscape and Visual Impact Assessment' (GLVIA), 3rd Edition, 2013, Landscape Institute (UK) & IEMA;
- 'Visual Representation of Development Proposals', Landscape Institute, Technical Guidance Note 06/ 19, 17 September 2019;
- National Parks and Wildlife Service (NPWS), http://www.npws.ie/;
- Walking Routes, https://www.sportireland.ie/outdoors/find-your-trails;
- Ordnance Survey Ireland, 1:50,000 Discovery Mapping;
- Kerry County Development Plan 2015 – 2021;
- Landscape Character Assessment prepared for the Renewable Energy Strategy 2012, Kerry County Council (KCC) Planning Policy Unit, November 2012;
- Clare County Development Plan 2017-2023;
- Landscape Character Assessment of County Clare, ERM, March 2004;
- Limerick County Development Plan 2010-2016;
- National Marine Planning Framework, Department of Housing, Local Government and Local Heritage, June 2021; and
- Regional Seascape Character Assessment for Ireland 2020.

10.3.2 Landscape and Visual Impact Assessment Criteria

This assessment has been prepared based on the Environmental Protection Agency (EPA) Draft guidance document 'Guidelines on the Information to be contained in Environmental Impact Assessment Reports, 2017, EPA guidance documents. Best practice guidance, such as the 'Guidelines for Landscape and Visual Impact Assessment, 3rd Edition (GLVIA3), 2013, Landscape Institute (UK) & IEMA' provide specific guidelines for landscape and visual impact assessments. Therefore, a combination of the draft EPA guidelines, the Landscape Institute guidelines and professional experience has informed the methodology for the assessment herein. The Landscape Institute guidelines require the assessment to identify, predict and evaluate the significance of potential effects to landscape characteristics and established views. The assessment is based on an evaluation of the sensitivity to change and the magnitude of change for each landscape or visual receptor. For clarity, and in accordance with best practice, the assessment of potential effects on landscape character and visual amenity, although closely related, are undertaken separately.

The assessment acknowledges that landscape and visual effects change over time as the existing landscape external to the Proposed Development evolves and proposed planting establishes and matures.

The significance of an effect or impact is determined by two distinct considerations:

1. The **Nature** of the receptor likely to be affected, namely:
    - The value of the receptor.
    - The susceptibility of the receptor to the type of change arising from the Proposed Developments; and
    - The sensitivity to change is related to the value attached to the receptor.

2. The **Magnitude** of the effect likely to occur, namely:
    - The size and scale of the landscape and visual effect (for example, whether there is a complete or minor loss of a particular landscape element);
    - The geographical extent of the areas that will be affected;
    - The duration of the effect and its reversibility; and
    - The quality of the effect – whether it is neutral, positive or negative.

The table below provides the definition of the duration of both landscape and visual effects.

Table 10-1 Definition of Duration of Effects

Duration	Description
Temporary	Effects lasting one year or less
Short Term	Effects lasting one to seven years
Medium Term	Effects lasting seven to fifteen years
Long Term	Effects lasting fifteen to sixty years
Permanent	Effects lasting over sixty years

The quality of both landscape and visual effects is defined in the table below:

Table 10-2 Definition of Quality of Effects

Quality of Effects	Description
Neutral	This will neither enhance nor detract from the landscape character or view
Positive (Beneficial)	This will improve or enhance the landscape character or view
Negative (Adverse)	This will reduce the quality of the existing landscape character or view

10.3.3 Assessment Process

The assessment is undertaken based on the following key tasks and structure:

- Establishment of the Baseline or receiving environment;
- Appreciation of the Proposed Development; and
- Assessment of effects.

10.3.4 Establishment of the Receiving Environment

A baseline study has been undertaken through a combination of desk-based research and site appraisal in order to establish the existing conditions of the landscape and visual resources of the study area. Desk based research has involved a review of mapping and aerial photography, relevant planning and policy documents, the relevant Landscape Character Assessments and other relevant documents and publications.

10.3.5 Appreciation of the Proposed Development

In order to be able to accurately assess the full extent of likely effects on landscape character and visual amenity it is essential to develop a thorough and detailed knowledge of the Proposed Development. This includes a comprehensive understanding of its location, nature and scale and is achieved through a review of detailed descriptions of the Proposed Development and drawings (see Planning Application Drawings accompanying the application) and an onsite appraisal.

The landscape and visual impact assessment has considered all elements of the Proposed Development.

10.3.6 Assessment of Effects

The landscape and visual impact assessment seeks to identify, predict and evaluate the significance of potential effects to landscape characteristics and established views. The assessments are based on an evaluation of the sensitivity to change and the magnitude of change for each landscape or visual receptor.

The assessment acknowledges that landscape and visual effects change over time as the existing landscape internal and external to the Proposed Development evolves. The assessment therefore reports on potential effects during both construction/ operation and completion of the Proposed Development. The prominence of the Proposed Development in the landscape or view will vary according to the existing screening effects of local topography, intervening existing vegetation and building structures.

GLVIA3 requires that a clear distinction is drawn between landscape (which includes the urban landscape) and visual effects:

- Landscape effects relate to the degree of change to characteristics or physical components of an urban area, which together form the character of that landscape, e.g. topography, streets, buildings and open space.
- Visual effects relate to the degree of change to an individual receptor's or a receptor group's view of that landscape, e.g. local residents, users of public open space, footpaths or motorists passing through the area.

As mentioned in the scope above, construction and operational stages of the Proposed Development are assessed separately. Distinctions may be drawn between temporary and permanent effects, with permanent effects typically being of greater importance. Residual effects are those likely to arise from the Proposed Development taking into account all embedded measures.

The assessment forms part of an iterative process where, as potentially significant effects are identified, these inform the design of the Proposed Development. Mitigation of the development has been considered throughout the process, including site selection, consultation and design development. This process and the considerations, which informed it, are described within the Design Statement included in the planning submission package.

When considering the potential effect of changes that a future development may have on the landscape and visual resource it is necessary to identify those key elements of the landscape which make it distinctive. These can be seen as layers which overlay each other and vary in dominance from place to place. These layers mainly comprise of the buildings, structures and spaces which influence the pattern of uses, activity and movement in a place and the experience of those who visit, work and live there.

Cumulative effects arise from changes brought about by one development in conjunction with another of similar character. Cumulative effects are considered where the presence of developments of a similar type or scale, that have planning consent but are not constructed, or that are the subject of undetermined applications may have a combined effect on the perception of landscape character and visual amenity.

10.3.7 Scope

10.3.7.1 Study Area

A study area radius of 7 km has been determined from the boundary of the Proposed Development for the assessment of landscape and visual effects. The extent of the study area is based on initial findings of the desktop study later verified onsite during fieldwork survey.

It is acknowledged that the Proposed Development may be visible from locations beyond the study area, and as such it is important to note that the study area defines the area within which potential effects could be significant, rather than defining the extent of visibility.

10.3.7.2 Effects Scoped Out

For the purposes of this assessment, the Proposed Development is assumed to become a permanent feature in the landscape following the completion and the implementation of landscape mitigation measures. The assessment takes account of this in the determination of residual landscape and visual effects.

10.3.8 Landscape Effects (and Seascape Effects)

Landscape effects describe the impact on the fabric or structure of a landscape or landscape character. In this case, the landscape character also includes seascape character considering the location along the Shannon Estuary. Definitions for landscape effects can therefore be equally be used as a guidance for seascape effects herein. The assessment of landscape effects firstly requires the identification of the components of the landscape. The landscape components are also described as landscape receptors and comprise the following:

- Individual landscape elements or features;
- Specific aesthetic or perceptual aspects; and
- Landscape character, or the distinct, recognisable and consistent pattern of elements (natural and man-made) in the landscape that makes one landscape different from another.

The assessment will identify the interaction between these components and the Proposed Development during construction and operational phases. The condition of the landscape and any evidence of current pressures causing change in the landscape will also be documented and described.

10.3.8.1 Landscape Value

Landscape value is frequently addressed by reference to international, national, regional and local designations, determined by statutory and planning agencies. However, absence of such a designation does not necessarily imply a lack of quality or value. Factors such as accessibility and local scarcity can render areas of nationally unremarkable quality, highly valuable as a local resource. The quality and condition is also considered in the determination of the value of a landscape. The evaluation of landscape value is undertaken with reference to the definitions stated in the table below:

Table 10-3 Landscape Value

Landscape Value	Classification Criteria
High	Nationally designated or iconic, unspoilt landscape with few, if any, degrading elements.
Medium	Regionally or locally designated landscape, or an undesignated landscape with locally important landmark features and some detracting elements.
Low	Undesignated landscape with few if any distinct features or with several degrading elements.

10.3.8.2 Landscape Susceptibility

Landscape susceptibility relates to the ability of a particular landscape to accommodate the Proposed Development. Landscape susceptibility is appraised through consideration of the baseline characteristics of the landscape, and in particular the scale or complexity of a given landscape.

The evaluation of landscape susceptibility is undertaken with reference to a three-point scale, as outlined in the table below.

Table 10-4 Landscape Susceptibility Criteria

Landscape Susceptibility	Classification Criteria
High	Small scale, intimate or complex landscape considered to be intolerant of even minor change.
Medium	Medium scale, more open or less complex landscape considered tolerant to some degree of change.
Low	Large scale, simple landscape considered tolerant of a large degree of change.

10.3.8.3 Landscape Sensitivity

Landscape sensitivity to change is determined by employing professional judgment to combine and analyse the identified landscape value, quality and susceptibility and is defined with reference to the scale outlined in the table below:

Table 10-5 Landscape Sensitivity to Change Criteria

Landscape Sensitivity	Classification Criteria
High	Landscape characteristics or features with little or no capacity to absorb change without fundamentally altering their present character. Landscape designated for its international or national landscape value or with highly valued features. Outstanding example in the area of well cared for landscape or set of features that combine to give a particularly distinctive sense of place. Few detracting or incongruous elements.
Medium-high	Landscape characteristics or features with a low capacity to absorb change without fundamentally altering their present character. Landscape designated for regional or county-wide landscape value where the characteristics or qualities that provided the basis for their designation are apparent or a landscape with highly valued features locally. Good example in the area of a well-cared for landscape or set of features that combine to give a clearly defined sense of place.
Medium	Landscape characteristics or features with moderate capacity to absorb change without fundamentally altering their present character. Landscape designated for its local landscape value or a regional designated landscape where the characteristics and qualities that led to the designation of the area are less apparent or are partially eroded or an undesignated landscape which may be valued locally – for example an important open space. An example of a landscape or a set of features which is relatively coherent, with a good but not exceptional sense of place - occasional buildings and spaces may lack quality and cohesion.
Medium-low	Landscape characteristics or features which are reasonably tolerant of change without determent to their present character. No designation present or of little local value. An example of an un-stimulating landscape or set of features; with some areas lacking a sense of place and identity.
Low	Landscape characteristics or features which are tolerant of change without determent to their present character. An area with a weak sense of place and/ or poorly defined character/ identity. No designation present or of low local value or in poor condition. An example of monotonous unattractive visually conflicting or degraded landscape or set of features.

10.3.8.4 Landscape Receptors

The landscape resources within the study area that could be affected by the development include:

- Physical resources such as buildings, open space, trees, watercourses etc.;
- Designated, valued or recognised components that contribute to landscape character; and
- Cultural heritage interests that contribute to landscape character.

Landscape receptors are defined as those landscape resources within the study area from which the development may be visible or where potential visibility of the development in one part of the landscape resource affects the experience of another part. Field assessment studies were used to check the potential visibility of the development from the landscape resources within the study area. Within this section specific consideration is also given to changes to landscape elements such as the built fabric, open space or trees.

10.3.8.5 Sensitivity of Landscape Receptors

The sensitivity of a landscape receptor is an expression of its ability to accommodate the Proposed Development as part of its own character. The sensitivity of a landscape varies according to the nature of the existing resource and the nature of the proposed changes as a result of the Proposed Development. The sensitivity of the landscape is based on interpretation of a combination of judgements relating to their susceptibility to the type of change or development proposed and the value attached to the landscape.

10.3.8.6 Landscape Character

Landscape character is a complex mix of physical features and patterns and cultural elements. Buildings, structures and spaces and the resulting layout and urban grain, the density and mix, scale and appearance, human interaction and cultural and historic features combine to create a common ‘sense of place’ and identity that is experienced as landscape character. Definable units (character areas and character zones) can be used to categorise the landscape and the level of detail and size of unit can be varied to reflect the scale of definition required. It can be applied at national, regional and local levels.

The quality or condition of a landscape character receptor is a reflection of its attributes, such as the condition of the buildings and spaces or vegetative components and the attractiveness and landscape quality of the area as well as its sense of place. A landscape with consistent, intact and well-defined, distinctive attributes is generally considered to be of higher quality and in turn, higher sensitivity, than a landscape where the presence of inappropriate or discordant elements has detracted from its inherent attributes. The higher the quality of a receptor the greater is its sensitivity to the Proposed Development.

10.3.8.7 Magnitude of Landscape Change

Magnitude of change is an expression of the size or scale of change in the landscape, the geographical extent of the area influenced and the duration and reversibility of the resultant effect. The variables involved are described below:

- The extent of existing landscape elements that will be lost, the proportion of the total extent that this represents and the contribution of that element to the character of the landscape;
- The extent to which aesthetic or perceptual aspects of the landscape are altered either by removal of existing components of the landscape or by addition of new ones;
- Whether the effect changes the key characteristics of the landscape, which are integral to its distinctive character;
- The geographic area over which the landscape effects will be felt (within the Proposed Development site itself; the immediate setting of the Proposed Development site; at the scale of the landscape type or character area; on a larger scale influencing several landscape types or character areas); and
- The duration of the effects (short term, medium term or long term) and the reversibility of the effect (whether it is permanent, temporary or partially reversible).

Changes to landscape characteristics can be both direct and indirect. **Direct change** occurs where the Proposed Development will result in a physical change to the landscape within or adjacent to the Proposed Development site. **Indirect changes** are a consequence of the direct changes resulting from the Proposed Development. They can often occur away from the Proposed Development site (for example, off-site construction staff parking) and may be a result of a sequence of interrelationships or a complex pathway (for example, a new road or footpath construction may increase public access and associated problems e.g. littering). They may be separated by distance or in time from the source of the effects. The magnitude of change affecting the baseline landscape resource is based on an interpretation of a combination of the criteria set out in the table below:

Table 10-6 Magnitude of Landscape Change Criteria (Landscape Effects)

Magnitude of Landscape Change	Classification Criteria
None	No change.
Negligible	Little perceptible change.
Low	Minor change, affecting some characteristics and the experience of the landscape to an extent; and Introduction of elements that is not uncharacteristic.
Medium	Noticeable change, affecting some key characteristics and the experience of the landscape; and Introduction of some uncharacteristic elements.
High	Noticeable change, affecting many key characteristics and the experience of the landscape; and Introduction of many incongruous developments
Very High	Highly noticeable change, affecting most key characteristics and dominating the experience of the landscape; and Introduction of highly incongruous development.

10.3.9 Visual Effects

Visual effects are determined by the extent of visibility and the nature of the visibility (i.e. how a development is seen within the landscape); for example, whether it appears integrated and balanced within the visual composition of a view or whether it creates a focal point.

Negative visual effects may occur through the intrusion of new elements into established views, which are out of keeping with the existing structure, scale and composition of the view. Visual effects may also be beneficial, where an attractive focus is created in a previously unremarkable view or the influence of previously detracting features is reduced. The significance of effects will vary, depending on the nature and degree of change experienced and the perceived value and composition of the existing view.

10.3.9.1 Receptors

For there to be a visual impact, there is the need for a viewer. Views experienced from locations such as settlements, recognised routes and popular vantage points used by the public have been included in the assessment. Receptors are the viewers at these locations. The degree to which receptors, i.e. people, will be affected by changes as a result of the Proposed Development depends on a number of factors, including:

- Receptor activities, such as taking part in leisure, recreational and sporting activities, travelling or working;
- Whether receptors are likely to be stationary or moving and how long they will be exposed to the change at any one time;
- The importance of the location, as reflected by designations, inclusion in guidebooks or other travel literature, or the facilities provided for visitors;

- The extent of the route or area over which the changes will be visible;
- Whether receptors will be exposed to the change daily, frequently, occasionally or rarely;
- The orientation of receptors in relation to the Proposed Development and whether views are open or intermittent;
- Proportion of the developments that will be visible (full, sections or none);
- Viewing direction, distance (i.e. short-, medium- and long-distance views) and elevation;
- Nature of the viewing experience (for example, static views, views from settlements and views from sequential points along routes);
- Accessibility of viewpoint (public or private, ease of access);
- Nature of changes (for example, changes in the existing skyline profile, creation of a new visual focus in the view, introduction of new man-made objects, changes in visual simplicity or complexity, alteration of visual scale, landform and change to the degree of visual enclosure); and
- Nature of visual receptors (type, potential number and sensitivity of viewers who may be affected).

10.3.9.2 Value of the View

Value of the view is an appraisal of the value attached to views and is often informed by the appearance on Ordnance Survey of tourist maps and in guidebooks, literature or art. Value can also be indicated by the provision of parking or services and signage and interpretation. The nature and composition of the view is also an indicator. The value of the view is determined with reference to the definitions outlined in the table below:

Table 10-7 Value of the View

Value	Classification Criteria
High	Nationally recognised view of the landscape, with no detracting elements.
Medium	Regionally or locally recognised view, or unrecognised but pleasing and well composed view, with few detracting elements.
Low	Typical or poorly composed view often with numerous detracting elements.

10.3.9.3 Visual Susceptibility

The GLVIA guidelines identify that the susceptibility of visual receptors to changes in views and visual amenity is a function of:

- The occupation or activity of people experiencing the view at a particular location; and
- The extent to which their attention or interest may therefore be focused on the views and visual amenity they experience at particular locations.

For example, residents in their home, walkers whose interest is likely to be focused on the landscape or a particular view, or visitors at an attraction where views are an important part of the experience often indicate a higher level of susceptibility. Whereas receptors occupied in outdoor sport, where views are not important, or at their place of work, are often considered less susceptible to change. Visual susceptibility is determined with reference to the three-point scale and criteria outlined in the table below:

Table 10-8 Visual Susceptibility

Susceptibility	Classification Criteria
High	Receptors for which the view is of primary importance and are likely to notice even minor change.
Medium	Receptors for which the view is important but not the primary focus and are tolerant of some change.
Low	Receptors for which the view is incidental or unimportant and is tolerant of a high degree of change

10.3.9.4 Visual Sensitivity

Sensitivity to change considers the nature of the receptor; for example, a person occupying a residential dwelling is generally more sensitive to change than someone working in a factory unit. The importance of the view experienced by the receptor also contributes to an understanding of the susceptibility of the visual receptor to change as well as the value attached to the view.

A judgement is also made on the value attached to the views experienced. This takes account of:

- Recognition of the value attached to particular views, for example in relation to heritage assets, or through planning designations;
- Indicators of the value attached to views by visitors, for example through appearance in guidebooks or on tourist maps, provision of facilities for their enjoyment (sign boards, interpretive material) and references to them in literature or art; and
- Possible local value; it is important to note that the absence of view recognition does not preclude local value, as a view may be important as a resource in the local or immediate environment due to its relative rarity or local importance.

The visual sensitivity to change is based on interpretation of a combination of all or some of the criteria outlined in the table overleaf.

Table 10-9 Sensitivity to Change Criteria

Visual Sensitivity	Classification Criteria
High	Users of outdoor recreational facilities, on recognised national cycling or walking routes or in nationally designated landscapes. Residential buildings.
Medium-high	Users of outdoor recreational facilities, in highly valued landscapes or locally designated landscapes or on local recreational routes that are well publicised in guide books. Road and rail users in nationally designated landscapes or on recognised scenic routes, likely to be travelling to enjoy the view.
Medium	Users of outdoor recreational facilities including public open space in moderately valued landscapes. Users of primary transport road network, orientated towards the Proposed Development, likely to be travelling for other purposes than just the view.
Medium-Low	People engaged in active outdoor sports or recreation and less likely to focus on the view.

	Primary transport road network and rail users likely to be travelling to work with oblique views of the project or users of minor road network.
Low	People engaged in work activities indoors, with limited opportunity for views of the Proposed Development.

10.3.9.5 Magnitude of Visual Change

Visual effects are direct effects as the magnitude of change within an existing view will be determined by the extent of visibility of the Proposed Development. The magnitude of the visual effect resulting from the development at any particular viewpoint or receptor is based on the size or scale of change in the view, the geographical extent of the area influenced and its duration and reversibility. The variables involved are described below:

- The scale of the change in the view with respect to the loss or addition of features in the view and changes in its composition, including the proportion of the view occupied by the development;
- The degree of contrast or integration of any new features or changes in the landscape form, scale, mass, line, height, sky lining, back-grounding, visual clues, focal points, colour and texture;
- The nature of the view of the development, in relation to the amount of time over which it will be experienced and whether views will be full, partial or glimpses.
- The angle of view in relation to the main activity of the receptor, distance of the viewpoint from the development and the extent of the area over which the changes will be visible; and
- The duration of the effects (short term, medium term or long term) and the reversibility of the effect (whether it is permanent, temporary or partially reversible).

The magnitude of visual effect resulting from the development at any particular viewpoint or receptor is based on the interpretation of the above range of factors and is set out in the table below:

Table 10-10 Magnitude of Visual Change Criteria (Visual Effects)

Magnitude of Visual Change	Classification Criteria
None	No change in the existing view.
Negligible	The development will cause a barely discernible change in the existing view.
Low	The development will cause very minor changes to the view over a wide area or minor changes over a limited area.
Medium	The development will cause modest changes to the existing view over a wide area or noticeable change over a limited area.
High	The development will cause a considerable change in the existing view over a wide area or a significant change over a limited area.
Very High	The development will cause significant changes in the existing view over a wide area or a change which will dominate over a limited area.

10.3.10 Significance Criteria

The objective of the assessment process is to identify and evaluate the potentially significant effects arising from the Proposed Development. The assessment will identify the residual effects likely to arise from the finalised design taking into account mitigation measures and the change over time.

The significance of effects is assessed by considering the sensitivity of the receptor and the predicted magnitude of effect in relation to the baseline conditions. In order to provide a level of consistency and transparency to the assessment, and allow comparisons to be made between the various landscape and visual receptors subject to assessment, the assessment of significance is informed by pre-defined criteria as outlined in the table below. When assessing significance, individual effects may fall across several different categories of significance and professional judgement is therefore used to determine which category of significance best fits the overall effect to a landscape or visual receptor.

The significance of the effects can be adverse (negative) or beneficial (positive) according to the definitions set out in the table below:

Table 10-11 Categories of Significance of Landscape and Visual Effects

Significance Category	Description of Effect
Profound	An effect that obliterates sensitive characteristics within the landscape and/ or visual environment.
Very Significant	An effect which, by its character, magnitude, duration, or intensity significantly alters most of a sensitive aspect of the landscape and/ or visual environment.
Significant	An effect which, by its character, magnitude, duration, or intensity alters a sensitive aspect of the landscape and/ or visual environment.
Moderate	An effect that alters the landscape in a manner that is consistent with existing and emerging baseline trends.
Slight	An effect which causes noticeable changes in the landscape and/ or visual environment without affecting its sensitivities.
Not Significant	An effect which causes noticeable changes in the landscape and/ or visual environment but without significant landscape and/ or visual consequences.
Imperceptible	An effect capable of measurement but without significant landscape and/ or visual consequences.

The significance of the effect is determined by considering the magnitude of the effect and the quality of the baseline environment affected by the Proposed Development. The basis for consideration of the significance of effects is included overleaf.

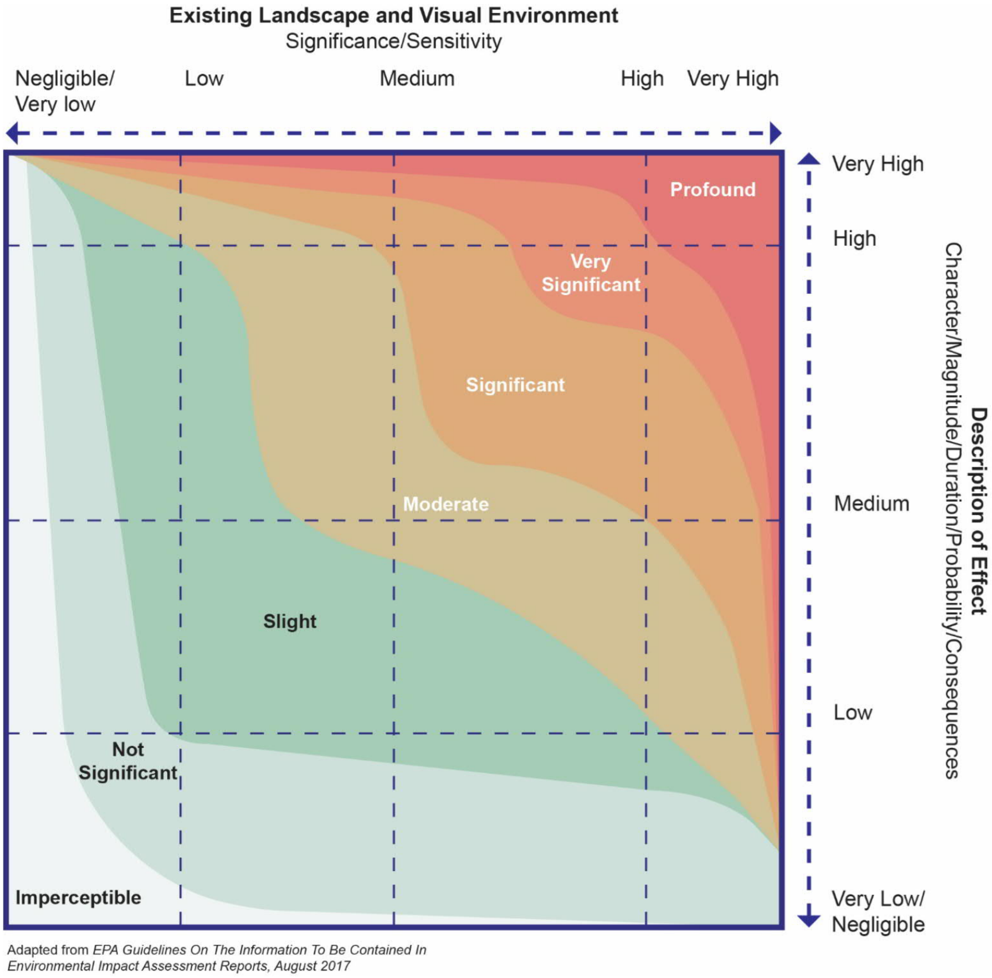

Figure 10-1 Basis for Consideration of Significance of Effects

Effects will be assessed for all phases of the Proposed Development. Construction effects are considered to be temporary, short term effects which occur during the construction/ decommission phase only. Operational/ residual effects are those long-term effects, which will occur as a result of the presence or operation of the development.

The quality of each effect is based on the ability of the landscape character or visual receptor to accommodate the Proposed Development, and the impact of the development within the receiving context. Once this is done, the quality of the effect is then is assessed as being neutral, beneficial or adverse. A change to the landscape or visual resource is not considered to be adverse simply because it constitutes an alteration to the existing situation.

10.3.11 Cumulative Effects

In addition to landscape and visual effects, it is also important to consider potential cumulative effects. Significant cumulative effects may occur where a number of similar developments combine to increase the prevalence of that type of development within a landscape or view to the extent that they become a defining characteristic. Cumulative effects will also arise from incremental changes caused by other past, present or reasonably foreseeable actions together with the Proposed Development.

The cumulative assessment evaluates the additional change resulting from the Proposed Development in relation to the theoretical baseline scenario and follows a similar methodology to that used for the landscape and visual assessments. The table below states definitions which are used to determine cumulative effects.

The cumulative assessment includes developments that are consented but not constructed, that are the subject of undetermined applications, or are currently at scoping which are similar in type and scale to the Proposed Development. Existing approved projects or projects already under construction are considered part of the baseline receiving environment and have been considered in cumulation.

10.3.11.1 Magnitude of Cumulative Effects

The principle of magnitude of cumulative effects makes it possible for the proposed scheme to have major effects on a particular receptor, while having only minor cumulative effects in conjunction with other existing developments.

The magnitude of cumulative effects arising from the proposed scheme is assessed as very high, high, medium, low or negligible, with intermediate categories, based on interpretation of the following parameters:

- The additional extent, direction and distribution of existing and other developments in combination with the Proposed Development;
- The distance between the viewpoint, the Proposed Development and the cumulative developments; and
- The landscape setting, context and degree of visual coalescence of existing and Proposed Development and cumulative developments.

10.3.11.2 Significance of Cumulative Effects

As for the assessment of landscape and visual effects, the significance of any cumulative effects follows a same classification described in Section 10.3.10 above, and will be assessed as profound, very significant, moderate, slight, not significant, imperceptible.

10.3.11.3 Types of Visual Cumulative Effects

In addition to the magnitude of cumulative visual effects, the below specific types of visual cumulative effects will also be assessed. The table below states definitions which are used to determine cumulative effects.

Table 10-12 Definition of Specific Types of Cumulative Effects

Specific Types of Cumulative Effects	Characteristics
In combination	Where two or more developments are or would be within the observers arc of vision at the same time without moving her/ his head.
In Succession	Where the observer has to turn her/his head to see various developments actual and visualised.1

10.3.11.3 Limitations of Cumulative Assessment

The cumulative assessment focuses on potential cumulative effects relating to the main permanent structure of each cumulative development. This is due to the uncertainty of the timing of construction activities for each of the identified developments. As a result, temporary structures and activity relating to construction have not been considered within the cumulative assessment.

10.3.12 Field Work

A site survey of the study area and beyond was carried out in February and November 2020 identifying the potential visibility of the Proposed Development and key additional viewpoints within the core study area and the wider landscape. Photomontages showing the existing view and the superimposed development on photomontages have been produced from key representative viewpoints, taking into account topography, existing buildings, screening vegetation and other localised factors. The Booklet of Planning Application Photomontages contains details on viewpoint locations and Photomontages 1 – 16 (Appendix A10-1, Vol. 4). Photomontage locations are also indicated in Figure F10-1, Vol. 3.

[1] Guidelines for Landscape and Visual Impact Assessment, Third Edition, LI and Institute of Environmental Management & Assessment (2013).

10.3.13 Selection of Viewpoints

Viewpoint selection has been carried out according to the current best practice standards and the following industry guideline:

- Photography and Photomontage in Landscape and Visual Impact Assessment, Landscape Institute Advice Note 01/2011; and
- 'Visual Representation of Development Proposals', Landscape Institute, Technical Guidance Note 06/19, 17 September 2019.

It is not feasible to take photography from every possible viewpoint located in the study area. Photography has been taken from viewpoints, which are representative of the nature of visibility at various distances and in various contexts. Viewpoint photography is used as a tool to come to understand the nature of the potential residual effects. The selection process of viewpoint locations is as follows:

- The location of viewpoints within the study area is informed by desktop and site surveys;
- Identification and selection of representative viewpoints showing typical open or intermittent views within a local area, which will be frequently experienced by a range of viewers; and
- Identification and selection of specific viewpoints from key viewpoints in the landscape such as routes or locations valued for their scenic amenity, main settlements etc.

10.3.14 Photomontages

Photomontages are photorealistic visualisations produced using specialist software. They illustrate the likely future appearance of the Proposed Development from a specific viewing point. They are useful tools for examining the effects of the development from a number of critical viewpoint positions at publicly accessible locations within the study area.

However, photomontages in themselves can never provide the full picture in terms of potential effects. Photomontages are one source of information and used as a tool to help to understand the nature of potential effects and to assist the determination of the magnitude and significance of residual landscape and visual effects. They can only inform the assessment process by which judgements are made. A visualisation can never show exactly what the Proposed Development will look like in reality due to factors such as; different lighting, weather and seasonal conditions which vary through time and the resolution of the image. As the photomontages are representative of viewing conditions encountered, some of them may show existing buildings or vegetation screening some or all parts of the developments. Such conditions are normal and representative.

The images provided give a reasonable impression of the scale of the development and the distance to the development but can never be 100% accurate. It is recommended that decision-makers and any interested parties or members of the public should ideally visit the viewpoints onsite, where visualisations can be compared to the 'real life' view, and the full impact of the Proposed Development can be understood.

Viewpoints/ Photomontages 1 – 15 show the Proposed Development including the following information:

- Existing View, showing the baseline image; and
- Photomontage, showing the Proposed Development including all visible components at full height.

Photomontage images have been produced with reference to best practice and the following industry guidelines:

- 'Visual Representation of Development Proposals', Landscape Institute, Technical Guidance Note 06/19, 17 September 2019;
- Guidelines for Landscape and Visual Impact Assessment (GLVIA), Third Edition, Landscape Institute and Institute of Environmental Management and Assessment, IEMA, 2013; and

- Visual Representation of Wind Farms, Version 2.2, Scottish Natural Heritage, February 2017 (in relation to viewpoint selection, technical equipment, function and limitations of visualisations).

10.3.15 Zone of Theoretical Visibility (ZTV)

Mapping the extent of the area from which a development is likely to be visible is commonly referred to as a Zone of Theoretical Visibility (ZTV). ZTV prediction does not take into account the effects of seasons, lighting, weather conditions or visibility over distance. Moreover, a ZTV does not take into account the screening effects of existing vegetation or built structures and can omit topographical variations of up to 10 m. Therefore, in reality, ZTV mapping's principal use is to identify viewing points for further analysis.

10.4 Baseline Environment

This section provides a summary of the current (2019) baseline conditions within the study area, as defined in Section 10.3.1 - Study Area and Section 10.4.4 - Establishment of the Baseline.

10.4.1 Site Location and Description

The Proposed Development site is located in north Co. Kerry along the south shore of the Shannon Estuary 4.5 km to the west of the Tarbert and 3.5 km to the east of the village of Ballylongford which spans the Ballyline River. The site occupies part of two townlands, Kilcolgan Lower and Ralappane. It incorporates farmland and parts of the shoreline on the Shannon Estuary.

The character of the landscape is of low-lying, rolling agricultural pastureland, strongly influenced, and determined by its exposed estuarine setting. The broad waters of the Shannon Estuary are the defining landscape feature, while the prominent built developments at Moneypoint and Tarbert Island, together with large electricity pylons going off into the distance, draw the immediate focus. Within its estuarine context, the existing site is largely indistinct, being without features of note, such as distinct cliffs and woodland.

The location of the site on the edge of the southern shore results in it being particularly visible in scenic views from the northern shore of the estuary; from the waters of the estuary and Scattery Island and Hog Island; and from sections of the south shore extending west to beyond Ballylongford Bay and Carrig Island.

While portions of the site are openly visible from areas and properties immediately south and southeast, e.g. Ralappane House, the site is not particularly visible within the wider landscape. The undulating nature of the landscape east of the site provides middle-ground screening while even low roadside and field vegetation provides effective foreground and middle-ground screening of views from within the flatter landscape west of the site.

The Shannon Estuary within the study area is also the location for several large and visually prominent industrial developments such as Moneypoint Power Station at the shore in Co. Clare and Tarbert Power Station at the shore in north Co. Kerry. The closest large scale industrial activities are the 846MWe coal-fired Moneypoint Power Station, approximately 3 km to the north, and the 594 MWe oil-fired Tarbert Power Station at Tarbert, approximately 5 km to the east. The Rusal Aughinish (formerly Aughinish Alumina) plant at Foynes is located approximately 26 km to the east in Co. Limerick and outside of the study area.

The Proposed Development site is approximately 52 hectares (including both onshore and offshore elements) and has been zoned for industrial use by KCC. The site is bordered to the north by the Shannon Estuary and to the south by the L1010 Coast Road, connecting Tarbert to Ballylongford. The Proposed Development site is currently in pasture with some tillage, comprising primarily improved grassland with some wet grassland adjacent to the Shannon Estuary shore. Its boundary to the shore is formed by low sandy cliffs. A small stream runs in a north-westerly direction through the site and discharges into the Shannon Estuary. Field boundaries consist mostly of hedgerows and some small drainage ditches.

The topography of the land within the Proposed Development site is generally undulating and rising up from the Shannon Estuary shoreline. Some of the fields are waterlogged in wet weather and there are pockets of marshy ground. There are currently several old disused farm buildings and structures on the Proposed Development site .

10.4.2 Receptor Groups

The main receptor groups within the study area are as follows:

- Residential;
- Vehicular Traffic;
- Workers; and
- Visitors/ Tourists.

10.4.2.1 Residential

Residential receptors will have a High sensitivity to visual changes as views will be experienced on a daily basis and therefore, even the smallest change in the landscape character or visual amenity will be noticed. Residences located within the Co. Kerry part of the study area are sparse and scattered across the area and along the local and regional roads. They cluster in villages such as Ballylongford and Tarbert. Long distance visibility from residences is often limited by local vegetation or undulating topography. However, open views north towards the Shannon Estuary can be experienced from elevated locations and where intervening vegetation is low. The closest dwellings to the Proposed Development are located along the L1010 in the vicinity of the Proposed Development location and Ralappane House, which is located east, southeast of the Proposed Development site and reached via an access road from the L1010.

Residences within Co. Clare follow a similar pattern as in Co. Kerry. They are sparsely dispersed across the study area but concentrate in the and around the town of Kilrush. Views across the Shannon Estuary are available from the Coast Road and from elevated locations along the N67 and beyond.

Residences located in Co. Limerick and within the eastern most section of the study area concentrate also along the main road such as the N67 and are otherwise scarcely scattered along local roads.

10.4.2.2 Vehicular Traffic

Vehicular Traffic is present along all local, regional and national roads within the study area. It includes also ferry passengers between Tarbert and Killimer. The sensitivity of vehicular traffic is considered Medium as receptors often travel to get from one place to another with little attention for views. However, the study area contains a number of scenic roads, protected views and prospects as well as the Wild Atlantic Way touring route. Traffic along these routes, which include scenic views across the Shannon Estuary will be focusing on views as well as the traffic. High sensitivity can be attributed to vehicular traffic of residents of the local area around the Proposed Development in particular, where views are an important component on their way to or from home.

10.4.2.3 Workers

Workers at their place of work in local commercial and industrial facilities will have a Low sensitivity to changes in views as their primary focus is not related to the visual amenity.

10.4.2.4 Visitors/ Tourists

The study area contains a number of scenic roads, protected views and prospects as well as the Wild Atlantic Way touring route. The visual amenity is part of the experience for visitors/ tourists travelling along these designated routes and will therefore have a Medium to High sensitivity to the quality of the components of the landscape character and visual amenity.

10.4.3 County Kerry – Landscape Designations

10.4.3.1 Landscape Character

According to Objective ZL-2 contained in the current Kerry County Development Plan 2015-2021, KCC is to '*Prepare a Landscape Character Assessment of the County following the publication of the proposed National Landscape Strategy. This assessment will include capacity studies for different forms of development and will involve consultation with adjoining local authorities*'.

Landscape Character Areas were identified for the Renewable Energy Strategy by KCC in 2012, based on this assessment, the Proposed Development site is located within the following Landscape Character Area (LCA):

- 2 – Tarbert Pastures.

The study area also covers the following landscape character areas:

- 1 – Ballylongford Creek; and
- 4 – Inner River Plain.

10.4.3.2 Tarbert Pastures

The landscape character assessment describes this character as follows (extract only):

'*This compact area is located on the southern shore of the River Shannon, around Glencloosagh and Tarbert Bay's. Subtle variations in topography between Knockfinglas Point, Dooncaha and Tarmonhill create the inland boundary. There is one viewing point for this area.*

- ***Scale:*** *This is a small area with small features due to the topography.*
- ***Landform:*** *Undulating*
- ***Landcover:*** *Pasture. Areas of sessile oak woodland around Tarbert.*
- ***Road Network:*** *There is a dense network of roads in the area.*
- ***Settlement Pattern:*** *Tarbert village, with small clusters of dwellings and farms away from the main road network.*
- ***Prominent Features:*** *Tarbert Power Station and its chimney's.*
- ***Perception:*** *Although intensely farmed, residential development is relatively scarce ensuring a quiet peaceful aspect to the landscape.*
- ***Quality of Landscape:*** *Rural landscape.*

Table 10-13 Conclusions of the Development Capacity Assessment

Development Capacity Assessment

		Yes	No	Detail
1	Designated amenity/ view as per Kerry County Development Plan 2009-2015?	✓		Secondary Special Amenity to northeast of Tarbert, between N69 and estuary.
2	Is the landscape important for scenert, tourism or recreation?		✓	
3	Identified in the public consultation as a scenic landscape?		✓	1 group (out of 3) identified small area next to Tarbert as particularly scenic.
4	Is there a limited amount of the particular landscape in the county?		✓	
5	Does it provide a setting that contributes to the character/ amenity of a settlement?	✓		Tarbert
6	Coastal landscape?	✓		Estuary

Development Capacity Assessment

7	Are there dominant features in the landscape?	✓		Tarbert Power Station and where visible the Estuary.
8	Are cultural, historical or archaeological associations present in the landscape?	✓		Historical
9	Windfarm(s) in the area or visible from the area?		✓	Turbines permitted in Gurteenavallig to Southwest of Tarbert.
10	Is the landscape of national/ county importance?		✓	

Figure 10-2 Development Capacity Assessment[2]

The development capacity summary states the following (relevant extracts only):

'*It would appear that population density would not be as high as other parts of North Kerry. There is a significant area of land zoned industrial along the estuary, known as the Ballylongford Landbank. There is landscape capacity in the landbank area given the industrial nature of the area. However this land is zoned for industrial uses and wind development would prejudice its potential for industrial development. Outside of the landbank there is some landscape capacity but this is limited by the quality and agricultural nature of the landscape. There is also a need to protect the setting around the town of Tarbert and the scenic area to the northeast of the town. There was no consensus amongst the three public consultation summary maps. Planning permission for turbines has been granted in the townland of Gurteenavallig, Planning Reg. No. 11/ 299. This will alter to some extent the character of the area, adding an industrial aspect to this otherwise rural landscape. Additional wind development of a limited extent would not therefore significantly change the nature of the landscape. Given this capacity, the area is zoned as being Open to Consideration*'.

It should be noted that the above capacity statement and development capacity summary is somewhat out of date. Existing wind farms at Leanamore (located within this LCA 2 – Tarbert Pastures) and Tullahennel Wind Farm (located in the adjoining LCA 4 – Inner River Plain) are a visible elements in this character area even at longer distances. However, the overarching landscape character apart from Tarbert Island, which can be described as industrial, is rural. The statements in the capacity summary appear to contradict each other. It describes this LCA as 'industrial' and later as 'rural landscape' apart from industrial features.

The area has indeed a scenic value. While the overall landbank may lack prominent landscape features, it is part of the intrinsic open character of the River Shannon Estuary leading west towards the Atlantic. Its low but undulating coastline with shallow sandy cliffs and beaches within the study area form part of a transition zone between land and sea and provide scenic views between the shores of Co. Kerry and Co. Clare, which can be appreciated from either shore or islands such as Scattery Island. This has been recognised by the designation of the R551 as part of the Wild Atlantic Way. While the Shannon Estuary features major and visually prominent industrial developments such as Moneypoint and Tarbert Power Stations, it has retained its rural character along the coastline further west. The coastline has capacity for recreational use in terms of scenic coastal walking routes if access to the land could be facilitated.

The 2 adjoining landscape character area are described below:

10.4.3.3 Ballylongford Creek

The landscape character assessment describes this character as follows (extract only):

[2] As included in Landscape Character Assessment prepared for the Renewable Energy Strategy 2012 & Adopted/ Proposed Archaeological Landscapes, Kerry County Council Planning Policy Unit, November 2012, Page A-15

'*Subtle changes in topography create the limit to this area. These changes run from Letter Point on Bunaclugga Bay to the summit of Knockanore Mountain before falling east to Tullahennel and crossing flat topography to Leanamore. From here the boundary turns north to join a rise in topography at Glansillagh before joining the shoreline of the River Shannon at Knockfinglas Point. There is one viewing point for this area.*

- ***Scale:*** *The extent of this landscape area is relatively small. The landscape within this area is comprised of small features such as fields, walls, hedges and individual houses. These elements break up the landscape into small-scale units, with the height and scale of Knockanure Mountain being the dominant feature.*
- ***Landform:*** *There is a gentle slope towards the estuary, generally flat.*
- ***Landcover:*** *Moorland is present on high topography on the northeast slopes of Knockanore Mountain. The remaining part of the area is generally pasture with some marginal land.*
- ***Road Network:*** *There is a dense network of roads in the area.*
- ***Settlement Pattern:*** *Generally within the villages of Asdee and Ballylongford, and in clusters along the main access roads. Isolated farmsteads are also present.*
- ***Prominent Features:*** *Knockanore Mountain, River Shannon Estuary.*
- ***Perception:*** *It is a peaceful landscape.*
- ***Quality of Landscape:*** *This landscape has a prominent landmark in Knockanore Mountain which is visible from the surrounding area. It is an attractive rural landscape with views north towards the Shannon Estuary'.*

Similar to the development capacity assessment of LCA 2 -Tarbert Pastures, this landscape character assessment states that the character area is not important for scenery or has scenic landscapes. Again, this cannot be supported following site surveys in the area. The interaction between land an estuary are important features along the coastline and elevated areas in the hinterland. Open views of the Shannon Estuary are scenic as well as the small scale undulating landscape. While section of the coast are low rise or flat, they bare a tranquil and pleasant setting. The sandy beaches and as well as Carrick Island and Carrigafoyle Castle are scenic features in the landscape character area and provide long distance views across the Shannon estuary. The coastline has capacity for recreational use in terms of scenic coastal walking routes if access to the land could be facilitated.

10.4.3.4 Inner River Plain

The landscape character assessment describes this character as follows (extract only):

'*The southern boundary extends from the summit of Knockathea in Co. Limerick, across a line of low hills to the north of Listowel to the eastern side of Knockanore Mountain. The northern boundary continues across the relatively flat topography between Tullahennel to higher topography at Tarmonhill on the Co. Limerick border …*'.

- ***Scale:*** *The scale of the landscape varies from large open moorland in the higher areas to smaller patchwork fields created by hedgerows, walls and a multiplicity of local roads.*
- ***Landform:*** *Flat in the western part but rises up to the east.*
- ***Landcover:*** *Some moorland on the higher ground in the area with pasture lower down. The flat lands in the centre of the area are pasture. There is some peatbog in places.*
- ***Enclosure:*** *Pasture is enclosed within hedgerows and hedge banks. Mature hedgerows are also present around settlements.*
- ***Road Network:*** *There is a dense network of roads in the area.*
- ***Settlement Pattern:*** *Comprises isolated farms and dwellings with a concentration of built development along main roads and at Moyvane.*

- ***Prominent Features:*** *Knockanore Mountain*
- ***Perception:*** *Quiet pleasant rural landscape disturbed only by heavy development along roads.*
- ***Quality of Landscape:*** *This is a marginal area which is generally flat which results in the area not having any particular qualities.*

This landscape character is located in the southern part of the study area. Intervisibility with the Proposed Development is unlikely.

10.4.3.5 County Clare – Landscape Designations

10.4.3.6 Landscape Character

The Landscape Character of Co. Clare is described within the Landscape Character Assessment of County Clare, March 2004, which is referenced in the Clare County Development Plan 2017-2023. It also defines Seascape Character Areas, which are described separately in Section 10.3.7 herein.

The landscape character assessment identifies a range of classifications for the landscape of Co. Clare. The below is an extract of the most relevant classifications located within the study area.

The study area covers the following Landscape Character Types and Landscape Character Areas as indicated in Figure F10-1, Vol. 3 – Landscape Designations:

<u>Landscape Character Types (LCT)</u>

10.4.3.7 FRH – Farmed Rolling Hills

This type is described as follows (extract):

The land cover consists of a mosaic of forestry and pasture/ grassland, no drumlins and rolling uneven topography. Infrastructure can be highly visible across this landscape type. Views are afforded from more elevated hills across the surrounding areas and to the Shannon estuary.

10.4.3.8 FLR – Farmed Lowland Ridges

This type is described as follows (extract):

The land cover is pasture, deciduous woodland and scrub and follows a linear ridge topography.

<u>Landscape Character Areas (LCA)</u>

10.4.3.9 LCA 18 – Shannon Estuary Farmland

Landscape Character Area Extent

'This area extends from Ballynacally in the north along the R473, encompassing the Labasheeda peninsula and continuing along the Shannon estuary to Kilrush. It is fringed by the Kilrush farmlands to the north'.

Geology and Landform

'… This area is composed of a prominently ridged landscape, with linear hills aligned south-west to north-east. The coastal fringe is flatter and slopes towards the Shannon. It also becomes increasingly flatter towards Kilrush'.

Landscape Condition and Sensitivity

'*This area is of variable condition. In parts, the traditional landscape pattern dominates. The area is more intact in the east and north, where it is less accessible. Occasional modern residential development along the estuary line can be inappropriate and not reflective of local styles.*

Around Kilrush and along the coast, tourist and holiday home development has also adversely affected the landscape. Moneypoint power station is a singularly large-scale detractor on the Shannon, accompanied by a number of prominent pylons. The ridges create many small-scale areas unsuitable for large development.

The sensitivity remains higher in the more intact areas, with elevated areas also sensitive due to their increased visibility. The estuary coastline is partly degraded due to infrastructure and the industrial activity within the Shannon estuary.

The woodland scrub around Clonderlaw Bay and the broadleaved areas in the grounds of Kilrush House are classified as visually vulnerable and sensitive under the county development plan. The coastline to Clonderlaw Bay is also classified as an area of high amenity under this plan'.

Key Characteristics

- *'Prominently ridged landscape, with linear hills aligned south-west to north-east.*
- *Secluded areas interspersed with more open views. Views are afforded across the Shannon estuary and across to Limerick from elevated areas and on the estuary shores.*
- *Coastal fringe is flatter and slopes down towards the sea.*
- *Diverse habitat and land cover.*
- *Scattery Island is an important historical and focal feature.*
- *Complex patterns of pasture, woodland and scrub habitats.*
- *Old Vandeleur Estate plantations, gardens and restored woodland recreation area'.*

The Clare County Development Plan categorises the landscape of the County into 3 'Living Landscapes'.

'*County Clare comprises a number of areas that have similar characteristics for which similar planning policies are applicable. A description of each area is provided below along with the criteria used to define the boundaries of each area. The descriptions outline the vision and future role of the particular landscape together with policies/ objectives that will guide development of that landscape*'.

The three categories have differing objectives as follows:

- **Settled Landscapes:** Areas where people live and work;
- **Working Landscapes:** Intensively settled and developed areas within Settled Landscapes or areas with a unique natural resource; and
- **Heritage Landscapes:** Areas where natural and cultural heritage are given priority and where development is not precluded but happens more slowly and carefully.

The study area includes area includes all 3 categories. Sections of heritage Landscapes are located south of Kilrush along the coast and include islands in the Shannon Estuary including Scattery Island. Working Landscapes are also located along the coast and include Moneypoint Power Station and ancillary developments. The remainder of the study area covering Co. Clare is categorised as 'Settled Landscapes'.

The Landscape Character Assessment assesses also forces for change. It states the following in relation to build developments, among others:

'Table 6.3b Broad Landscape Guidance for Built Development

Materials and Colour

- *Limit the range of materials and colours used on any one building and use natural materials, such as timber, stone and slate to link with existing buildings.*
- *Select cladding materials and colours for modern industrial and farming buildings to minimise their impact in the countryside. Avoid the use of light colours, which can reflect the light, and intense greens or blues, which often clash with the surrounding natural tones of fields and woods. The treatment of roofs is particularly important when considering the visual impact these have on views to lowland areas from surrounding hills.*
- *Ensure that the materials and colours used are in harmony with one another and with existing buildings nearby'.*

10.4.4 County Limerick – Landscape Character Assessment

The eastern section of the study area covers parts of Co. Limerick and the following landscape character area (LCA) as described in Limerick County Development Plan 2010-2016:

10.4.4.1 Shannon Integrated Coastal Management Zone (ICMZ)

'*This zone comprises a large area of northern County Limerick and is bounded on one side by the Shannon Estuary while its southern boundary is defined by the gradually rising ground, which leads onto the agricultural zone and the western hills to the south west. The presence of the estuary is the defining characteristic of the region. The landscape itself is generally that of an enclosed farm type, essentially that of a hedgerow dominant landscape. This differs from the other agricultural landscapes of the County in that the field patterns, particularly close to the estuary, tend to be less regular than those elsewhere in the County*'.

In relation to visual effects, Objective EH O12 states the following:

'*…*

(b) To protect the views and prospects along the N69 (see Map 7.6), as a priority for the Planning Authority. Only in exceptional circumstances (e.g. domestic extensions and/ or a suitably screened dwelling for a son or daughter of a landowner where the son or daughter is engaged in full time farming or other exceptional circumstances) will development be allowed between the road and the estuary. Where housing is permitted single storey high quality design together with sensitive site location and landscape is required.

…'.

10.4.5 Protected Views and Prospects/ Scenic Routes

10.4.5.1 Co. Kerry

Kerry County Development Plan 2015-2021 identifies a number of Views and Prospects. Relevant designations located within the study area are indicated in Figures F10-1 Landscape Designations and F10-2 Landscape and Seascape Designations and are listed below:

- Views north of the River Shannon estuary and Co. Clare shores from a section of the R551 between Ballylongford and Asdee. This section is also part of the Wild Atlantic Way driving route.
- Estuarine views east and northeast along sections of the L6010 towards Carrigafoyle Castle north of Ballylongford. This section is also part of the Wild Atlantic Way driving route.
- Views west of Lislaughtin Abbey from a short section of the L1010 northeast of Ballylongford.
- Views east and southeast of Tarbert Bay along sections of the N69 including its section on Tarbert Island to the ferry terminal. This section is also part of the Wild Atlantic Way driving route

Relevant extracts of the development plan state the following:

'*County Kerry contains areas of outstanding natural beauty which are recognised internationally. There is a need to protect and conserve views and prospects adjoining public roads throughout the County. These views and prospects are important to the amenity of the County and to its tourist industry.*

…

It is not proposed that the protection and conservation of these views and prospects should give rise to the prohibition of development along these routes, but & Landscaping development where permitted, should not seriously hinder or obstruct these views and should be designed and located to minimise their impact.

…'.

It is an objective for the Council to:

'*ZL-5: Preserve the views and prospects as defined on Map No's 12.1, 12.1a– 12.1u.*

ZL-6: Facilitate the sustainable development of existing viewing points as identified by Fáilte Ireland along the route of the Wild Atlantic Way, while ensuring the protection of environmental attributes in the area through the implementation of environmental protection objectives, standards and guidelines of this Plan'.

10.4.5.2 Co. Clare

Clare County Council recognises that the Shannon Estuary is an important tourist asset and designated a number of scenic routes along the River Shannon estuary. The following Scenic Route is located within the study area:

Coast road south east of Cappagh to Carrowdotia South, which includes sections of the N67

This designated scenic route is also part of the Wild Atlantic Way.

Clare County Development Plan includes a number of objectives in relation to Scenic Routes located in 'Heritage Landscapes' and 'Working Landscapes'. Scenic Route 19 travels through both designations. Relevant extracts are included below.

CDP13.4 Shannon Estuary Working Landscapes

'*It is an objective of the Development Plan:*

…

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; and*

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*'.

CDP13.5 Heritage Landscapes

'*It is an objective of the Development Plan:*

To require that all proposed developments in Heritage Landscapes demonstrate that every effort has been made to reduce visual impact. This must be demonstrated for all aspects of the proposal – from site selection through to details of siting and design. All other relevant provisions of the Development Plan must be complied with. All proposed developments in these areas will be required to demonstrate:

- *That sites have been selected to avoid visually prominent locations;*
- *That site layouts avail of existing topography and vegetation to minimise visibility from scenic routes, walking trails, public amenities and roads; and*
- *That design for buildings and structures minimise height and visual contrast through careful choice of forms, finishes and colour and that any site works seek to reduce the visual impact of the development*'.

CDP13.7 Scenic Routes

It is an objective of the Development Plan:

A. *To protect sensitive areas from inappropriate development while providing for development and change that will benefit the rural community;*

B. *To ensure that proposed developments take into consideration their effects on views from the public road towards scenic features or areas and are designed and located to minimise their impact; and*

C. *To ensure that appropriate standards of location, siting, design, finishing and landscaping are achieved.*

10.4.5.3 Co. Limerick

The current Limerick County Development Plan 2010-2016 designates Views and Prospects. According to the Draft Limerick Development Plan 2022-2028, these designations will remain unchanged.

The eastern extend of the study area covers a section of County Limerick and designated Views and Prospects as follows and as indicated in Figure F10-1 – Landscape Designations:

- Shannon estuary from Foynes to Glin, which is incorporated into the Shannon Estuary Integrated Coastal Management Zone.

A number of objectives in relation to views and prospects are defined by the Council. The below is an extract of relevant objectives:

Objective EH O12: Shannon Coastal Zone Landscape Character Area
'*It is the objective of the Council:*

…

B. *To protect the views and prospects along the N69 (see Map 7.6), as a priority for the Planning Authority. Only in exceptional circumstances (e.g. domestic extensions and/ or a suitably screened dwelling for a son or daughter of a landowner where the son or daughter is engaged in full time farming or other exceptional circumstances) will development be allowed between the road and the estuary. Where housing is permitted single storey high quality design together with sensitive site location and landscaping is required.*

…'.

Objective EH O17: Scenic Views and Prospects

a) *It is the objective of the Council to safeguard the scenic views and prospects by integrating them into landscape character areas, which will ensure a more balanced approach towards landscape issues within the County.*

b) *In areas where scenic views and prospects are listed in Map 7.6 there will be a presumption against development except that which is required in relation to farming and appropriate tourism and related activities, or a dwelling required by a long term land owner or his/ her family that can be appropriately designed so that it can be integrated into the landscape.*

c) *The Planning Authority will exercise a high level of control (layout design, siting, materials used, landscaping) on developments in these areas. In such areas site specific designs are required. It should be noted that in areas outside these delineated areas, high standards will also be required.*

The Draft Limerick Development Plan 2022-2028 objective are very similar and state the following:

Objective EH O30: Views and Prospects
'*It is the objective of the Council:*

a) *Preserve, protect and encourage the enjoyment of views and prospects of special amenity value or special interests and to prevent development, which would block or otherwise interfere with views and/ or prospects.*

b) *In areas where scenic views and prospects are listed in the Draft Plan, there will be a presumption against development, except that required to facilitate farming and appropriate tourism and related activities. The development must be appropriately designed so that it can be integrated into the landscape*'.

10.4.6 Seascape Character

The River Shannon estuary is part of seascape character areas of local and national planning bodies as follows:

10.4.6.1 Co. Kerry

Currently no planning references to a seascape character assessment or a definition of seascape designations.

10.4.6.2 Co. Clare

Clare County Development and the associated Landscape Character Assessment includes details on Seascape Character Areas (SCA) along the shores of County Clare. Figure F10-2 – Seascape Character, indicates the location of relevant seascape character areas located within the study area namely:

- SCA 10 – Lower Shannon; and
- SCA 11 – River Shannon.

SCA 10 – Lower Shannon

Seascape Character Area Extent

'*The Lower Shannon SCA is situated between Kilcredaun Point and Lynchs Point (east of Money Point)*'.

Geology and Landform

'*Long sand and shingle beaches with an exposed feel when winds are from the south west*'.

Historic Seascape and Human Influences (Extract)

'*There is a monastic complex, possibly from the sixth century, and medieval round towers and churches on Scattery Island. It remained a pilgrimage and burial site after the Elizabethan slighting of the monastery and the island's conversion to a defensive fort (its pattern – or penitential round – was suppressed in the early 1800s)*'.

Condition and Sensitivity

'*The condition of the seascape is moderate becoming poorer closer to the River Shannon SCA. Power stations and windfarms are dominant features degrading views across the water in County Kerry and Limerick. Changes would be evident due to low lying and exposed nature of the area*'.

Key Characteristics

- '*The River Shannon in this area is wide, creating a greater coastal than estuarine sense;*
- *Views from Kilrush to Scattery Island and Hog Island;*
- *Settlement is concentrated around Kilrush including caravan parks and golf club;*
- *Pylons and Money Point Power Station are prominent features;*
- *Kilrush is a designated Heritage Town and Sea Angling Centre;*
- *Kilrush Marina is a major infrastructure providing 120 berths at all stages of the tide. It has been awarded Blue Flag status;*
- *Scattery Island is a designated ACA (Architectural Conservation Area); and*
- *There are views across to Ballylongford and County Kerry*'.

The development plan states that '*Liaison with Kerry and Limerick County Council should be undertaken with reference to all proposed developments along their coastline*'.

Extract in relation to 'Forces for change'

'*…*

> *Coastal development in prominent locations which would detract from the seascape value of the area e.g. power station, wind farms, marinas, etc. within view on the Kerry and Limerick coastline*

…'.

Extract from ‘Principles for Seascape Management’

‘…

> *Linear urban development should be avoided and all other development should be screened appropriately*
>
> *Views to the coastline of Limerick and Kerry should be retained*
>
> *Promote agricultural and environmental schemes to avoid dereliction of coastal based landscapes*

…’.

<u>SCA 11 – River Shannon</u>

Seascape Character Area Extent
‘*The River Shannon SCA extends from Limerick to east of Money Point. It is bounded by Kerry Head to the South and Kilrush farmlands to the North*’.

Geology and Landform
‘*The River Shannon SCA consists of a shallow low-lying and muddy linear coastline. This area is composed of a prominently ridged landscape, with linear hills aligned south-west to north-east. The coastal fringe is flatter and slopes towards the Shannon. It also becomes increasingly flatter towards Kilrush*’.

Condition and Sensitivity
‘*The estuary is in moderate to good condition. However, industrial and commercial activity dominates the view from land to sea.*

Low lying, flat and open views to sea increase the area's sensitivity to change particularly from shipping and industrial activities’.

Key Characteristics

- ‘*Coastal fringe is flatter and slopes down towards the sea;*
- *Views to scattered farm house settlements;*
- *Deep water berthing facilities;*
- *Views of shipping, commercial, industrial activity, pasture land and forestry;*
- *Focal point for travelling the waterways of Ireland;*
- *Shannon Airport is a landmark transport node of transcontinental significance (also, Fergus Estuary Seascape Area below); and*
- *Car ferry service to Tarbert along the north coast of County Kerry*’.

Extract in relation to ‘Forces for change’

‘…

> *Visible impacts of shipping and commercial activity*
>
> *Plantations of coniferous forestry*

…’.

Extract from ‘Principles for Seascape Management’

‘…

> *Best practice forestry guidelines should be adhered to in order to avoid inappropriately siting or design of plantations*

Infrastructural developments including road widening along the coastline should consider local landscape character

Linear development along the coastline should be avoided and all other development should be screened appropriately.

…'.

10.4.6.3 Co. Limerick

Currently no planning references to a seascape character assessment or a definition of seascape designations.

10.4.6.4 Regional Seascape Character Assessment for Ireland

The Regional Seascape Character Assessment has been prepared for the Marine Institute. The report presents Regional Seascape Character Areas.

Seascape character assessment represents a core component of the evidence base for Marine Spatial Planning and marine policy formulation. Seascape character assessment (SCA) has emerged as a method for assessing, characterising, mapping and describing seascape character.

Seascape is defined as '*an area of sea, coastline and land, as perceived by people, whose character results from the actions and interactions of land with sea, by natural and/ or human factors*', according to the definition from 'An Approach to Seascape Character Assessment, Natural England 2012.

The assessment distinguishes between Regional Seascape Character Types and Regional Seascape Character Areas.

The Shannon Estuary within the study area is located within the following:

Regional Seascape Character Type: 2 – Large Estuary

The Shannon Estuary is part of this character type and has the following principal drivers:

- '*Partially enclosed coastal body associated with confluence of large rivers;*
- *Complex tidal patterns of tidal channels associated with ebb and flow of tidal streams. Mudflats, and small islands present;*
- *Commonly zone of deposition Sloping landform with inlets and small islands;*
- *Deciduous woodland fringes occasional shorelines;*
- *Transitional zone between freshwater and marine with rich habitat for a range of flora and fauna; and*
- *Long history of human activity and habitation associated with sheltered rich estuarine environment*'.

Regional Seascape Character Area: SCA8 – Shannon Estuary and Tralee Bay

The below is an extract of a wealth of information provided in the overall assessment document:

'*The SCA extends eastwards from Limerick including the Shannon Estuary, Mouth of the Shannon from Kilcredaun Point to Kilconley Point, extending landward to the north at Loop Head, encompassing Kerry Head and Brandon Head (Brandon Point/ Dulick Point). This SCA extends 12 nautical miles offshore*'.

Vistas and Views (extract)

- '*Within the estuary views are across the channel with parts of the views framed by the indented shoreline and strips of woodland close to the shoreline, often associated with former demesne landscapes. The vertical features of industrial units such as the towers of Moneypoint and Tarbert help to situate views within this area as it largely low lying and sloping to the shoreline. Whilst industrial elements can be a features within this part of the*

- *SCA the eye is often drawn to the interesting and diverse inlets with wooded shorelines, small rocky shores and a dynamic intertidal zone.*
- *At the elevated parts of this SCA, the views become expansive and long views are possible north and south; where sea stacks and cliffs are visible they draw the eye and the crashing waves against the rocks can dominate the view.*
- *Lighting – clusters of lighting associated with the larger settlements and villages can be seen across the estuary and along the coast. Lighting at Tarbert, Moneypoint, Auginish can be seen associated with stacks and chimneys. The light spill from Limerick City is also visible closer to the city*'.

10.4.6.5 National Marine Planning Framework (NMPF)

The NMPF categorised Shannon Estuary into the following Seascape Character Area:

- Shannon Estuary and Tralee Bay

It also defines it as a 'Large Estuary' in terms of its 'Seascape Coastal Type'. It uses therefore the same categorisation as set out in the Regional Seascape Character Assessment of Ireland as described above in Section 10.4.6.4.

The NMPF sets out the following policy:

'***Seascape and Landscape Policy 1:*** *Proposals should demonstrate how the likely significant impacts of a development on the seascape and landscape of an area have been considered. Proposals will only be supported if they demonstrate that they, in order of preference:*

a) avoid,

b) minimise, or

c) mitigate

significant adverse impacts on the seascape and landscape of the area.

d) If it is not possible to mitigate significant adverse impacts, proposals must set out the reasons for proceeding.

This policy should be included as part of statutory environmental assessments'.

It also states the following (extract):

'Many areas of [the] coastline are distinctive for their natural beauty and their diverse range of activities.

This policy aims to make sure that proposals consider their potential impacts on the seascape and landscape of an area. This is not only important for the protection of iconic views and character but also to aid in the process of enabling development where it is most appropriate.

The effects of development, such as through wind and tidal energy projects, port development, coastal defences, cable landings and pipelines, on an area's seascape and landscape should be considered.

This is not only for individual areas, but also for the contributions they make to nationally designated sites and their settings. Increased footfall from tourism and recreation activities may raise the awareness of an area, but it can also change marine character and the visual resource. Routing and site selection are important tools in ensuring that impacts on seascape and landscape are minimised and mitigated …

The final part of this policy identifies the need to set out the reasons for proceeding where significant adverse impacts on the seascape and landscape of the area cannot be avoided, minimised or mitigated. Where this is required, reasoning should include how optimisation of space might be achieved, what measures are proposed to minimise and mitigate significant adverse impact (if such steps are not possible, a description of why this is), as well as setting out the reasons why a given proposal should proceed in light of the likely impact … '.

10.4.7 Wild Atlantic Way

According to Fáilte Ireland, the Wild Atlantic Way is a ‘defined touring route, stretching along the Atlantic coast from Donegal to West Cork’.

Sections of this touring route are located with the study area in Co. Kerry, Co. Limerick and Co. Clare as mapped in Figures F10-1 Landscape Designations and F10-2 Landscape and Seascape Designations. Sections of Designated Views and Prospects as well as Scenic Routes using the same route/ locations as the Wild Atlantic Way.

Sections of the Wild Atlantic Way located within the study follow the route of the R551 in either direction to Ballylongford and Tarbert, the L6010 to Carrigafoyle Castle, the N67 between Tarbert and Tarbert Ferry Port, the Tarbert-Killimer Ferry Route, sections of the N67 between Killimer and Kilrush but deviating from N67 to the coastal road and the R473 into Kilrush before joining the N67 again. It also extends east from Tarbert towards Foynes along the N69.

Kerry County Development Plan states the following:

‘*The Fáilte Ireland Wild Atlantic Way has identified a network of existing viewing points along its route. In order to maximise the potential of the Wild Atlantic Way these existing viewing points will be protected … The Council will work with Fáilte Ireland in the sustainable development of these viewing points*’.

10.5 Characteristics of the Proposed Development

A detailed description of the Proposed Development is included in Chapter 02 – Project Description.

10.6 Assessment of Impact and Effect

The following potential visual effects, direct and indirect townscape effects, as well as the duration and nature of effects arising from the Proposed Development, have been identified. Photomontages 1-15 illustrate the Proposed Development from representative viewpoint locations within the study area. A description of each photomontage is included in Section 10.6.3 herein.

10.6.1 Effects at Construction

Effects at construction and most works will include earthworks, removal of vegetation, etc., albeit with some level of additional construction works required for the actual location of the Proposed Development and associated developments. The construction stage will give rise to some level of landscape and visual impacts, primarily through additional disturbance, including:

- Loss of existing vegetation.
- Extended soil stripping, earthworks, grading, etc.
- Installation of additional structures related to the Plant.
- Potential effects to visual amenity within the locality or the wider study area as a result of the visibility of construction activities such as ground works, the construction and associated scaffolding, cranes etc.
- Effects of temporary to short-term site infrastructure such as site traffic, construction compounds, soil storage areas etc. especially those located in areas adjacent to visual receptors.
- Physical effects arising from construction of the Proposed Development will be confined to the development site.

It is considered that the emergence of new structures within an extended area of construction activity will be the most visually prominent aspect of the construction works relating to the Proposed Development.

Views of this area and any associated earthworks will also be partly restricted due to the undulating nature of the topography within the Co. Kerry part of the stud area. Open views of the majority of construction works will be possible from the Shannon Estuary itself and the shores of Co. Clare including elevated location in the hinterland. Landscape and visual effects will therefore range from **low** to **high** and their significance from **slight neutral** to **significant adverse** but **temporary-short term** depending on the distance to the Proposed Development and the extent of intervening topography and vegetation.

Photomontages 1-15 supplementing this assessment illustrate the visual effects at operational stage only. The proposed construction works do not allow for a meaningful illustration in photomontages as these can only show one particular snapshot in time, which will not capture the dynamic and complex nature of construction works comprehensively.

Visual effects and their significance during construction works will be temporary to short-term. They will be highest within the immediate vicinity of the site, primarily along the adjacent roads. Principal views of construction works will likely be experienced within a radius of approximately up to 500m from the site boundary as well as from dwellings facing the development site located within approximately 1 km from the site boundary. The magnitude of visual effects is considered **medium** to **high** in close distance views. Their significance is considered **moderate-significant adverse**.

The visibility of construction works within the wider study area beyond 1 km will be limited to middle distance open and partial views within Co. Kerry but to open views across the Shannon Estuary from the coastline in Co. Clare. Middle-and longer distance views will depend on weather conditions and associated visibility. Visual effects from these areas are considered **low** to **medium**, their significance **slight neutral** to **moderate adverse**.

Long distance views from locations within Co. Limerick are limited to elevated locations and will comprise sections of the upper construction works such as cranes. The magnitude of change will be **low** to **negligible** and their significance **not significant** or **imperceptible neutral**.

10.6.2 Effects at Operation

Figure F10-1, Vol. 3 illustrates 15 viewpoints from locations selected as 'Representative Viewpoints' for the assessment of landscape and visual effects of the Proposed Development. Views from these locations have been developed into photomontages, which are included in the Booklet of Photomontages accompanying this planning application.

Operational effects will result in:

- Likely effects of the development on views and visual amenity such as the potential for the development to alter (beneficial or adverse) the composition of the view from a viewpoint; and
- Likely cumulative effects of the development in combination with other planned and proposed developments of similar type and scale upon the landscape and visual resource of the study area.

10.6.3 Landscape Effects (and Seascape Effects)

The following likely direct and indirect landscape effects have been identified, (along with their duration and nature) arising from the Proposed Development. Direct or indirect landscape effects on the fabric of the landscape and its receptors are closely related to the nature and extent of visibility.

The Proposed Development is located within a green field site, which is zoned for industrial development. The site is currently used as agricultural land and is tradversed by a number of existing mature hedgerows, scrub and drainage ditches. The site is located in Landscape Character Area 'Tarbert Pastures' and is zoned for industrial/ strategic development. The landscape character is considered to have a Low-Medium value. The landscape is sensitive to large scale developments. Its sensitivity is considered Medium. While the overall character of the landscape lacks distinct features, its setting along the shores of the Shannon Estuary, its openness, gentle undulations and sparse tree cover provide a sense of transition between land and ocean. The Shannon Estuary at this point is already broad and within reach of the Atlantic.

Key features surrounding the Proposed Development site include low-lying, rolling agricultural pastureland, strongly influenced, and determined by its exposed estuarine setting, along the Shannon Estuary. The broad waters of the Shannon Estuary are the defining landscape feature. However, prominent existing industrial developments at Moneypoint and Tarbert Island and related electricity pylons draw the immediate focus in the landscape.

The main landscape effects of the Proposed Development will be associated with the introduction of large industrial buildings including the LNG Terminal and ships (which will be berthed at the terminal for the majority of the year), leading to a long term change in landscape character at the site and an intensification of the industrial character along the Shannon Estuary. It is anticipated that the Proposed Development will alter the landscape character within approximately 1 km radius on the side of Co. Kerry. Change to the landscape character will be noticeable beyond 1 km and up to approximately 6 km along the coastline of Co. Clare and in elevated areas near the coast.

Direct and long-term change will occur locally where the Proposed Development will be physically located. The landscape character at site location will change from rural agricultural to an industrial. The Proposed Development will retain existing screening vegetation onsite where possible. A detailed landscape masterplan indicates the retention of existing vegetation including hedgerows, and proposes new planting along the entrance road minimising the impact on vegetation cover within the area and supporting the integration of the Proposed Development into its environs. At the site location, the magnitude of landscape change is considered **high** and the resulting significance is **very significant adverse** as the Proposed Development replaces an estuarine rural landscape character with an industrial character.

Indirect change will occur outside of the Proposed Development site boundary, where the visibility of the Proposed Development has an influence on the perception of the character of the landscape. The indirect change in landscape character is greatest in its immediate and close surroundings where open and partial views are possible within approximately 1 km radius from the Proposed Development site boundary in views from the Co. Kerry side of the Shannon Estuary. The magnitude of change in these areas is considered **medium** to **high**. The significance of landscape effects on the landscape character is therefore considered to be **moderate** to **significant adverse**. The Proposed Development will industrialise the landscape character and further intensify the industrial components of the landscape character in the wider study area when seen in conjunction with the existing industrial landscape character around Moneypoint Power Station.

Indirect change and the significance of landscape effects will reduce with increasing distance from the Proposed Development in the remaining study area (beyond approximately 1 km from the Proposed Development site boundary). The magnitude of landscape effects is considered **low** to **medium** and their significance Slight to **moderate adverse**. Given the prominence of the location, the intensification of the industrial character can be recognised over long distances across the Shannon Estuary in Co. Clare, where the change in landscape character will be recognisable at distance ranging between approximately 2.5 km – 6 km depending on weather conditions.

In the context of the wider study area, the Proposed Development will be perceived in conjunction with other existing large-scale industrial developments along the Shannon Estuary, which define already the overall character of estuary and its shorelines within the study area. The Proposed Development will therefore not be seen as totally uncharacteristic and can integrate into the wider landscape character.

The sensitivity and value of the seascape character of SCA 10 – Lower Shannon is considered Medium as existing large scale power stations and wind farms are prominent features the seascape character. The seascape character will be directly and indirectly affected. The addition of another large scale industrial facility with a new jetty and mooring areas will reinforce and intensify the industrial components within the estuarine character and become a prominent feature in the overall low lying and exposed nature of the area. The magnitude of effects on the seascape character are therefore considered **medium** and their significance is considered **moderate adverse**. The Proposed Development with its prominent buildings including the LNG Terminal and ships will further detract from the seascape value of the River Shannon SCA due to the low lying and exposed nature of the area as identified in the ‘Forces for change’ stated in the Seascape Character Assessment of County Clare.

Indirect effects will be experienced in the wider seascape character (beyond approximately 3 km from the Proposed Development site) of the Lower Shannon, where the number of industrial components will increase and further industrialise the character of the seascape long term. The magnitude of effects on the seascape character are therefore considered **low-medium** and their significance **slight-moderate adverse**. However, the proposed change in seascape character is not totally uncharacteristic considering existing large industrial developments within this seascape character area and the zoning of the development site for industrial developments. Landscape and mitigation proposals to minimise likely adverse effects on the landscape and seascape character are described in Section 10.8 – Mitigation and Monitoring Measures of this chapter.

A summary of outline landscape and seascape effects of the Proposed Development on key receptors located within the study area is provided in the table below.

Table 10-13 Summary of Landscape Effects

Receptor	Landscape Susceptibility	Landscape Sensitivity	Magnitude of Change (at operation)	Quality of Effects	Significance of Landscape Effects
Landscape character area *'Tarbert Pastures'* (at the development site)	Medium-Low	Medium	High	Adverse	Very Significant
Landscape Character Area *'Tarbert Pastures'* (outside of the Proposed Development site within 1 km of the site boundary)	Medium-Low	Medium	Medium-High	Adverse	Moderate-Significant
Landscape Character Area *'Tarbert Pastures'* (beyond 1 km of the Proposed Development site)	Medium-Low	Medium	Low-Medium	Adverse	Slight-Moderate
Landscape Character Area '*Ballylongford Creek*' (beyond 500m and up to 1 km of the Proposed Development site)	Medium	Medium	Medium	Adverse	Moderate
Landscape Character Area '*Ballylongford Creek*' (beyond 1 km and up to 4 km of the Proposed Development site)	Medium	Medium	Low-Medium	Adverse	Slight-Moderate
Landscape Character Area '*Ballylongford Creek*' (beyond 4 km of the Proposed Development site)	Medium	Medium	Low	Neutral	Not Significant

Receptor	Landscape Susceptibility	Landscape Sensitivity	Magnitude of Change (at operation)	Quality of Effects	Significance of Landscape Effects
Landscape Character Area '*Inner River Plain*'	Medium	Medium	Very Low to None	Neutral	Imperceptible
Landscape Character Area '*Shannon Estuary Farmland'*	Medium	Medium - High	Low-Medium	Adverse	Slight-Moderate
Landscape Character Area '*Shannon ICZM'*	Medium	Medium	Very Low to None	Neutral	Imperceptible
Seascape Character Area '*Lower Shannon'*	Low	High	Medium	Adverse	Moderate
Regional Seascape Character Type: *2 – Large Estuary* (or Seascape Coastal Type according to the National Marine Planning Framework)	Low	High	Medium	Adverse	Moderate
Regional Seascape Character Area: *SCA8 – Shannon Estuary and Tralee Bay* (or Seascape Character Area according to the National Marine Planning Framework)	Low	High	Medium	Adverse	Moderate

10.6.4 Visual Effects

Visual effects will mainly relate to the introduction of HRSG and turbine halls as well as storage tanks / silo's, the LNG Terminal and LNG ships.

The main visual receptor groups are residents, vehicle travellers including ferry passengers, workers and visitors / tourists. Residents will have the highest sensitivity to change than road users or ferry passengers. Vehicle travellers and workers will focus mainly on traffic or their commercial tasks and not primarily on available views. Ship passengers will see the Proposed Development in conjunction with the prominent existing Tarbert Power Station and Moneypoint Power Station structures.

Visual effects will mainly relate to the introduction of a new large industrial facility onshore and the LNG terminal and ships within the River Shannon.

The closest residential dwellings in the immediate environment of the Proposed Development are located along the L1010 and the overall local road network in the area within approximately 1 km radius from the Proposed Development boundary in Co. Kerry. The highest visual change will be in in the vicinity of the new entrance area along the L1010, at Ralappane House immediately east of the Proposed Development and in elevated areas where views of sections of the upper buildings such as the proposed 3 HRSG and turbine halls along with storage tanks/ silo's become available. The LNG terminal will often be screened in views from residences by topography, intervening vegetation and the proposed onshore structures itself. Viewpoints / Photomontages 1-4 & 6 are located within approximately 1 km of the development boundary in Co. Kerry and are described in detail in Sections 10.6.4.1 and following herein.

Within the Co. Kerry side of the study area beyond 1 km from the boundary, views become quickly intermittent due to undulating topography and intervening vegetation. Viewpoints / Photomontages 5, 7 & 8 illustrate views from within 1-7 km from the boundary. Viewpoint / Photomontage 9 illustrates a long distance view to the east at approximately 9.5 km distance. Visual effects for these viewpoints and general surrounding areas at these various distance are described in detail in Sections 10.6.4.5 and following herein.

The Proposed Development will introduce a prominent industrial facility in available views within the Co. Kerry section of the study area. It will often be seen in conjunction with the existing Moneypoint Power Station and associated wind farm. In that respect, and considering the zoning of the site and surrounding areas for industry, the proposed development is not uncharacteristic in available views. However, it will introduce prominent structures in a currently rural section of the shoreline. It will intensify the industrial character of estuarine views. It will create a new points of focus in available close distance views (within approximately 1 km of the site). The significance of visual effects is considered to range from slight to significant adverse depending on the openness of the view and the extent of intervening topography and existing vegetation. Some close distance views are fully screened by intervening commercial forest plantations. Considering the location and the middle to long distance nature of views within 1 – 7 km from the development site boundary, visibility will also depended on weather conditions and the level of haziness.

The majority of open views of the Proposed Development will be experienced from the Co. Clare side of the Shannon Estuary, where middle to long distance open views of the proposal will be possible. This includes most coastal roads within the study area as well as elevated sections of the N67 and adjoining local roads, refer to Viewpoints / Photomontages 12 & 14. Visibility is generally considered middle to long distance in nature (beyond 1 km) due to the width of the estuary. Despite the distance, the Proposed Development will become a discernible new focus point in views from the shoreline. Refer to Viewpoints / Photomontages 10, 11 & 13. The Proposed Development will be a new component on often panoramic views across the estuary into Co. Kerry. It will be seen in conjunction with existing wind turbines including Leanamore Wind Farm and Tullahennel Wind Farm in Co. Kerry and Money Point Power Station and its chimney stacks in Co. Clare. Similar as for views in Co. Kerry, existing views contain already large scale industrial or light industrial developments, and the Proposed Development will therefore not be totally out of character. It will nevertheless industrialise additional areas further west along the shoreline, which are currently rural and natural in appearance. Visual effects are considered to range from low-high and the significance from slight to significant adverse depending on the distance and panoramic nature of the views. Considering the generally open nature of shoreline or elevated views from areas close to the shoreline, the visual change is still significant despite the middle to long distance nature of these views. A detailed description of Viewpoints / Photomontages listed above is contained in Sections 10.6.4.10 and following herein.

Viewpoint / Photomontage 15 illustrates a view from the ferry between Tarbert-Killimer within the River Shannon Seascape Character Area. The Proposed Development will further industrialise the Shannon Estuary in views west. However, it will be seen as one industrial component of several in available views. The buildings including the LNG Terminal and ships will be clearly visible in good weather conditions and add to the existing industrial character of the view. The development will, however, not alter the existing views significantly as it will be seen in panoramic views in conjunction with existing large power station structures of Tarbert and Moneypoint Power Station including wind turbines. A detailed description of this Viewpoint / Photomontage is contained in Section 10.6.4.15 herein.

Night-time photomontages have been produced for Viewpoints / Photomontages 8 and 12. The set of photomontages show the existing lit situation and the proposed scenario with main lights turned on only (day-to-day lighting required) and all lights turned on. A detailed description an assessment of visual effects is provided in the individual viewpoint / photomontage descriptions in Sections 10.6.4.8 and 10.6.4.12.

Viewpoints / Photomontages 1-15 (refer to Booklet of Photomontages) illustrate views from representative viewpoints within the study area, which captures estuarine views from the northern and southern shores of the Shannon Estuary.

10.6.4.1 Viewpoint/ Photomontage 1: View northwest from the L1010 at Carhoonakilla, Co. Kerry

This viewpoint is located at an approximate 972m distance to the centre of the site along the L1010 in the townland area of Carhoonakilla and shows an open view to the northwest. Beyond the road boundary, the landscape is comprised of undulating agricultural fields, enclosed by hedgerows. A farm settlement is partially visible in the distance in the left of this view, consisting of residential buildings along with ancillary outbuildings, sheds and barns. To the right of the view, on the horizon sits a band of farmed coniferous trees in front of which are two electricity pole sets associated with an overhead transmission line. A grouping of mature trees is visible in the distance to the left of the farm buildings.

The value of this view is considered to be low. The sensitivity of this view is considered medium-low. Visual receptors will mainly be vehicle drivers including cyclists or walkers. The susceptibility to change is considered medium as the view may be important to receptors but it will not be the primary focus.

In the photomontage, sections the upper parts of the proposed HRSG halls as well as storage tanks / silo's will become visible above the ridge in the background beyond the existing farm buildings in the centre of the view. The Proposed Development does not protrude much higher than the existing buildings. Some screening is offered by existing intervening vegetation associated to the farm in the distance. The Proposed Development will cause a noticeable but not prominent change in the current view. The magnitude of visual effects is considered **medium** and the significance is **slight adverse**.

10.6.4.2 Viewpoint/ Photomontage 2: View north from local road at Kilcolgan Upper, Co. Kerry

This viewpoint is located at an approximate 1,038 m distance to the centre of the site along L1010 in the townland of Kilcolgan Upper. The view is orientated to the north and is representative of a number of similar views in this area and displays an open undulating landscape in an estuarine setting. Sections of the River Shannon and the coastline of Co. Clare can be seen in seen in the distance. Mature/ semi-mature trees dissect the view in the centre, a dwelling sits in the right of this view. The existing Moneypoint Power Station with its prominent stacks, as well as the associated wind farm can be seen in the background of this view.

The value of this view is considered to be medium. The sensitivity of this view is considered medium-high. Receptors of this view include mainly vehicle drivers including cyclists, local residents and walkers. The susceptibility of the view to change is considered medium.

The upper sections of the proposed 3 HRSG and turbine halls along with storage tanks/ silo's and other building structures will become visible in the middle distance. The Proposed Development will become a prominent new point of focus in this view. It will intensify the industrial character of this view bringing industrial elements further south and closer to this viewpoint. While prominently visible, the Proposed Development is not totally uncharacteristic when seen in combination with the existing power station buildings at Moneypoint. The Proposed Development will extend the established pattern of industrial development further west along the Shannon Estuary. While the underlying existing characteristic components of the view remain, there will be a clearly recognisable change in the overall composition of the view. The magnitude of visual effects is considered **medium-high** and the significance is **significant adverse**.

10.6.4.3 Viewpoint/ Photomontage 3: View north from local road at Glencullare North, Co. Kerry

This viewpoint is located at an approximate 1,988 m distance to the centre of the site along a local road in the townland of Glencullare North, and further south than Viewpoint/ Photomontage 2. This more elevated view is orientated to the north and representative of views in this area. Intermittent open views of the Shannon Estuary and Co. Clare in the distance are offered. A dwelling and an associated ancillary building as well as local overhead transmission lines are visible in this view. Existing vegetation includes roadside hedgerows and few single stands or small clusters of trees. Two existing stacks and other buildings associated with Moneypoint Power Station become partially visible in the background.

The value of this view is considered to be medium. The sensitivity of this view is considered medium-high. Receptors of this view include mainly vehicle drivers including cyclists, local residents and walkers. The susceptibility of the view to change is considered Medium.

The upper sections, mainly the HRSG and turbine halls, of the Proposed Development will become visible in the middle distance below the horizon line. From this viewing location, the roof sections of the three turbine halls will be the most visible elements followed by smaller scale ancillary buildings. The magnitude of change is considered **medium** and the resulting significance of visual effects is considered to be **slight-moderate adverse** as the development will increase the prevalence of large industrial infrastructure in this view when seen in combination with the existing Moneypoint Power Station components.

10.6.4.4 Viewpoint/ Photomontage 4: View east/ northeast from Kilcolgan Lower. Co. Kerry

This viewpoint is located at an approximate 1,281 m distance to the centre of the site along a local access road north of the L1010 in the townland of Kilcolgan Lower. The view is orientated east/ northeast and is representative of views in this area, which include partially open views along the Shannon Estuary. The existing Moneypoint Power Station with its two chimney stacks as well as the associated wind farm are prominent features in the background of this view.

The value of this view is considered to be medium. The sensitivity of this view is considered medium. Receptors of this view include mainly vehicle drivers including cyclists, local residents and walkers. The susceptibility of the view to change is considered Medium.

Sections of the proposed HRSG and turbine halls as well as the air cooled condenser units will become visible in the middle distance. The views will also include the superstructures of the proposed LNG ships. The Proposed Development will be partially screened by intervening topography and vegetation. The HRSG and air cooled condenser units will become prominent new structures in this view and a new point of focus apart from the existing chimney stacks and wind turbines of Moneypoint Power Station in the background. The magnitude of visual change is considered **medium** and resulting significance of visual effects is considered to be **moderate adverse** as the development will further industrialise the view and increase the prevalence of large industrial infrastructure in this view when seen in combination with the existing Moneypoint Power Station components.

10.6.4.5 Viewpoint/ Photomontage 5: View northeast from L1010 in the townland of Kilcogan Lower east of Saleen Pier, Co. Kerry

This viewpoint, located at an approximate 2,256 m distance to the centre of the site, is representative of views northeast along the L1010. The foreground of the view comprises an agricultural field bounded by hedgerows and drainage ditches as well as a deciduous tree plantation in the middle distance. Local overhead distribution lines are located along the road. Sections of the Shannon Estuary are visible in the background. Residential properties are located behind the photographer of this view and are generally located individually or in small clusters along the L1010.

The value of this view is considered to be low. The visual receptors are mainly vehicle drivers and residents, some of which have windows facing into the same directions as this view. The sensitivity and susceptibility to change is considered medium-high.

The Proposed Development will be fully screened by intervening vegetation and topography an therefore not result in visual effects from this viewpoint.

10.6.4.6 Viewpoint/ Photomontage 6: View northeast from L1010 in the townland of Kilcogan Lower, Co. Kerry

This viewpoint, located at an approximate 1,827 m distance to the centre of the site, is representative of views northeast along the L1010 in the townland of Kilcogan Lower. A cluster of residential properties is located along the local road together with roadside hedgerows. Local overhead distribution lines are located along either side of the road. Intervening vegetation screens views of the Shannon Estuary.

The value of this view is considered to be low. The visual receptors are mainly vehicle drivers and local residents, some of which have windows facing towards the Proposed Development site. The sensitivity and susceptibility to change is considered medium.

The Proposed Development will be fully screened by intervening vegetation and topography an therefore not result in visual effects from this viewpoint.

10.6.4.7 Viewpoint/ Photomontage 7: View northeast from the R551, Bridge Street, Ballylongford, Co. Kerry

This viewpoint, located at an approximate 4,660 m distance to the centre of the site, is representative of views looking northeast from the R551 overlooking wetlands towards the Shannon Estuary. Moneypoint Power Station with its 2 stacks and associated wind farm are prominent focus points in the background. This section of the R551 is part of the Wild Atlantic Way touring route.

The value of this view is considered to be medium-high. The visual receptors are residents of adjacent properties, pedestrians, vehicle drivers and tourists. The sensitivity and susceptibility to change is considered medium-high.

Upper sections of the proposed HRSG and turbine halls will become partially visible in the background beyond the ruins of Lislaughtin Abbey. The majority of the Proposed Development is screened by intervening vegetation and topography as well as existing built structures. Due to the proposed colours of the built structures, the development will not become a prominent point of focus. While discernible, it will integrate into the existing view. The magnitude of visual change is therefore considered **low** and the resulting significance of visual effects is considered to be **not significant adverse**.

10.6.4.8 Viewpoint/ Photomontage 8: View east from Carrig Island, Co. Kerry

This viewpoint is located at an approximate 3,418 m distance to the centre of the site. The open view looks east from the shores of Carrig Island upstream along the River Shannon Estuary. The estuarine views include the coastline and headlands of the Co. Kerry shoreline as well as the Co. Clare shoreline in the distance. Moneypoint Power Station with its 2 stacks and prominent ancillary building structures including loading terminals in the River Shannon as well as the adjacent wind farm development will be clearly visible. Wind turbines associated with the Leanamore Wind Farm on the Co. Kerry side are also discernible.

The value of this view is considered medium. Receptors of this view will be local residents, walkers and visitors to Carrig Island. Their susceptibility to change is considered medium-high. The sensitivity of this area can be categorised as medium-high.

Day-time Photomontage

The Proposed Development will become visible in the centre of the view in the distance. The proposed jetty of the LNG Terminal as well as the LNG ships will become visible and new points of focus in the distance. The Proposed Development will introduce an industrial character along the southern shores of the Shannon Estuary in this view and intensify the overall industrial elements of this view. However, the Proposed Development will become one focus points among other existing ones in this panoramic view. The overall character of this view, its open nature and panoramic quality will not be altered. The proposed colour scheme will help integrating the Proposed Development within the existing visual character of the southern shoreline. The magnitude of change is considered **medium** and the resulting significance of visual effects is considered to be **moderate adverse**.

Night-time Photomontage/ Main Lights Turned On Only

During the hours of darkness, the existing Moneypoint Power Station is the most prominently lit up area along the northern shores of the Shannon Estuary, other sources of light are dotted along the remaining parts of the northern and southern shores of the estuary with the second most prominent source being Tarbert Power Station in the background. The Proposed Development with main lights turned on only will be a barely discernible addition to the overall lit up sections along the estuary. The LNG Terminal and associated ships will become the most discernible part of the lit Proposed Development. The magnitude of visual change during the hours of darkness will be **low** and the significance is considered **slight adverse**.

Night-time Photomontage/ All Lights Turned On

The Proposed Development will become a more obvious feature along the shore of the estuary at times when all lights of the Proposed Development are turned on. However, it will not become a prominent new lit up feature in the night view as the proposed lighting scheme is designed to focus on the ground and on areas where light is needed only thus reducing the amount of light spill into the surrounding environs as far as feasible. While the overall shoreline will be lit up further, the magnitude of visual change is considered **low-medium** and the significance **slight-moderate adverse**.

It should be noted that the visibility of the proposed lit up development will be highly depended on weather conditions at this distance.

10.6.4.9 Viewpoint/ Photomontage 9: View east from Littor Beach, Co. Kerry

This viewpoint, located at an approximate 9,440 m distance to the centre of the site, is representative of views east from Littor Beach with a panoramic view across Bunaclugga Bay. The low shorelines north and south along the wide Shannon Estuary allow for long distance panoramic views without significant vertical natural features. However, Moneypoint Power Station with its two chimney stacks, ancillary building structures and the associated wind farm are prominent vertical features in this long distance view. Tarbert Power Station with its chimneys and boiler halls are seen in the background along the southern shore of the estuary. Wind turbines associated with the Leanamore Wind Farm on the Co. Kerry side come into view on the right side in this view.

The value of this view is considered to be medium-high. The visual receptors are mainly walkers along the beach at times of low tide. The sensitivity and susceptibility to change is considered high.

The Proposed Development will be seen at a long distance from this viewpoint. Upper sections of the proposed HRSG and turbine halls will become partially visible as well as the proposed LNG Terminal and ships. While the Proposed Development will be discernible, it will not become another prominent industrial feature in this view. However, visibility of the Proposed Development will intensify the built up and industrial section along the shorelines of the Shannon estuary. The proposed building colours will help to integrate the development into its setting and avoid the creation of prominent new focus points. The magnitude of visual change is therefore considered **low** and the resulting significance of visual effects is considered to be **slight neutral**.

10.6.4.10 Viewpoint/ Photomontage 10: View southeast from Cappagh Pier, Coast Road, Co. Clare

This viewpoint, located at an approximate 6,618 m distance to the centre of the site, is representative of views southeast from Cappagh Pier close to the town of Kilrush. The Coast Road at Cappa Village in the townland area of Cappagh provides open estuarine views of sections of Hog Island (on the right in this view) as well as sections of the northern shore in Co. Clare (on the left in this view) and the southern shores of the Shannon Estuary in Co. Kerry (in the centre of this view). The shorelines are overall gently undulating and sparsely vegetated with any significant taller vegetation. Clusters of trees and residential dwellings can be seen along section of the Co. Clare shoreline and in the distance along the Co. Kerry shore. A single wind turbine and wind turbines associated with Leanamore Wind Farm are also visible in the centre setback from the Co. Kerry shoreline providing light industrial features in this view. The 2 chimney stacks of Moneypoint Power Station are out of view but are generally a discernible feature in the distance in views from this area. This view as well as other views along the Coast Road are designated as a scenic route in Clare County Development Plan and form also part of the Wild Atlantic Way touring route.

The value of this view is considered to be high. Visual receptors are mainly walkers, vehicle drivers, pedestrians and visitors. The sensitivity and susceptibility to change is considered high.

The Proposed Development will be openly visible in the centre of this view. The most discernible features will be the HRSG halls, the LNG Terminal and ships. However, most built structures of the Proposed Development will be visible. Considering the long distance and the high dependency on clear weather conditions, the Proposed Development will not become a prominent feature in this view, however it will, on a clear day become a new point of focus and it will intensify the industrial elements in this view. The proposed building colour scheme with its muted dark greens and greys is designed to particularly address open views across the Shannon Estuary. The Proposed Development will be seen against the land with its various shades of green and brown. The proposed colour scheme will pick up some of these colours and help the visual integration of the Proposed Development into its setting avoiding bright colours, which would otherwise point at and emphasise the proposed built structures even in long distance views. The magnitude of visual change is considered **medium**. The resulting significance is considered to be **moderate-significant averse**.

10.6.4.11 Viewpoint/ Photomontage 11: View southeast from Coast Road at Aylevarroo, Co. Clare

This viewpoint, located at an approximate 4,780 m distance to the centre of the site, is representative of views along the Coast Road from at Aylevarroo Bay. This open view across the Shannon Estuary and of the southern shoreline at Co. Kerry as well as other views along the Coast Road are designated as a scenic route in Clare County Development Plan and form also part of the Wild Atlantic Way touring route. The view contains a number of wind turbines setback from the shores in Co. Kerry. The wider panoramic view further left and not visible in this images contains the prominent built structures including chimney stacks of Moneypoint Power Station and the associated wind turbines. Tarbert Power Station would also become visible further left to this view. However, this view captures what a human eye can see without turning and focuses on the viewshed containing the Proposed Development.

The value of this view is considered to be medium-high. The visual receptors are mainly vehicle drivers including cyclists and occasional walkers. The sensitivity and susceptibility to change is considered medium.

The Proposed Development will be openly visible along the shoreline of Co. Kerry. The most prominent features will be the HRSG and turbine halls, the LNG Terminal and ships. However, most built structures of the Proposed Development will be visible. The Proposed Development will become a new point of focus in this view and intensifies the number of industrial developments along the Shannon Estuary in views from this area. Similar to Viewpoint/ Photomontage 10, the proposed building colour scheme with its muted dark greens and greys is designed to particularly address open views across the Shannon Estuary. The Proposed Development will be seen against the land with its various shades of green and brown. The colour scheme will pick up some of these colours and help the visual integration of the Proposed Development into its setting avoiding bright colours, which would otherwise emphasise further the existence of the proposed industrial structures in this view. The magnitude of visual change is considered **medium-high**. The resulting significance is considered to be **significant averse**.

10.6.4.12 Viewpoint/ Photomontage 12: View southwest from N67 at Moyne Court, Co. Clare

This viewpoint, located at an approximate 4,409 m distance to the centre of the site, is representative of elevated views from the N67 at Moyne Court, looking south, southeast across the Shannon Estuary in the direction of the Proposed Development site. This view as well as other views along the N67 are designated as a scenic route in Clare County Development Plan and form also part of the Wild Atlantic Way touring route. The south sloping terrain towards the Shannon estuary contains generally low vegetation, clusters of small trees, low voltage transmission lines and some dwellings. The appearance of the existing vegetation is windswept. While out of view to the left of this image, Moneypoint Power Station and wind farm are vertical prominent features in the overall setting of the area. In the distance across the Shannon, the Co. Kerry shoreline and undulating landform form the backdrop and include wind turbines including Leanamore Wind Farm.

The value of this view is considered to be medium-high. Visual receptors include mainly vehicle drivers including cyclists and local residents. The sensitivity and susceptibility to change is considered medium.

The Proposed Development will be openly visible from this viewpoint. The most prominent features will be the HRSG and turbine halls, the LNG Terminal and ships as well as storage tanks / silo's. The Proposed Development will industrialise sections of the Kerry shoreline in this view and alter the visual character of the Co. Kerry shoreline in this view. It will become a point of focus and will be seen together with existing industrial structures at Moneypoint Power Station and the associated wind farm. The Proposed Development will be seen against the land with its various shades of green and brown. The proposed building colour scheme will pick up some of these colours and help the visual integration of the Proposed Development into its setting avoiding bright colours, which would otherwise emphasise further the existence of the proposed industrial structures in this view. The magnitude of visual change is considered **medium-high**. The resulting significance is considered to be **significant averse**.

Night-time Photomontage/ Main Lights Turned On Only

During the hours of darkness, sections of the existing Moneypoint Power Station are prominently lit up on the Co. Clare side. Demarcation lights of wind turbines located in the vicinity of Moneypoint Power Station and across the Shannon estuary along the coastline of Co. Kerry are also red pointers in the dark. Other lights, including some very bright spots are dotted along the Co. Kerry shoreline and relate mainly to residential dwellings or farms.

The Proposed Development with main lights turned on will be most recognisable through the lit LNG Terminal and ships. The remaining structures will be a barely discernible addition to the overall nightscape. The magnitude of visual change during the hours of darkness will be **low** and the significance is considered **slight adverse**.

Night-time Photomontage/ All Lights Turned On

The Proposed Development will become another discernible industrial feature along the shore of the estuary at times when all lights of the Proposed Development are turned on. The glow is, however, muted due to the application of a proposed lighting scheme that is designed to focus on the ground and on areas where light is needed only thus reducing the amount of light spill into the surrounding environs as far as feasible. The overall shoreline will be lit up further extending recognisable lit industrial facilities further west along the Shannon Estuary. The magnitude of visual change is considered **medium-high** and the significance **moderate-significant adverse**.

It should be noted that the visibility of the proposed lit up development will be highly depended on weather conditions at this distance.

10.6.4.13 Viewpoint/ Photomontage 13: View south from N67 across Ballymacrinan Bay, Co. Clare

This viewpoint, located at an approximate 3,661 m distance to the centre of the site, is representative of shore views from the northern banks of the Shannon Estuary of the study area, looking south across the Shannon Estuary of the Proposed Development site. The foreground of the view comprises a pebble shoreline with the waters of Shannon Estuary spanning across the scene. A wind turbine and met mast associated with Moneypoint Power Station can be seen left in the view. The tall verticality of these structures contrast with wide open view across the Shannon Estuary and its low shorelines from this location. The distant shoreline and hillsides of Co.Kerry define the background of this view and include a number of clusters of wind turbines including Leanamore Wind Farm and Tullahennel Wind Farm. This view as well as other views along the N67 in this area are designated as a scenic route in Clare County Development Plan and form also part of the Wild Atlantic Way touring route.

The value of this view is considered to be medium-high. The visual receptors are local residents, vehicle drivers including cyclists and walkers. The sensitivity and susceptibility to change is considered medium-high.

The Proposed Development will be openly visible with most of his components across the Shannon Estuary. It will become a new point of focus in this view and industrialise this section of the Co. Kerry shoreline. In the overall context of the location of this viewpoint, which is in close proximity to the existing Moneypoint Power Station and associated wind farm, the intensification of the industrial nature of the shoreline along the Shannon Estuary is not totally uncharacteristic.

The most discernible features will be the HRSG halls, the LNG Terminal and ships. The Proposed Development will mostly be seen against the land with its various shades of green and brown. The upper sections of the HRSG halls will break the skyline from this location. The proposed building colour scheme will pick up some of shades of the existing surrounding landscape and help the visual integration of the Proposed Development into its setting avoiding bright colours, which would otherwise point at and emphasise the proposed built structures in views across the Shannon Estuary. The magnitude of visual change is considered **medium-high**. The resulting significance is considered to be **moderate-significant averse**.

10.6.4.14 Viewpoint/ Photomontage 14: View southwest from the N67 west of Killimer, Co. Clare

This viewpoint, located at an approximate 4,206 m distance to the centre of the site. It is representative of elevated views from a car park located along the N67 opposite the Church of St. Imy at Carrowdotia, west of Killimer in Co. Clare. Views along the N67 across the Shannon Estuary are generally intermittent due to road side vegetation and an undulating land profile in this area. This viewpoint location provides an open view passing a residential property and across the existing Moneypoint Power Station facilities including loading cranes, a wind turbine and one of the two chimney stacks. The Shannon estuary is located in the middle distance and an elevated panoramic long distance view opens up along the shores of Co. Kerry and beyond in the background. A number of clusters of wind turbines including Leanamore Wind Farm and Tullahennel Wind Farm can be seen in the distance on the Co. Kerry side. This viewpoint at the N67 is located along a designated scenic route as identified in the Clare County Development Plan which is also part of the Wild Atlantic Way touring route.

The value of this view is considered to be low-medium. The visual receptors are local residents, visitors to the Church of St Imy, vehicle drivers including cyclists and walkers. The sensitivity and susceptibility to change is considered medium-high.

The majority of the Proposed Development will be openly visible in the distance. The existing intervening loading cranes will only partially obscure views of small sections of the Proposed Development in the distance. The Proposed Development will introduce a large industrial complex along the shoreline of Co. Kerry in this view and industrialise this view further. When seen in conjunction with the prominent existing components of Moneypoint Power Station, the Proposed Development is not totally uncharacteristic. However, it will become a new point of focus, particularly the proposed LNG Terminal and ships, the HRSG halls and storage silos. The overall development will be seen against the land. The proposed building colour scheme will pick up some of shades of the existing surrounding landscape and help the visual integration of the Proposed Development into its setting avoiding bright colours, which would otherwise point at and emphasise the proposed built structures further in views across the Shannon Estuary. The magnitude of visual change is considered h**igh**. The resulting significance is considered to be **moderate-significant adverse**.

10.6.4.15 Viewpoint/ Photomontage 15: View soutwest from Tarbert-Killimer ferry, Co. Clare

This viewpoint, located at an approximate 5,400 m distance to the centre of the site, is representative of views within the northern section of the Tarbert-Killimer ferry journey. This view illustrates an open and transient view west from the ferry along the Shannon Estuary flanked by the undulating shorelines of Co. Clare and Co. Kerry. Existing wind farm developments can be seen in the background on the Co. Kerry side. This particular view is focused towards the direction of the Proposed Development and contains one wind turbine associated with the wind farm at Moneypoint Power Station. If the viewer is to turn the head left the existing Tarbert Power Station and ancillary developments including storage tanks would become visible in views south. If the view where to turn further right to the north, the existing 2 chimney stacks of Moneypoint Power Station would become visible. The character of this view is determined by the seascape of the River Shannon. The overall seascape character in this area is defined by a mix of large industrial developments (Tarbert and Moneypoint Power Stations), fields bounded by hedgerows and low trees as well as clusters of coniferous plantations. The view from this particular viewpoint contains still large sections of natural although man-altered landscape along the shores. This view as well as the overall ferry journey between Tarbert and Killimer form part of the Wild Atlantic Way touring route.

The value of this view is considered to be medium. The visual receptors are ferry passengers. The sensitivity and susceptibility to change is considered medium-high.

The Proposed Development will be openly visible in the distance. During clear weather conditions, the Proposed Development will introduce an industrial facility and a new point of focus along the Co. Kerry shore in the middle distance. The most prominent features will be the HRSG halls, storage silos, the LNG Terminal and ships. The proposed building colour scheme will pick up some of shades of the existing surrounding landscape and help the visual integration of the Proposed Development into its setting avoiding bright colours, which would otherwise point at and emphasise the proposed built structures further in views across the Shannon Estuary. The magnitude of visual change is considered low-medium. The resulting significance is considered to be **moderate adverse**.

A summary table of visual effects from representative viewpoint locations is enclosed below:

Table 10-14 Summary of Visual Effects from Representative Viewpoint Locations

Viewpoint / Photo-montage	Receptor Group	Value of View	Susceptibility of View to Change	Sensitivity of View	Magnitude of Visual Effects (at operation)	Quality of Effects	Significance of Effects
1	Vehicle drivers, cyclists, walkers	Medium	Medium	Medium-Low	Medium	Adverse	Slight
2	Residents, vehicle drivers, cyclists, walkers	Medium	Medium	Medium-High	Medium-High	Adverse	Significant
3	Residents, vehicle drivers, cyclists, walkers	Medium	Medium	Medium-High	Medium	Adverse	Slight-Moderate
4	Residents, vehicle drivers, cyclists, walkers	Medium	Medium	Medium	Medium	Adverse	Moderate
5	Residents, vehicle drivers	Low	Medium-High	Medium-High	None	Neutral	None
6	Residents, vehicle drivers, cyclists, walkers	Low	Medium	Medium	None	Neutral	None
7	Residents, vehicle drivers, pedestrians, tourists	Medium-High	Medium-High	Medium-High	Low	Adverse	Not Significant
8 Day-Time	Residents, vehicle drivers, pedestrians, tourists	Medium	Medium-High	Medium-High	Medium	Adverse	Moderate
8 Night-Time (Main Lights turned on only)	Residents, vehicle drivers, pedestrians, tourists	Medium	Medium-High	Medium-High	Low	Adverse	Slight
8 Night-Time (All Lights turned on)	Residents, vehicle drivers, pedestrians, tourists	Medium	Medium-High	Medium-High	Low-Medium	Adverse	Slight-Moderate
9	Walkers	Medium-High	High	High	Low	Neutral	Slight

10	Residents, vehicle drivers, walkers, visitors	High	High	High	Medium	Adverse	Moderate-Significant
11	Vehicle drivers, cyclists, walkers	Medium-High	Medium	Medium	Medium-High	Adverse	Significant
12 Day-Time	Residents, vehicle drivers, cyclists	Medium-High	Medium	Medium	Medium-High	Adverse	Significant
12 Night-Time (Main Lights turned on only)	Residents, vehicle drivers, cyclists	Medium-High	Medium	Medium	Low	Adverse	Slight
12 Night-Time (All Lights turned on)	Residents, vehicle drivers, cyclists	Medium-High	Medium	Medium	Medium-High	Adverse	Moderate-Significant
13	Residents, vehicle drivers, cyclists, walkers	Medium-High	Medium-High	Medium-High	Medium-High	Adverse	Moderate-Significant
14	Residents, vehicle drivers, cyclists, walkers, visitors	Low-Medium	Medium-High	Medium-High	High	Adverse	Moderate-Significant
15	Ferry passengers	Medium	Medium-High	Medium-High	Low-Medium	Adverse	Moderate

10.6.5 Effects on Protected Views and Prospects/ Scenic Routes

10.6.5.1 Co. Kerry

Relevant protected views and prospects located within the study area are indicated in Figures F10-1 Landscape Designations and F10-2 Landscape and Seascape Designations. Visual effects on protected views and prospects are described below:

Views north of the River Shannon estuary and Co. Clare shores from a section of the R551 between Ballylongford and Asdee:

Designated views are pointing north and away from the Proposed Development. No landscape and visual effects will therefore arise from the Proposed Development in these views.

Estuarine views east and northeast along sections of the L6010 towards Carrigafoyle Castle north of Ballylongford: Available views of Carrigafoyle Castle will not be altered including estuarine views to the north and east in close proximity. However, similar as illustrated in Viewpoint/ Photomontage 8 (as described in Section 10.6.4 above), sections of the Proposed Development (mainly the upper sections of the proposed HRSG and turbine halls and sections of the LNG Terminal and ships) will become partially visible in the distance when road side vegetation along this road is low and allows for long distance views north and east. Estuarine views include the coastline and headlands of the Co. Kerry shoreline as well as the Co. Clare shoreline in the distance. Moneypoint Power Station with its 2 stacks and prominent ancillary building structures including loading terminals in the River Shannon as well as the adjacent wind farm development will be clearly visible. Wind turbines associated with the Leanamore Wind Farm on the Co. Kerry side are also discernible.

The magnitude of change in open views is considered medium and the resulting significance of visual effects is considered to be moderate adverse.

Views west of Lislaughtin Abbey from a short section of the L1010 northeast of Ballylongford: Designated views are pointing west, northwest and away from the Proposed Development. No landscape and visual effects will therefore arise from the Proposed Development in these views.

Views east and southeast of Tarbert Bay along sections of the N69 including its section on Tarbert Island to the ferry terminal: Designated views are pointing east and southeast and away from the Proposed Development. No landscape and visual effects will therefore arise from the Proposed Development in these views.

10.6.5.2 Co. Clare

Relevant designated scenic roads located within the study area are indicated in Figures F10-1 Landscape Designations and F10-2 Landscape and Seascape Designations. Visual effects on scenic roads are described below:

Coast road south east of Cappagh to Carrowdotia South (which includes sections of the N67)

Viewpoint / Photomontages 10 – 13 illustrate views from this scenic route and are described in Section 10.6.4 above. In summary, the magnitude of visual effects is considered to range between Medium and Medium-High during day-time hours. The significance is considered Moderate-Significant. Viewpoint / Photomontage 12 illustrates also the effects at night-time. The magnitude of visual effects ranges between Low and Medium-High and the resulting significance between Slight and Moderate-Significant depending if the Proposed Development is partially or fully lit. In general, views along this scenic route include open views across the Shannon Estuary and the southern shores in Co. Kerry. These often long distance views include long stretches of natural coastline but include also significant existing industrial developments such as Moneypoint Station as well as wind farms on either side of the shore. Views contain therefore often sections of industrial developments already. The Proposed Development will become a new point of focus in available views and depending on the distance, a prominent new feature in views. Given the long distance which ranges between 3.5 – 6.5 km, the extent of visibility will be depended on weather conditions. The Proposed Development will be seen in the context of existing industrial facilities and while it will intensify the industrial nature of views, it will not be totally uncharacteristic in available views.

10.6.6 Effects on the Wild Atlantic Way

Sections of the Wild Atlantic Way touring route are located within the study area as indicated in Figures F10-1 Landscape Designations and F10-2 Landscape and Seascape Designations. Sections of Designated Views and Prospects (Co. Kerry) as well as Scenic Routes (Co. Clare) using the same route/ locations as the Wild Atlantic Way.

10.6.6.1 Co. Kerry

Views from the Co. Kerry section will be limited to intermittent and glimpsed views of upper sections the Proposed Development in the distance but are often fully screened by intervening roadside vegetation and topography considering that the touring route is mainly well setback from the shoreline or views are orientated away from the Proposed Development. Viewpoint / Photomontage 07 indicates a view from this touring route in Co. Kerry and has been described in detail in Section 10.6.4 above.

In summary, the magnitude of visual change in Viewpoint / Photomontage 07 is considered low and the resulting significance of visual effects is considered to be not significant adverse.

10.6.6.2 Co. Clare

The majority of views of the Proposed Development will be experienced from Co. Clare where open views across the Shannon Estuary and the Proposed Development site are available. Viewpoints / Photomontages 10-15 indicate views from sections of this touring route located in Co. Clare including the car ferry between Tarbert and Killimer. A detailed description is provided in Section 10.6.4 above.

In summary, the magnitude of visual change is considered ranging between medium and high. The resulting significance is considered ranging between moderate and significant adverse depending on the distance to the Proposed Development and the openness and panoramic quality of available views. The majority of available views, however, contain sections of the existing industrial components such as Moneypoint Power Station and existing wind farm developments. While the Proposed Development will intensify the industrial nature of views, it will not be totally uncharacteristic as it will often be seen in conjunction with existing industrial developments.

10.7 Cumulative Landscape and Visual Effects

Cumulative landscape and visual effects may result from additional changes to the baseline landscape or views as a result of the Proposed Development in conjunction with other developments of a similar type and scale.

The following developments have been considered relevant as part of the cumulative landscape and visual impact assessment:

The footprint of the current Proposed Development was subject to a previous planning application for an LNG regassification terminal which was granted permission in 2008 (PL08B. PA0002 now expired) with an amendment to the phasing of the construction granted in 2013 (PL08.PM0002). Similarly, permission for the combined heat and Power Plant was granted in 2013 (PL08. PA0028). Foreshore licence applications have also been granted for the following – drainage outfall (FS006224), construction of a jetty (FS006225), construction of a materials jetty (FS006227), construction of a seawater intake and outfall (FS006228),

The current Proposed Development is intended to replace the facilities granted planning permission under (PL08.PM0002) and (PL08. PA0028). There will be no cumulative landscape and visual effects with these planning permissions.

The Proposed Development will be connected to the existing natural gas network at Leahies in Co. Limerick by an underground gas pipeline which was granted planning permission in 2009 (PL08.GA0003). The gas pipeline is important to the operation of the LNG Terminal so will likely be constructed at the same time. This development will have the potential to cause temporary landscape and visual effects during the construction phase resulting from the removal of vegetation along the gas pipeline corridor, earthworks and moving machinery. Main receptors of these effects will be local residents and vehicles drivers. Cumulative landscape and visual effects are considered to be **medium** to **high** locally and their significance is considered to range from **moderate** to **significant adverse** but temporary in views where the construction sites of both developments can be discernible at the same time. Visibility of construction works will diminish quickly with increasing distance from the construction site due to intervening vegetation and topography. The significance of landscape and visual effects will therefore reduce to **slight** and **imperceptible neutral**.

There are two other developments associated with the Proposed Development comprising the laying of a medium voltage (10/ 20 kV) land 220 kV underground cables which will connect the Shannon Technology and Energy Park to connect to the national electrical transmission system. These cables will run 5 km east from a substation within the Proposed Development under the L1010 road to the ESBN/ EirGrid Killpaddogue 220 kV substation. The cables and substation are subject to separate planning designs and planning applications.

These developments could have the potential to cause additional landscape and visual effects during their construction stage if the constructions stage overlaps with the one from the Proposed Development. Effects will arise from the removal of vegetation along the cable corridors, earthworks and moving machinery. Cumulative landscape and visual effects are considered to be **medium** to **high** locally and their significance is considered to range from **moderate** to **significant adverse** but temporary in views where the construction sites of both developments can be discernible at the same time. Main receptors of these effects will be local residents and vehicles drivers. Considering the use of the existing L1010, landscape effects will be minimal if roadside vegetation will be retained or reinstated. Visibility of construction works will diminish quickly with increasing distance from the construction site due to intervening vegetation and topography. The significance of landscape and visual effects will therefore reduce to **slight** and **imperceptible neutral**.

The overall masterplan for the Technology and Energy Park includes plans for the future development of a data centre within the lands southwest of the Proposed Development. These lands were investigated during the previous ES in 2006 and subsequent planning conditions. The data centre will be subject to a separate planning design and planning application and will be subject to their own surveys and landscape and visual impact assessment.

The Proposed Development and the data centre development will not be constructed simultaneously and there will be no landscape and visual cumulative effects arising during the construction phase. However, during operation and depending on the layout of the data centre and its visual presence, the landscape character will change further from a rural coastal setting to industrial. This change will be discernible along the southern shore of the River Shannon estuary in available views from the local road network and residential receptors in Co. Kerry as well as from the shores and from elevated areas further north in Co. Clare including designated scenic roads and the Wild Atlantic Way. Cumulative landscape and visual effects will likely be **significant adverse**.

Ten further planning applications are noted within approximately 5 km of the current Proposed Development over a 10-year period. Six of these applications (13138, 155, 18392, 18878, 19115 and 20850) relate to various elements of an electricity peaker power generating plant and battery energy storage system facility on a site 2.6 km to the east of the current Proposed Development. Elements of this development have already been constructed which is located on a site 2.6 km to the east of the current Proposed Development. Given the distance between these two developments, which includes an intervening dense mature tree plantation, it is unlikely that cumulative landscape and visual effects will arise.

10.7.1.1 Intertidal Applications/ Foreshore Applications

Planning application 14816 relates to the alteration of the existing 220 kV electricity station at Tarbert Island 4.5 km to the east of the current Proposed Development. Combined views are likely particularly west when crossing the River Shannon estuary by ferry between Tarbert and Killimer where open views of both developments will be possible. However, considering the existing prominence of the existing Tarbert Power Station and the distance between these developments, the magnitude of cumulative landscape and visual effects will be **low** and the significance **slight adverse**.

Planning applications 14816 and 17466 relate to alterations to the permitted accesses to Leenamore Wind Farm as well as the provision of a new substation compound with a single storey substation building and associated underground services. Leenamore Wind Farm is located 4 km to the south of the current Proposed Development. the existing Leenamore Wind Farm has already introduced a light industrial elements to the surrounding landscape character and visual amenity including long distance views from the shore zone of Co. Clare. Considering the scale of the proposed alterations to Leenamore Wind Farm cumulative landscape and visual effects are unlikely considering the locations and scale of the proposed developments, the effects of distance as well as intervening vegetation and topography.

The last planning application (304807-19) concerns the construction of a six-wind turbine wind farm at Aghanagran to the southwest of the village of Ballylongford approximately 5 km from the current Proposed Development. The Proposed Development will further industrialise the existing landscape and available views from locations where both developments will be visible in combination. Cumulative effects will be **low-medium** and their significance **slight** to **moderate adverse**.

The following foreshore licence applications are also noted outside the 5 km of the Proposed Development. These are mostly associated with the Shannon-Foynes Port company at Foynes comprising the applications FS005818, FS005790, FS006128, FS006594, FS006785, FS006837 and FS006975. Foynes is 22 km from the Proposed Development, outside of the study area and at a distance where it is highly unlikely for cumulative landscape and visual effects to arise. Similarly, the application FS007081 is located at Cahiracon in Co. Clare which is 24 km to the northeast of the Proposed Development across the Shannon Estuary.

10.8 Mitigation and Monitoring Measures

Mitigation is a term used to describe the measures or actions that may be taken to minimise environmental effects. The purpose of mitigation is to avoid, reduce and where possible remedy or offset, any significant adverse direct and indirect effects on the environment arising from the Proposed Development. The following main landscape and visual mitigation categories have been defined and are itemised below (and have been carried through to the Outline Construction Environmental Management Plan (OCEMP) where relevant):

10.8.1 Facade Colour Scheme

Considering the scale of the Proposed Development, landscape mitigation can provide screening of the lower parts of the development and the area around the site entrance but not for the upper sections of the built structures. The Proposed Development is located in a prominent setting along the shoreline of the Shannon Estuary with a low rise but undulating landscape as a backdrop, particularly when seen from the Co. Clare side. The principal landscape and visual mitigation measures for the Proposed Development is therefore inherent in the design of its architecture and its colour scheme.

With the primary objective to minimise the visual impact of the built structures and to allow the buildings to be as unobtrusive as feasible against their backdrop, the proposed colour scheme was drawn from colours found the surrounding local landscape.

The building colours consist generally of a mix between the following six main colours, which range all within a muted mid-dark grey and green spectrum.

The colours pick up existing colours of the landscape along the Co. Kerry shore and its hinterland against which the Proposed Development will be seen in the majority of views. The proposed colour scheme will help to take the attention of away from individual buildings and roofscapes and help blending-in the proposed built structures better with the landscape in available views from local residences, the public road network, the shore, and in estuarine views across the River Shannon including designated views and prospects, scenic routes and the Wild Atlantic Way.

Sections of Proposed Development will still become a new focus point in the majority of available views, particularly the HRSG and turbine halls, the LNG Terminal and ships as well as storage tanks / silo's. The implementation of the proposed colour scheme will help to take the attention away from the Proposed Development and make it one of several other existing industrial facilities along the Shannon Estuary rather than pinpointing it with bright colours, which would otherwise emphasise further the existence of the proposed industrial structures in available views. The colours will also work with varying weather and visibility conditions, where their muted colours can quickly blend in.

A similar colour scheme has been applied to the constructed ESB substation near Kilmorna, Co. Kerry, which successfully helped the integration of the built structures into the surrounding landscape in close and distant views including designated scenic views across the River Feale valley.

Similar muted colours have also been applied to new or refurbished oil tanks on Whiddy Island helping to integrate these structures in available views. While the tanks cannot be missed, their colour helps to avoid making them stand out. The capping of some of the tanks was not changed in colour and left in a light grey which keeps drawing the attention of the viewer. This emphasises the need of muted colours not just on facades but also on roof structures.

10.8.2 Construction Phase

Visual mitigation measures at construction include the following:

- Existing tree protection measures during construction shall be carried out in accordance with BS 5837:2012;
- Minimise external lighting related to construction works; and
- Regular cleaning or public roads to remove any track out and to reduce temporary to short-term effects on visual amenity.

10.8.3 Operational Phase – Landscape Mitigation

Landscape mitigation measures have been developed in order to screen the lower sections of the proposed range of buildings and the proposed access road to help the integration into the landscape. The objectives of the landscape design are to;

1. Screen the site from the public road and adjacent property;
2. Preserve the existing landscape;
3. Maximize pervious surfacing;
4. Provide natural habitat for animals to aim for “no net loss of habitat”.

The specific strategies are described as below;

- At the location where the main access road connected to the public road, there are woodland mix of shrubs and trees. There are hedgerows of trees from southwest to northeast along the property line.
- The existing landscape in the northwest part of the site (out of the 10m offset from the mass grading area) is retained and groups of trees are proposed there. To protect water quality of the stream near the site entry, there is a 5-10 m buffer of retained vegetation along the stream.
- The area of CHP power plant, LNG processing/metering and utility metering are surfaced with gravel when there is no driveway and equipment. The other disturbed are seeded with native grass.
- To provide more diverse habitat for local animals like badgers and birds, there is alternate bunches of trees and shrubs along entry road. Groups of trees are planting in the retained area in the northwest part of the site. The proposed planting species are native and could provide ecological service.

10.8.4 Operational Phase - Lighting

Mitigation measures to reduce visual effects in relation to additional lighting include the following:

- Lighting will be kept to essential locations only, with the position and direction of lighting being designed to minimise intrusion and disturbance to adjacent areas;

- Use of full cut-off lanterns are proposed to minimise light spillage and upward escape of light onto adjacent areas;
- Lighting will be minimised in terms of number of lights and the power of the lights (lux level);
- Directional lighting, facing and located away from any surrounding vegetation; and
- Lighting will be turned off where possible when not in use except to meet the minimum requirements for Health and Safety (refer to night-time photomontages for Viewpoints/ Photomontages 8 and 12 and the differences between 'main lights turned on only' and 'all lights turned on' as described in Section 10.6.4 above).

10.9 Do Nothing Scenario

All components of the environment are constantly changing due to a combination of natural and human processes. When predicting likely direct and indirect effects it is important to remember that there are two available for comparison: the existing environment and the environment as it will be in the future if no development of any kind were to take place – the 'do nothing ' impact.

In landscape terms, if the Proposed Development did not go ahead, the site will remain as a pattern of coastal fields and grasslands. The significance will be **imperceptible** and **neutral**.

In visual terms, the content in available views will remain similar without significant changes to the visual amenity. Likely changes will relate to changes to the existing vegetation due to maturing, pruning or natural development. The significance will be **imperceptible** and **neutral**.

However, the site location within an area zoned as 'Industrial' will retain the site as subject to considerable development pressure.

10.10 Residual Effects

Given the scale and location of the Proposed Development, the main landscape and visual mitigation measures focus on architectural mitigation and minimising lighting during night time. These measures will be implemented immediately and come into effect following the completion of construction works. Proposed landscape mitigation measures will enhance the screening of the lower parts of the Proposed Development include the entrance road and provide a suitable planting scheme within the site compound helping to screen the lower sections of the proposed onshore facilities.

Landscape mitigation will be recognisable locally and in short to medium distance views from the south where available. Landscape mitigation measures will be barely discernible in views south from the northern shores of the Shannon estuary due to their scale and the distance between the Proposed Development and the observer. The majority of visible built structures in available views will remain as at the time of the completion of construction works (façade design and colour scheme, lighting design). The proposed landscape mitigation measures will help the integration of the Proposed Development in available views. However, considering the often long distance nature of available views, landscape mitigation will not be able to further reduce landscape and visual effects, as identified in Section 10.5. The magnitude and significance of landscape and visual effects will therefore remain the same as described in Section 10.5.

10.11 Decommissioning Phase

As outlined in Chapter 02 – Project Description, in the event of decommissioning, measures will be undertaken by the Applicant to ensure that there will be no significant, negative environmental effects from the closed LNG Terminal and Power Plant. Examples of the measures that will be implemented are outlined in Section 2.11, Chapter 02 – Project Description. As a result, additional potential impacts and associated effects arising during the decommissioning phase are not anticipated above and beyond those already assessed during the construction phase.

10.12 Summary

10.12.1 Construction Effects

Landscape and visual effects and their significance at construction stage will be **temporary to short-term adverse** and will result in:

- Likely effects to landscape character or visual amenity within the locality or the wider study area as a result of the visibility of construction activities such as, scaffolding, cranes, the movement of construction vehicles along local roads, and other tall equipment such as machinery onsite;
- Effects of temporary – short-term site infrastructure such as site traffic and construction compounds; and
- Likely physical effects arising from construction of the development will be confined to the Proposed Development site.

10.12.2 Landscape and Seascape Effects (Operational Phase)

The main landscape effects of the Proposed Development will be associated with the introduction of large industrial buildings, leading to a long term change in landscape character at the site and an intensification of the industrial character along the Shannon Estuary. It is anticipated that the development will alter the landscape character within approximately 1 km radius on the side of Co. Kerry. Change to the landscape character will be noticeable beyond 1 km and up to approximately 6 km along the coastline of Co. Clare and in elevated areas near the coast.

At the site location, the direct landscape change is considered high and significant as the existing landscape character of an estuarine rural landscape character will be replaced with an industrial character.

The indirect change in landscape character is greatest and significant in its immediate and close surroundings where open and partial views are possible within approximately 1 km radius from the Proposed Development site boundary in views from the Co. Kerry side of the Shannon Estuary. The Proposed Development will industrialise the landscape character and further intensify the industrial components of the landscape character in the wider study area when seen in conjunction with the existing industrial landscape character around Moneypoint Power Station.

Indirect change and the significance of landscape effects will reduce to not significant with increasing distance from the Proposed Development in the remaining study area (beyond approximately 1 km from the Proposed Development site boundary). Given the prominence of the location, the intensification of the industrial character can be recognised over long distances across the Shannon Estuary in Co. Clare, where the change in landscape character will be recognisable at distance ranging between approximately 2.5 km – 6 km depending on weather conditions.

In the context of the wider study area, the Proposed Development will be perceived in conjunction with other existing large-scale industrial developments along the Shannon Estuary, which define already the overall character of estuary and its shorelines within the study area. The Proposed Development will therefore not be seen as totally uncharacteristic and can integrate into the wider landscape character.

The seascape character will be directly and indirectly affected. The addition of another large scale industrial facility with a new jetty and mooring areas will directly reinforce and intensify the industrial components in the estuarine character and become prominent features in the overall low lying and exposed nature of the area long term. Direct and significant effects will be experienced at the location of the new jetty and mooring platforms.

Indirect effects will be experienced in the wider seascape character (beyond approximately 3 km from the Proposed Development site) of the Lower Shannon, where the number of industrial components will increase and further industrialise the character of the seascape. The magnitude of effects on the seascape character are therefore considered significant and long term. However, the proposed change in seascape character is not totally uncharacteristic considering existing large industrial developments within this seascape character area.

10.12.3 Visual Effects (Operational Phase)

The main visual effects will relate to the introduction of a new large industrial facility onshore and the LNG terminal and ships within the River Shannon. The main visual receptor groups are residents, vehicle travellers including ferry passengers, workers and visitors / tourists. Residents will have the highest sensitivity to change than road users or ferry passengers. Vehicle travellers and workers will focus mainly on traffic or their commercial tasks and not primarily on available views. Ship passengers will see the Proposed Development in conjunction with the prominent existing Tarbert Power Station and Moneypoint Power Station structures.

The closest residential dwellings in the immediate environment of the Proposed Development are located along the L1010 and the overall local road network in the area within approximately 1 km radius from the Proposed Development boundary in Co. Kerry. The highest visual change will be in in the vicinity of the new entrance area along the L1010, at Ralappane House immediately east of the Proposed Development and in elevated areas where views of sections of the upper buildings such as the proposed 3 HRSG and turbine halls along with storage tanks/ silo's become available. The LNG terminal will often be screened in views from residences by topography, intervening vegetation and the proposed onshore structures itself, which is evident in Viewpoints / Photomontages 1-4 & 6 which are located within approximately 1 km of the development boundary in Co. Kerry.

Within the Co. Kerry side of the study area beyond 1 km from the boundary, views become quickly intermittent due to undulating topography and intervening vegetation. The Proposed Development will introduce a prominent industrial facility in available views within the Co. Kerry section of the study area. It will often be seen in conjunction with the existing Moneypoint Power Station and associated wind farm. In that respect and considering the zoning of the site and surrounding areas for industry, the proposed development is not uncharacteristic in available views. However, it will introduce prominent structures in a currently rural section of the shoreline. It will intensify the industrial character of estuarine views. It will create a new point of focus in available close distance views (within approximately 1 km of the site). Some close distance views are fully screened by intervening commercial forest plantations. Considering the location and the middle to long distance nature of views within 1 – 7 km from the development site boundary, visibility will also be depended on weather conditions and the level of haziness.

The majority of open views of the Proposed Development will be experienced from the Co. Clare side of the Shannon Estuary, where middle to long distance open views of the proposal will be possible. This includes most coastal roads within the study area as well as elevated sections of the N67 and adjoining local roads, seen in Viewpoints / Photomontages 12 & 14. Visibility is generally considered middle to long distance in nature (beyond 1 km) due to the width of the estuary. Despite the distance, the Proposed Development will become a discernible new focus point in views from the shoreline, which is evident in Viewpoints / Photomontages 10, 11 & 13. The Proposed Development will be a new component on often panoramic views across the estuary into Co. Kerry. It will be seen in conjunction with existing wind turbines including Leanamore Wind Farm and Tullahennel Wind Farm in Co. Kerry and Money Point Power Station and its chimney stacks in Co. Clare. Similar as for views in Co. Kerry, existing views contain already large scale industrial or light industrial developments, and the Proposed Development will therefore not be totally out of character. It will nevertheless industrialise additional areas further west along the shoreline, which are currently rural and natural in appearance. Considering the generally open nature of shoreline or elevated views from areas close to the shoreline, the visual change is still significant despite the middle to long distance nature of these views.

Viewpoint / Photomontage 15 illustrates a view from the ferry between Tarbert-Killimer within the River Shannon Seascape Character Area. The Proposed Development will further industrialise the Shannon Estuary in views west. However, it will be seen as one industrial component of several in available views. The buildings including the LNG Terminal and ships will be clearly visible in good weather conditions and add to the existing industrial character of the view. The development will, however, not alter the existing views significantly as it will be seen in panoramic views in conjunction with existing large power station structures of Tarbert and Moneypoint Power Station including wind turbines.

10.12.4 Cumulative Effects (Operational Phase)

Cumulative landscape and visual effects may result from additional changes to the baseline landscape character or visual amenity as a result of the Proposed Development being seen in conjunction with other projects similar in scale, type and nature.

The majority of developments resulting in potential cumulative landscape and visual effects are related to underground cabling and gas pipe works (PL08.GA0003), which will result in temporary landscape and visual effects during the construction phase. Effects will arise from the removal of vegetation along the cable corridors, earthworks and moving machinery.

Likely significant cumulative landscape and visual effects will arise from the overall masterplan for the Technology and Energy Park, which includes plans for the future development of a data centre within the lands southwest of the Proposed Development. The Proposed Development and the data centre development will not be constructed simultaneously and there will be no landscape and visual cumulative effects arising during the construction phase. However, during operation and depending on the layout of the data centre and its visual presence, the landscape character will change further from a rural coastal setting to industrial. This change will be discernible along the southern shore of the River Shannon estuary in available views from the local road network and residential receptors in Co. Kerry as well as from the shores and from elevated areas further north in Co. Clare including designated scenic roads and the Wild Atlantic Way. Cumulative landscape and visual effects will likely be **significant adverse**.

Ten other planning applications are noted within approximately 5 km of the current Proposed Development over a 10-year period. Six of these applications (13138, 155, 18392, 18878, 19115 and 20850) relate to various elements of an electricity peaker power generating plant and battery energy storage system facility on a site 2.6 km to the east of the current Proposed Development. Elements of this development have already been constructed which is located on a site 2.6 km to the east of the current Proposed Development. Given the distance between these two developments, which includes an intervening dense mature tree plantation, it is unlikely that cumulative landscape and visual effects will arise.

10.12.4.1 Intertidal Applications/ Foreshore Applications

Planning application 14816 relates to the alteration of the existing 220 kV electricity station at Tarbert Island 4.5 km to the east of the current Proposed Development. Combined views are likely particularly west when crossing the River Shannon estuary by ferry between Tarbert and Killimer where open views of both developments will be possible. However, considering the existing prominence of the existing Tarbert Power Station and the distance between these developments, the magnitude of cumulative landscape and visual effects will be **low** and the significance **slight adverse**.

Planning applications 14816 and 17466 relate to alterations to the permitted accesses to Leenamore Wind Farm as well as the provision of a new substation compound with a single storey substation building and associated underground services. Leenamore Wind Farm is located 4 km to the south of the current Proposed Development. the existing Leenamore Wind Farm has already introduced a light industrial elements to the surrounding landscape character and visual amenity including long distance views from the shore zone of Co. Clare. Considering the scale of the proposed alterations to Leenamore Wind Farm cumulative landscape and visual effects are unlikely considering the locations and scale of the proposed developments, the effects of distance as well as intervening vegetation and topography.

The last planning application (304807-19) concerns the construction of a six-wind turbine wind farm at Aghanagran to the southwest of the village of Ballylongford approximately 5 km from the current Proposed Development. The Proposed Development will further industrialise the existing landscape and available views from locations where both developments will be visible in combination. Cumulative effects will be **low-medium** and their significance **slight** to **moderate adverse**.

The following foreshore licence applications are also noted outside the 5 km of the Proposed Development. These are mostly associated with the Shannon-Foynes Port company at Foynes comprising the applications FS005818, FS005790, FS006128, FS006594, FS006785, FS006837 and FS006975. Foynes is 22 km from the Proposed Development, outside of the study area and at a distance where it is highly unlikely for cumulative landscape and visual effects to arise. Similarly, the application FS007081 is located at Cahiracon in Co. Clare which is 24 km to the northeast of the Proposed Development across the Shannon Estuary.

Table 10-14 Summary

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance
Construction	Changes to the baseline landscape and views	Sensitive	Negative	Significant	Visual mitigation measures at construction include the following: • Existing tree protection measures during construction shall be carried out in accordance with BS 5837:2012; • Minimise external lighting related to construction works; and • Regular cleaning or public roads to remove any track out and to reduce temporary to short-term effects on visual amenity.	Moderate
Operational	Alteration of a view from a viewpoint/ cumulative effective of planned development on landscape	Sensitive	Negative	Very significant	Landscape mitigation measures have been developed in order to screen the lower sections of the proposed range of buildings and the proposed access road to help the integration into the landscape.	Moderate

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CHAPTER 11
Traffic and Transport

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park
Environmental Impact Assessment Report

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11. Transport

11.1 Introduction

This chapter has been prepared with input from the wider Environmental Impact Assessment (EIA) team and from John Sisk and Son Ltd. (herein referred to as Sisk), an international contractor. The information provided by Sisk details the likely transport requirements during the construction phase of the Proposed Development. This chapter describes the transportation impacts and likely significant environmental effects of the Proposed Development during the construction and operation phases of the Development in accordance with the requirements of the Environmental Protection Agency (EPA) 'Guidelines on the information to be contained in Environmental Impact Assessment Reports' (Draft August, 2017). To assist in determining the impact that the Proposed Development has on the surrounding road network reference has been made to Transport Infrastructure Ireland (TII) standard 'PE-PDV-02045, Traffic and Transport Assessment Guidelines' (May, 2014). This chapter also sets out measures and strategies to mitigate any significant effects.

11.2 Competent Expert

This assessment has been undertaken by Carolyn Rollo, Associate Director, MA (Hons) CIHT (AECOM) and Zachary Cave, Traffic Planner/ Engineer, B Eng (Hons), MTPS, MIEI (AECOM). Carolyn Rollo has 14 years' experience supporting the public and private sector in securing consents for a variety of energy projects, she lecturers to peers on Transport Assessments and sits on the Council of the Chartered Institution of Highways and Transportation (CIHT). Zachary Cave has 3 years' experience supporting planning applications for Strategic Housing Developments, commercial and data centre developments, as well as assisting with the traffic and transport chapter of EIARs.

11.3 Study Area Description

A full description of the site is provided in Chapter 01 – Introduction and Chapter 02 – Project Description. The site is situated approximately 4.6 km to the west of Tarbert Town, 4 km to the north of Ballylongford Village and will be accessed off the L1010 Coast Road via a new priority-controlled junction.

Figure 11-1 illustrates the study area for the purposes of this chapter as well as the transport context of this study area, Figure 11-2 provides a more localised overview of the study area.

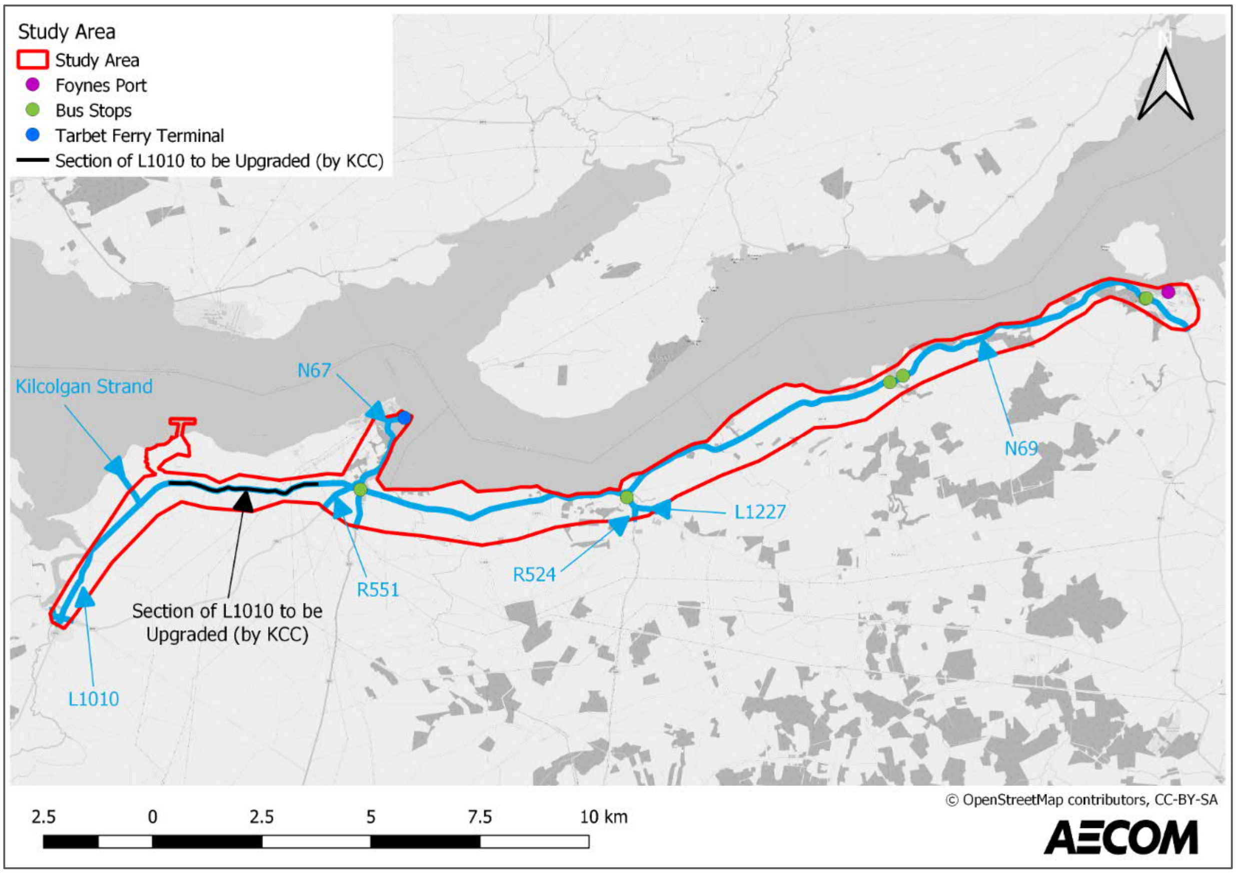


Figure 11-1 Transport Study Area (Kerry County Council)

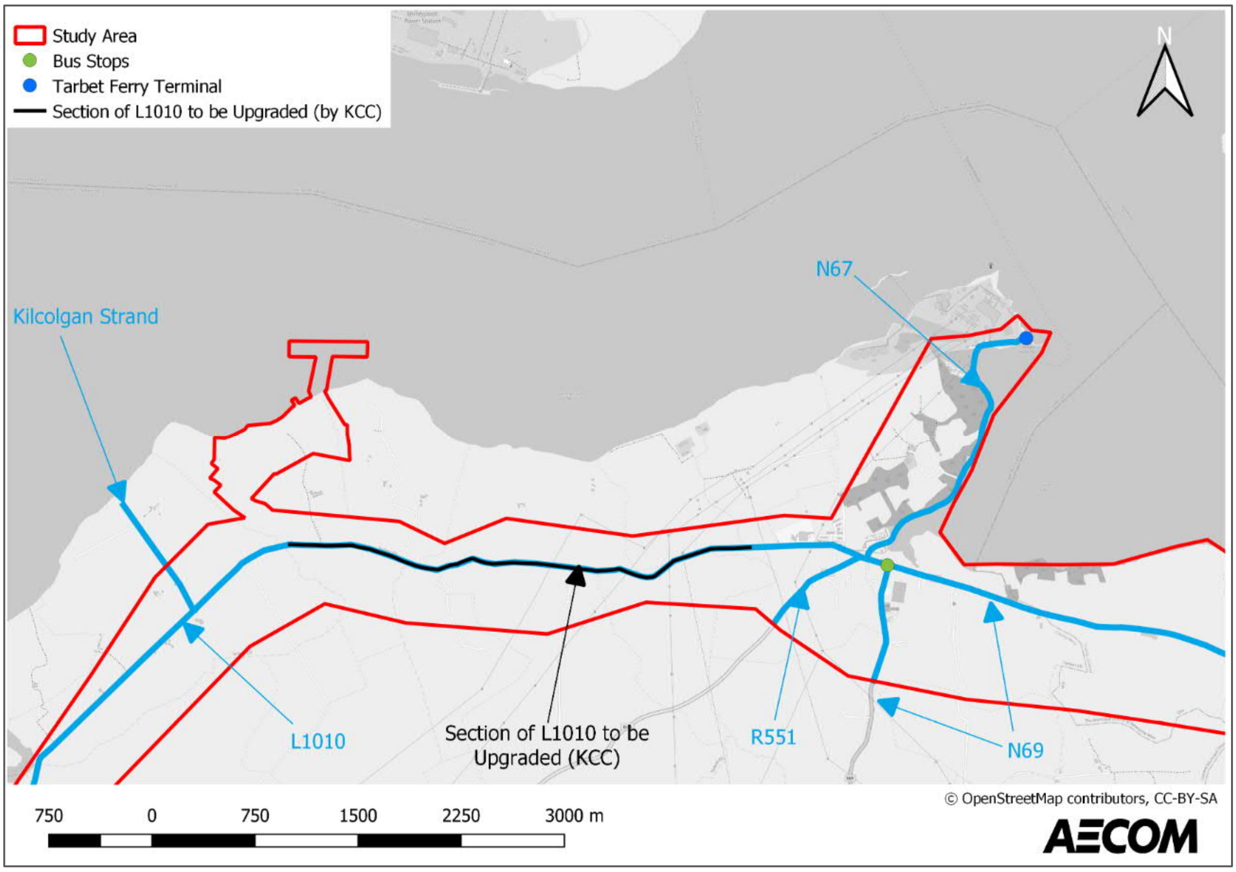


Figure 11-2 Transport Study Area Local

11.3.1 Land Use Zoning Objectives and Planning History

Within the Kerry County Development Plan 2015 – 2021, Land Use Zoning Objectives are identified for the Proposed Development. Shannon LNG lands are zoned for 'Industry'. Additionally, these lands are designated as the 'Tarbert/ Ballylongford Land Bank'.

11.3.2 Proposed Development

A full description of the Proposed Development is provided in Chapter 02 – Project Description. From a transport perspective the Proposed Development, including the potential construction scenario, is summarised in Table 11-1 and detailed further in Section 11.4. It is assumed that all construction materials will be transported by road.

Table 11-1 Anticipated Construction Schedule

Element	Construction Start	Duration	Construction End	Peak Staffing No. to complete Element of Work
Enabling Works	January 2023	10 months	October 2023	75 staff
LNG Terminal	+6 months	12 months	June 2024	200 staff
220 kV and MV (10/ 20 kV) Connections[1]	+8 months	14 months	September 2024	105 staff
CCGT 1 & 2	+9 months	21 months	June 2025	650 staff
Gas Pipeline[2]	+9 months	9 months	June 2024	200 Staff
CCGT 3	+11 months	18 months	August 2025	350 staff

For the operational phase the maximum number of people onsite on a day-to-day basis will be 57, this consists of 23 for the LNG Terminal and 34 for the Power Plant (CCGT). The 57 headcount excludes the FSRU vessel crew of approximately 35 persons all of whom remain onboard for the full time of their contract and the 16 crew required for the 4 tugs both of which will not contribute to road traffic volumes. Details of shift arrangements are discussed in Section 11.5.2.

11.3.3 Policy and Guidelines

The following is a list of sources of information consulted for use in this chapter;

- Kerry County Development Plan 2015 – 2021;
- Kerry County Zoning and Landscaping Maps, Map 12.1a, 2015 – 2021;
- Listowel Municipal District Local Area Plan 2020 – 2026;
- Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, August 2017);
- Guidelines on the Information to be Contained in Environmental Impact Statements, 2002;
- Advice Notes on Current Practice in the Preparation of Environmental Impact Statements, 2003;
- Traffic Signs Manual, (Department of Transport, Tourism and Sport, August 2019);
- PE-PDV-02045, Transport Assessment Guidelines, (TII, May 2014);

[1] The 220 kV and medium voltage (10/ 20 kV) connections are outside the Proposed Development, the quantum of traffic associated with their construction phase are included within the cumulative assessment of this chapter.
[2] The gas pipeline is outside the Proposed Development, the quantum of traffic associated with their construction phase are included within the cumulative assessment of this chapter.

- PE-PAG-02016, Project Appraisal Guidelines for National Roads Unit 5.2 – Data Collection (Transport Infrastructure Ireland, October 2016);
- PE-PAG-02017, Project Appraisal Guidelines for National Roads Unit 5.3 – Travel Demand Projections (Transport Infrastructure Ireland, May 2019);
- PE-PAG-02039, Project Appraisal Guidelines for National Roads Unit 16.1 – Expansion Factors for Short Period Traffic Counts (Transport Infrastructure Ireland, October 2016);
- DN-GEO-03031, Rural Road Link Design (Transport Infrastructure Ireland, June 2017)
- DN-GEO-03060, Geometric Design of Junctions (Priority junctions, direct accesses, roundabouts, grade separated, and compact grade separated junctions (Transport Infrastructure Ireland, June 2017);
- The Design Manual for Urban Roads and Streets, (Department of Transport, Tourism and Sport, May 2019); and
- National Development Plan (Department of Public Expenditure and Reform, February 2018).

11.3.4 Pre-Application Consultation

The TII have provided pre-application consultation in relation to the proposed development. The following are the items that the TII have indicated that the Development should have regard for, relevant to the scope of this chapter:

- *TII notes that the subject site accesses the local road network prior to access to the N67 and N69, national roads. Consultations should be had with the relevant Local Authority/ National Roads Design Office with regard to locations of existing and future national road schemes.*
- *TII would be specifically concerned as to potential significant impacts the development would have on the national road network (and junctions with national roads) in the proximity of the Development.*
- *The developer should assess visual impacts from existing national roads.*
- *The developer should have regard to any Environmental Impact Statement and all conditions and/ or modifications imposed by An Bord Pleanála regarding road schemes in the area. The developer should in particular have regard to any potential cumulative impacts.*
- *The developer, in preparing EIAR, should have regard to TII Publications (formerly DMRB and the Manual of Contract Documents for Road Works).*
- *It would be important that, where appropriate, subject to meeting the appropriate thresholds and criteria and having regard to best practice, a Traffic and Transport Assessment (TTA) be carried out in accordance with relevant guidelines, noting traffic volumes attending the site and traffic routes to/ from the site with reference to impacts on the national road network and junctions of lower category roads with national roads. In relation to national roads, TII's TTA Guidelines (2014) should be referred to.. The scheme promoter is also advised to have regard to section 2.2 of the TII TTA Guidelines which addresses requirements for sub-threshold TTA. Any improvements required to facilitate development should be identified. It will be the responsibility of the developer to pay for the costs of any improvements to national roads to facilitate the private development proposed as TII will not be responsible for such costs.*
- *The designers are asked to consult TII Publications to determine whether a Road Safety Audit is required.*
- *In the interests of maintaining the safety and standard of the national road network, the EIAR should identify the methods/ techniques proposed for any works traversing/ in proximity to the national road network.*
- *In relation to haul route identification, the applicant/ developer should clearly identify haul routes proposed and fully assess the network to be traversed. Where abnormal weight loads are proposed, separate structure approvals/ permits and other licences may be required in connection with the proposed haul route and all structures on the haul route should be checked by the applicant/ developer to confirm their capacity to accommodate any abnormal load proposed.*

- *In relation to grid connection and cable routing, proposals should be developed to safeguard proposed road schemes as TII will not be responsible for costs associated with future relocation of cable routing where proposals are catered for in an area of a proposed national road scheme. In that regard, consideration should be given to routing options, use of existing crossings, depth of cable laying, etc.*
- *In the context of existing national roads, alternatives to the provision of cabling along the national road network, such as alternative routing or the laying of cabling in private lands adjoining the national road, should be considered in the interests of safeguarding the investment in and the potential for future upgrade works to the national road network. The cable routing should avoid all impacts to existing TII infrastructure such as traffic counters, weather stations, etc. and works required to such infrastructure shall only be undertaken in consultation with and subject to the agreement of TII, any costs attributable shall be borne by the applicant/ developer. The developer should also be aware that separate approvals may be required for works traversing the national road network.*

Where an impact is anticipated on the national road network consideration has been given to TII comments. However it is anticipated that the most robust impacts will occur on the local road network. A meeting was held with Kerry County Council (KCC) Roads department on 28th April 2021 to discuss the project in respect of the local road network, the outcomes of this meeting are summarised as follows:

- KCC are undertaking a widening scheme of the L1010 which is to be completed prior to the start of the main construction elements;
- KCC stipulated that as part of the traffic analysis that consideration be given for construction staff arriving from the N69 Listowel direction;
- Each abnormal load will require its own abnormal load permit to be transferred from Foynes Port to the Proposed Development; and
- KCC recommended that the number of HGVs are to be limited from arriving from the N69 Listowel direction due to high kerbs and potential oversailing at the junction.

11.3.5 Structure of Chapter

The remainder of this chapter is divided into the following sections:

- Methodology – this section sets out the methodology in terms of impact significance and magnitude of effects;
- Baseline Environment – a description of the existing and proposed (by others) condition of the transport network within the study area;
- Transport Characteristics of the Proposed Development – this section presents a description of the proposals from a transport perspective relating to appropriate design standards and guidelines;
- Assessment of Impacts – this section identifies the potential travel demands of the Proposed Development during construction and operation and considering all modes for the movement of goods and people. This section also analyses the impact of the Proposed Development for the Do Nothing and Do Something scenarios. The construction and operational traffic flows have been assigned to the surrounding road network having regard to the existing traffic patterns. This section will demonstrate the results of the junction modelling analysis;
- Mitigation and Monitoring Measures – The transport impact of the Proposed Development including any traffic mitigating measures is addressed;
- Assessment of potential environmental effects; and
- Residual Impacts and Effects – consideration of the residual impact of construction and operation traffic flows when appropriate mitigation measures have been identified.

This chapter is supported by Appendix A11-1 and Appendix A-11.3: Framework Mobility Management Plan (see Volume 4).

11.4 Methodology

11.4.1 Approach

AECOM has undertaken both a desktop and onsite review which was carried out on 22nd January 2020 to inform this chapter, as well as commissioning traffic surveys which were undertaken in the period 28th January 2020 to Monday 3rd February 2020. In addition, Sisk has provided the design team with an Outline Construction Traffic Management Plan (OCTMP). KCC have also provided drawings which illustrate the planned upgrades to the L1010 Coast Road.

The study area for the chapter was established based on the anticipated routing to the Proposed Development site for construction and operational vehicles at points in which traffic could be most intensive, e.g. in proximity to the Proposed Development site.

11.4.2 Describing Potential Effects

In accordance with the Draft EPA (2017) Guidelines, potential effects are characterised by considering parameters shown in Table 11-2 below.

Table 11-2 Potential Effect Parameters

Potential Effect Parameter	Description
'Quality' of Effects	**Positive Effects** – A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities). **Neutral Effects** – No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error. **Negative/ Adverse Effects** – A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance).
Significance of Effects	**Imperceptible** – An effect capable of measurement but without significant consequences. **Not significant** – An effect which causes noticeable changes in the character of the environment but without significant consequences. **Slight Effects** – An effect which causes noticeable changes in the character of the environment without affecting its sensitivities. **Moderate Effects** – An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends. **Significant Effects** – An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment. **Very Significant** – An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment. Profound Effects – An effect which obliterates sensitive characteristics
Extent and Context of Effects	**Extent** – Describe the size of the area, the number of sites, and the proportion of a population affected by an effect. **Context** – Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)
Probability	**Likely Effects** – The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.

Potential Effect Parameter	Description
Only Likely (and Significant) effects are assessed in this chapter.	**Unlikely Effects** – The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.
Frequency and timing	**Momentary Effects** – lasting from seconds to minutes **Brief Effects** – lasting less than a day **Temporary Effects** – lasting less than a year **Short-term Effects** – lasting one to seven years. **Medium-term Effects** – lasting seven to fifteen years. **Long-term** Effects – lasting fifteen to sixty years. **Permanent Effects** – lasting over sixty years **Reversible Effects** – that can be undone, for example through remediation or restoration **Frequency of Effects** – Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)

11.4.3 Significance of Effects

A qualitative approach was used in this evaluation, generally following the significance classification in Table 11-2 and through professional judgment. The significance of a predicted effect is based on a combination of the sensitivity or importance of the attribute and the predicted magnitude of any effect.

As outlined in Chapter 01 – Introduction, once the description of the effect, including magnitude, character, duration etc. has been identified, this can be cross-referenced with the importance of the sensitivity of the receptor to derive the overall significance of effect as per the EPA guideline (EPA, 2017).

11.5 Baseline Environment

This section sets out transport characteristics of the study area environment. The receiving environment has been categorised under the following headings:

- Road Network;
- Road Safety;
- Walking Infrastructure;
- Cycling Infrastructure; and
- Bus/ Ferry Transport.

11.5.1 Road Network

Figure 11-1 and Figure 11-2 provides an overview of the road network within the study area.

11.5.1.1 L1010 (Coast Road)

The L1010 is a local road, single lane carriageway, which access to the Proposed Development is proposed from. The L1010 connects with the R551/ N67 in Tarbert Town and the R551/ R552 in Ballylongford Village. The L1010 is subject to a 50 km/hr speed limit on the approaches to Tarbert and Ballylongford, but this increases to 80 km/hr outside of these areas. A section of the L1010 is currently subject to an improvement scheme by KCC which extends from Tarbert Town to the Proposed Development access, it is anticipated that these improvements (road widening) would be complete prior to the commencement of the Proposed Development main construction elements.

The existing L1010 is approximately 5.5 m wide but this increases to approximately 6 m in the environs of Tarbert and Ballylongford. The road lacks any form of designated footpaths or cycleways and lacks public lighting along the rural carriageway, but lighting and road markings are provided in Tarbert and Ballylongford. The L1010 facilitates access to a number of residential properties and farms, on approach to Tarbert Town there is also access to the Tarbert Comprehensive School and The Tullahennel Wind Farm Substation. The L1010 is not a bus route. Figure 11-3 illustrates the characteristics of the existing L1010 carriageway.

Figure 11-3 L1010 Coast Road in Vicinity of Site Access

11.5.1.2 R551 Regional Road

The R551 is a single lane, regional road. The R551 connects Tarbert Town with Ballylongford Village and further onto either Ballybunnion and Listowel.

Within the study area the carriageway width is approximately 6 m with no existing footpaths, cycle lanes or lighting columns. The R551 is not a bus route. The R551 facilitates access to a number of residential properties and farms. The speed limit along the R551 is 80 km/h.

11.5.1.3 N67

The N67 (National Secondary Road) connects Co. Kerry with Co. Clare and Co. Galway, running in a north-west to south east direction and vice versa. Within the study area, on the southern approach to Tarbert Town footpaths and public lighting are provided along both sides of the carriageway. Between Tarbert Town and the Tarbert Ferry Terminal, a footpath is provided along the western side of the carriageway only which becomes an advisory walkway approximately 750 m from the Tarbert Ferry Terminal. This route includes a ferry crossing across the Shannon Estuary at the Tarbert Ferry Terminal, and details on this ferry crossing are included within Section 11.5.5 of this chapter.

11.5.1.4 N69

The N69 (National Secondary Road) connects Tralee in Co. Kerry with Limerick City running in a northerly direction from Tralee to Tarbert and an easterly direction towards Limerick and vice versa. Within the study area the road is approximately 6 m wide and is a bus route. Outside of the Towns and Villages, within the study area, no footpaths, cycle lanes or lighting columns are provided.

For the larger components required to construct the Proposed Development (classified as abnormal indivisible loads (AILs)) it is proposed that these components will be shipped to Foynes Port, approximately 27 km east of the Proposed Development and delivered to the site via the N69 through Tarbert Town and onto the upgraded L1010 to the site. A standalone AIL report (Appendix A11-2, Vol. 4) has been prepared to demonstrate the suitability of this route and where any special mitigating measures may be necessary.

11.5.1.5 Kilcolgan Strand

Kilcolgan Strand is a boreen which facilitates access to Kilcolgan Strand and is approximately 3 m wide with no existing footpaths, cycle lanes or lighting columns and is situated to the west of the Proposed Development. This road leads to an existing parking/ turning area from where pedestrians can access the shoreline. This access and turning area is outside the Proposed Development area and so will not be developed as part of this application.

11.5.1.6 Base Traffic Surveys

Traffic surveys were carried out by an independent survey company (IDASO) on behalf of Shannon LNG. The results from the traffic surveys have been used to inform this section.

Classified junction turning counts were undertaken on a neutral weekday on Tuesday 28th January 2020. The survey recorded data in 15-minute intervals and classified the data into Car, Taxi, Light Goods

Vehicle (LGV), Heavy Goods Vehicle (HGV) and Bus. The junction turning counts were undertaken at the following locations (illustrated in Figure 11-4):

1. R551/ L1010 (3-Arm Priority Junction);
2. N67/ R551 (3-Arm Priority Junction);
3. N69/ N67 (3-Arm Priority Junction); and
4. R551/ R552/ L1010 (4-Arm Junction).

Two Automatic Traffic Count (ATC) surveys were also undertaken along the L1010 Coast Road and Kilcolgan Strand. The ATC surveys were undertaken from Tuesday 28th January 2020 to Monday 3rd February 2020, between 00:00hrs to 24:00hrs. The ATC survey provides traffic flow, by vehicle classification, and speed information. It should be noted that given the traffic surveys were undertaken prior to any national or localised travel restrictions associated with the Covid-19 pandemic and thus the assessments undertaken as part this chapter are considered appropriate.

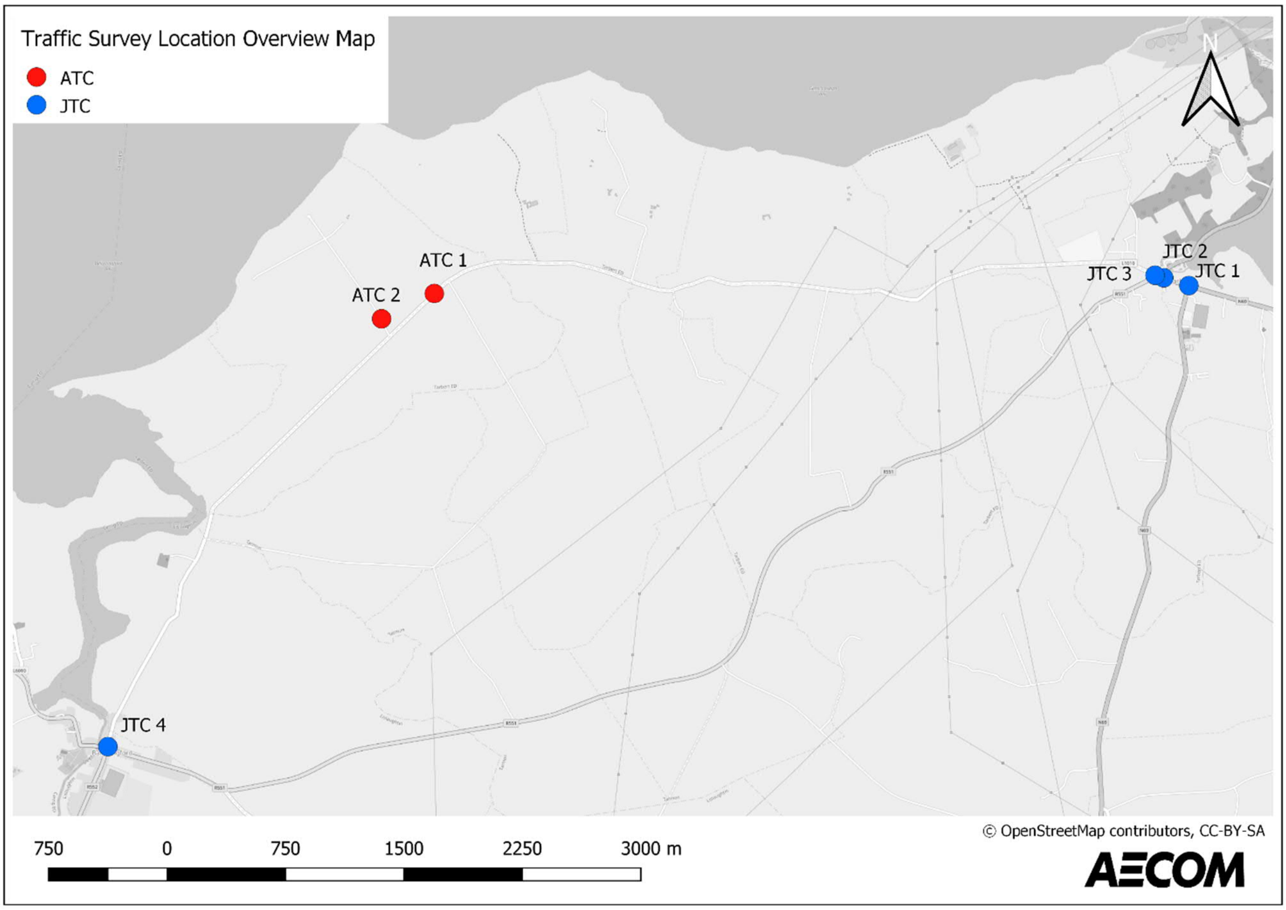


Figure 11-4 Traffic Survey Locations

11.5.2 Road Safety

A review of the Road Safety Authority's traffic collision data has been undertaken for the road network within the study area to identify any patterns of reoccurring traffic collisions and thus instances of potential safety concerns which may be exacerbated by the Proposed Development.

Traffic collision data is available from 2005 – 2016, this being the most recent data available. The incidents are categorized into severity of minor, serious and fatal. The results are shown in Figure 11-5.

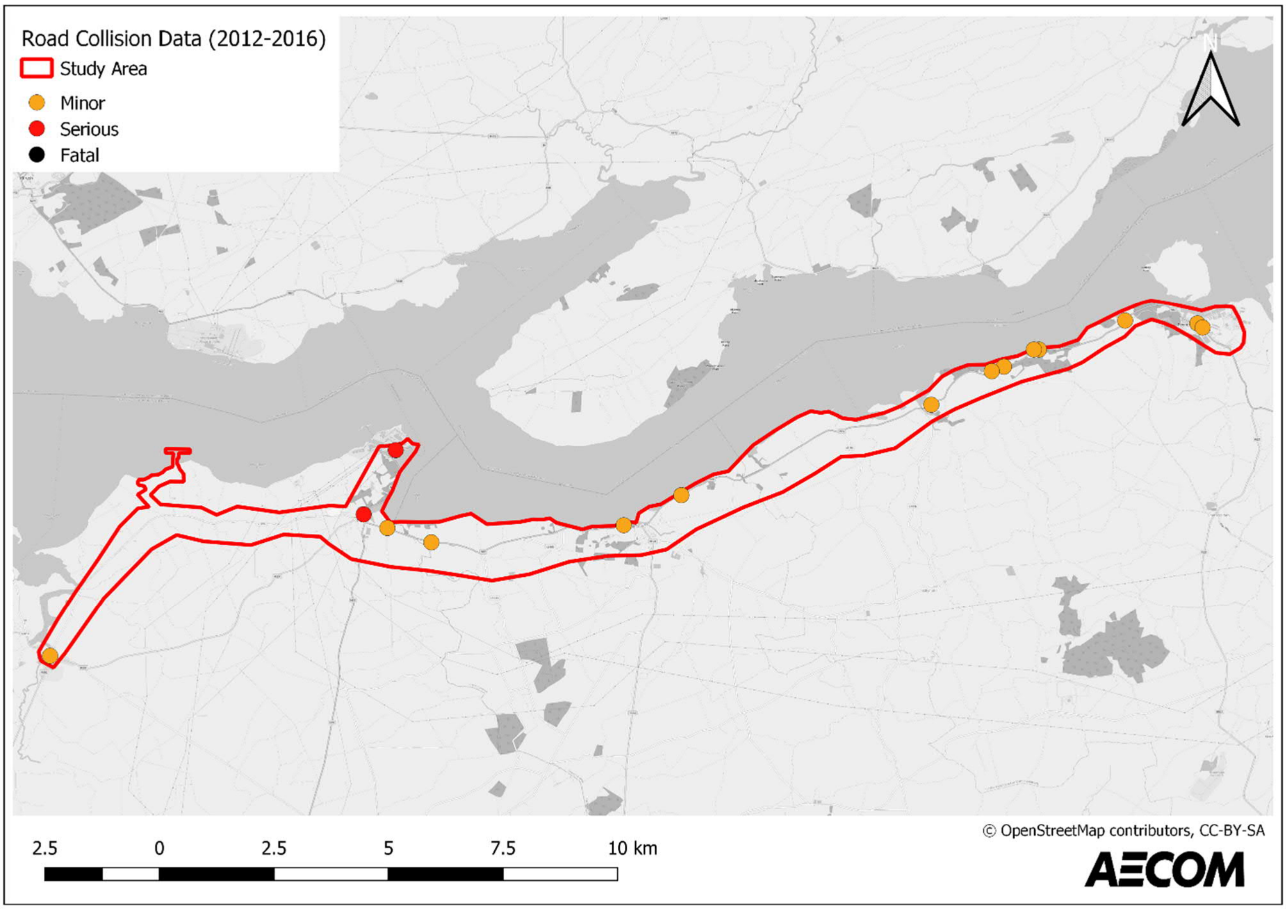


Figure 11-5 Road Collision Data (Source: Road Safety Authority)

The results of the analysis indicated that there have been 13 no. minor and 2 no. serious reported incidents within the study area.

There have been 3 no. collisions in Ballylongford Village. These incidents were noted as being minor in severity and there appears to be no correlation between the accident location or vehicle types involved.

11.5.3 Walking Infrastructure

There are no footways in the vicinity of the Proposed Development site access or along the L1010 road. Within the extents of the study area footpaths are located in the urban environs of Tarbert, Ballylongford, Glin, Loghill and Foynes.

11.5.4 Cycling Infrastructure

There are no designated cycling facilities provided within the extent of the study area.

11.5.5 Bus/ Ferry Travel

There is a bus stop located in Tarbert Town approximately 4.6 km from the site. There is a bus stop in Tarbert Town. Although this stop appears to have been at least temporarily suspended by Bus Eireann due to Covid-19 (as of timetables in March 2021), this chapter will assume that the bus stop will continue to be used in the future, Figure 11-1 shows the location of the bus stops in relation to the study area.

There is a ferry crossing from Tarbert to Killimer in Co. Clare located at the Tarbert Ferry Terminal, north of Tarbert Town and approximately 6.8 km east of the Proposed Development site. This ferry crossing takes approximately 20 minutes and runs every hour from 07:00 to 21:30. This service allows people to transport car, coaches, bicycles, motorcycle and large commercial vehicles from Killimer in Co. Clare to Tarbert in Co. Kerry. This crossing reduces the need to drive around the Shannon Estuary (137 km route).

11.6 Transport Characteristics of the Proposed Development

11.6.1 Access

Access into the Proposed Development will be off the L1010, via a new standard priority-controlled junction with a right turn pocket provided into the site. This junction will be used by all Proposed Development vehicles during construction and operation. The access arrangements are illustrated in Figure 11-6 and Figure 11-7.

The Proposed Development site access priority junction has been designed as per TII guidelines, 'DN-GEO-03060 – Geometric Design of Junctions', the proposed design geometries are illustrated as follows:

- 10.0 m wide site access road;
- Corner radii of approximately 10 m;
- Provision of a right turn pocket along the L1010,
  - 3.2 m wide right turn pocket; and
  - 60 m long lane.

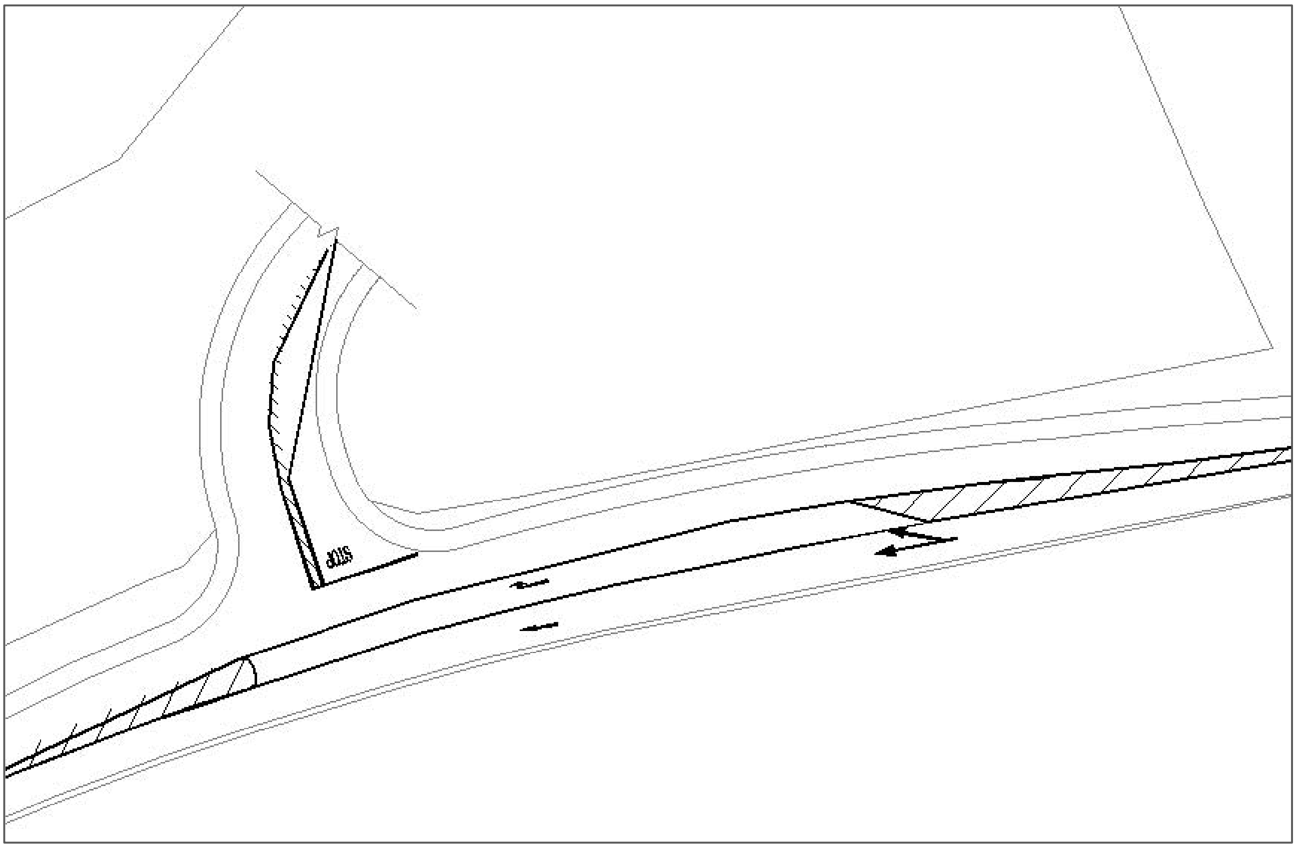
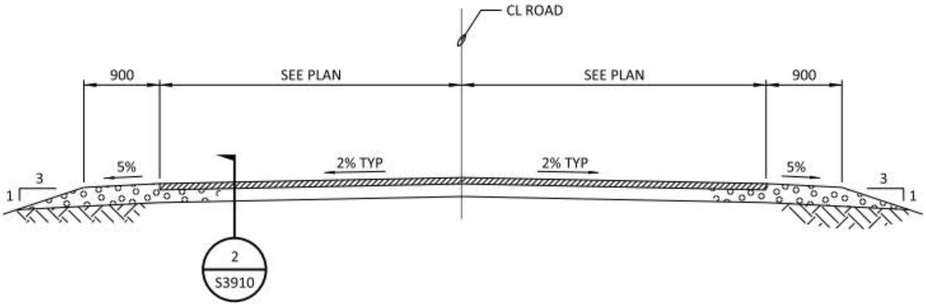
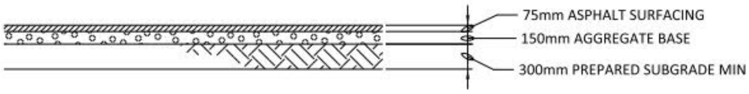


Figure 11-6 Proposed Site Access Arrangements (AECOM Drawing: PR452891-ACM-XX-00-DR-CE-00-0001)



TYPICAL ASPHALT SURFACE ROAD SECTION
NO SCALE



SECTION 2
SEE THIS DWG
NO SCALE

Figure 11-7 Proposed Internal Access Road Cross-Section

11.6.1.1 Swept Path Analysis

An Autotrack analysis has been carried out on the Proposed Development site access junction to demonstrate its capability to cater for an articulated lorry and the AILs (see Appendix A11-2, Vol. 4) accessing and egressing the site. AECOM Drawing 60619377-SPA-C-SNLNG-4001 demonstrates that the Proposed Development site can cater for an abnormal load of an overall length of 54.78 m.

11.6.1.2 Visibility Requirements

In order to inform the visibility requirements of the Proposed Development site access, the outcomes of the ATC survey have been reviewed, in particular relating to existing vehicle speeds. Please see Table 11-3 which provides a summary of the ATC results over the course of the survey period.

Table 11-3 L1010 Coast Road ATC Survey Summary

Direction along L1010	Posted Speed Limit (km/h)	Total Vehicles	Mean Speed (km/hr)	85%ile Speed (km/hr)
Northbound	80	925	68.9	82.0
Southbound	80	936	63.7	80.0
Combined	80	1,861	64.8	81.0

Table 11-3 indicates that the highest 85th percentile speed along the L1010 was recorded at 82.0 km/h travelling Northbound. The TII guidelines recommend a visibility requirement of 160 m based on an 85 km/h design speed. AECOM Drawing PR452891-ACM-XX-00-DR-CE-00-0101 illustrates that a visibility splay of 160 m x 3.0 m is achievable from the Proposed Development site access onto the L1010 Coast Road. It is however a recommendation that construction traffic associated with the Proposed Development will be subject to a reduced speed limit in comparison to the posted speed limit.

11.6.2 Car Parking

The Proposed Development has been reviewed against the KCC Development Plan Car Parking Standards. Please note, there are no specific parking standards within the KCC Development Plan for the Proposed Development. Temporary Car parking has therefore been based on a first principles approach considering the volume of construction personnel, thus 422 car parking spaces are proposed. As part of the operational phase it is proposed to provide a total of 42 spaces across the site with any overflow car parking being accommodated via the overflow car park situated west of the Power Plant/ LNG Terminal.

11.6.2.1 Mobility Impaired Parking Spaces

The Development Plan does not provide guidance in relation to mobility impaired parking.

It is proposed to provide a minimum of 2 mobility spaces within the Proposed Development site when the site becomes operational.

11.6.2.2 Electric Vehicles

It is proposed to provide a minimum of 2 no. electric vehicle charging points at the Proposed Development site when the site becomes operational.

11.6.3 Cycle Parking

It is proposed to provide a minimum 40 no. cycle parking spaces within the Proposed Development site both during construction and when the site becomes operational.

11.6.4 Haulage Routes

As part of the OCTMP Sisk have indicated that all construction traffic associated with the Proposed Development (heavy haul, general delivery and site operatives) will arrive via the N69 and the N67 with the AILs being delivered to Foynes Port then along the N69 to the site, which has been illustrated in Figure 11-8 for reference. Again, more detail on AILs is provided in Appendix A11-2, Vol. 4.

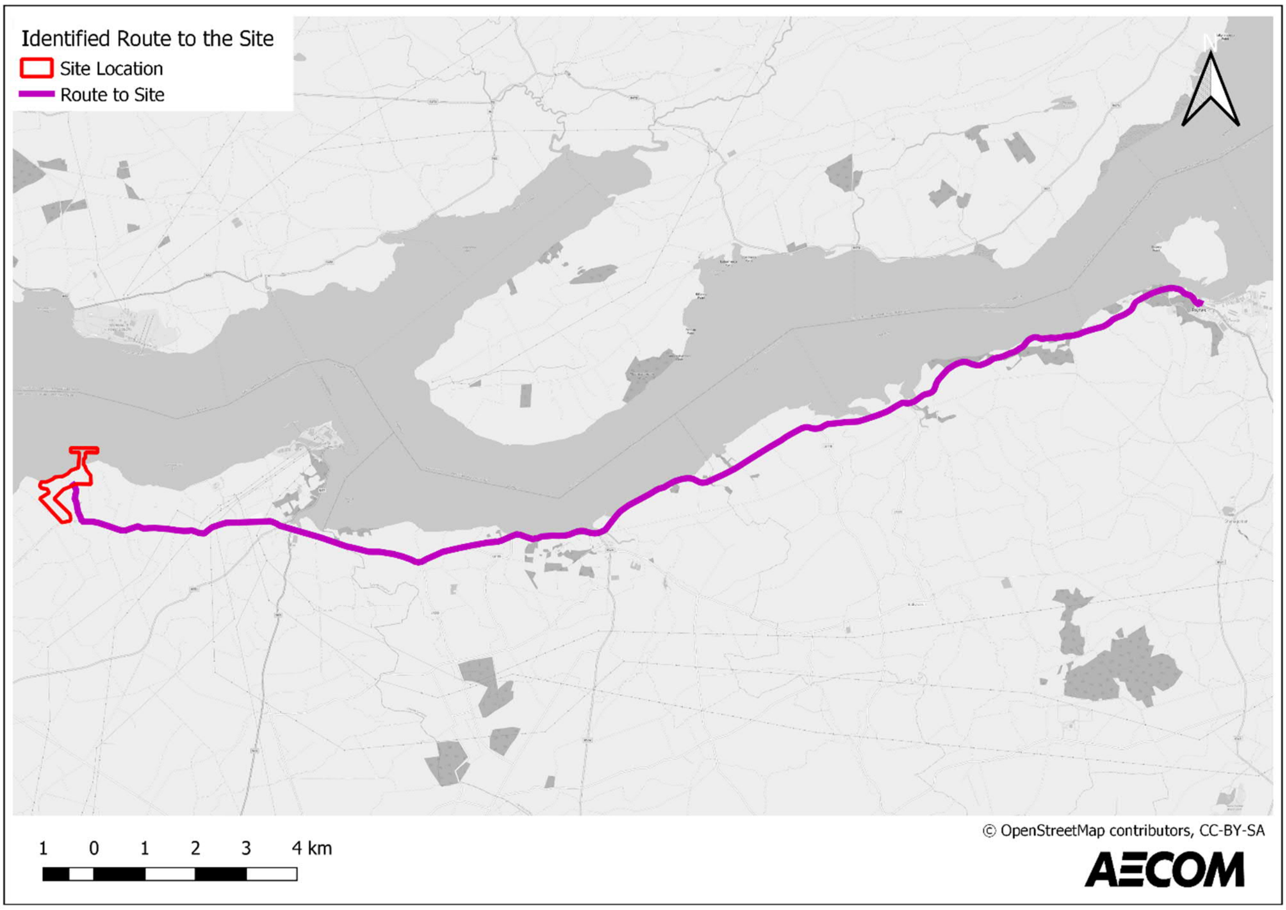


Figure 11-8 AIL Delivery Route

11.6.4.1 Access/ Egress Locations

The construction period of the Proposed Development will be approximately 32 months with the routes for access shown in Figure 11-8. Construction traffic will access and egress the Proposed Development site via a new priority junction and right turn pocket along the upgraded L1010 Coast Road. This vehicular entrance will serve all traffic arriving to the site. All HGV construction traffic will only be allowed to travel from the N69/ N67, through Tarbert Town and along the upgraded L1010 road to the Proposed Development site. No HGV traffic will be permitted to travel/ from the Ballylongford Village direction to the site or along the R551. Please see Figure 11-9 for reference.

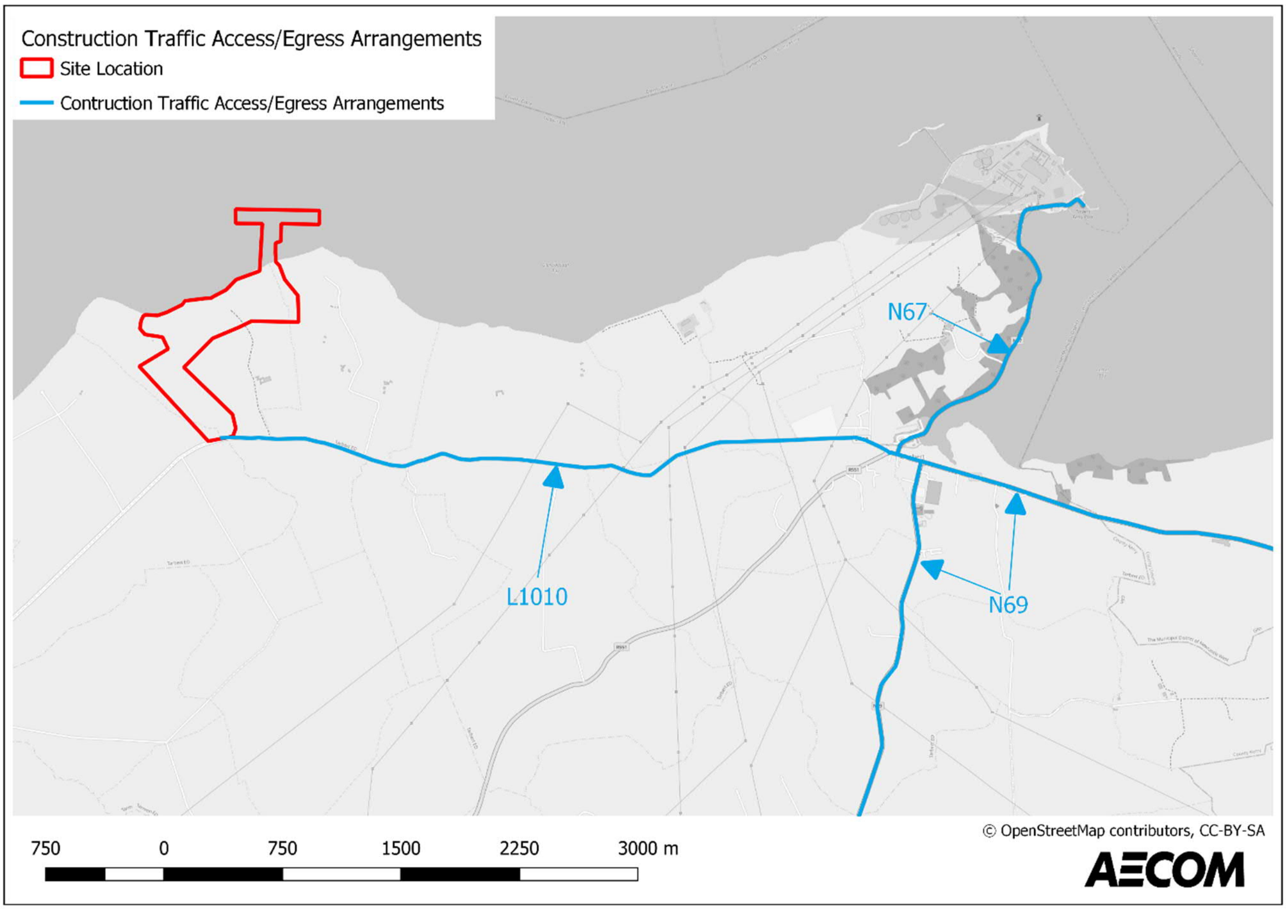


Figure 11-9 Proposed HGV Construction Access/ Egress Arrangements

11.7 Assessment of Impact and Effect

The Proposed Development has been assessed in terms of the following scenarios:

- Do Nothing Scenario;
- Do Something Construction Scenarios; and
- Do Something Operation Scenario.

The above three scenarios have been detailed with respect to the vehicle generation and traffic distribution in the following subsections.

11.7.1 Do Something Construction Scenarios

11.7.1.1 Do Something Construction Scenarios

The Do Something Construction will outline the impact that the Proposed Development may have on the receiving environment. An OCTMP has been prepared by Sisk and is appended to this EIAR (Appendix A11-1, Vol. 4) The OCTMP sets out the proposed methodology during the construction phase in terms of duration of construction phase, access arrangements, routing and impacts. The impact of traffic flows associated with the construction period is assessed upon the receiving environment.

- Construction Phase Scenario:
  - LNG Terminal constructed followed by substation and 2 no. CCGTs construction in parallel and the third CCGT following completion of no. 1 & 2; and
  - Construction anticipated to commence in 2023 with completion by 2025, a total duration of approximately 32 months.

This chapter also only assesses the impacts of general construction traffic, AILs are addressed in Appendix A11-2, Vol. 4.

Trip Generation & Assumptions

The OCTMP gives a detailed breakdown of the trips associated with the development for the construction programme. For the purposes of this assessment the peak months for construction have been considered only as this results in the greatest impact on the road network. The peak months for construction are anticipated to occur from October 2024 to December 2024, construction vehicles will be as follows:

- 975-onsite construction workers at peak times (542 vehicles)[3];
- 73 LGV deliveries per day; and
- 37 HGV deliveries per day.

Sisk have provided the following assumptions in regard to onsite operatives and delivery vehicles, which detail the mode of travel and arrival and departure profile, again these assumptions are intended to provide a robust case. For the LGVs and HGVs it has been assumed that these vehicles would arrive and depart at a uniform rate throughout the day. Table 11-4 and Table 11-5 details the proposed traffic generation during the morning and evening peak construction period for vehicles arriving to and departing from the Proposed Development site. Please note that these values are in vehicles and will be converted to Passenger Car Units (PCU) for the traffic analysis.

Morning Peak Period

- 100% of on-site construction workers would travel by car;
- Car occupancy would be 1.8 persons per vehicle;
- Based on the information provided by Sisk, the construction traffic times will be agreed with KCC in advance to avoid coinciding with the peak time associated with Tarbert Comprehensive School;
- 53% of on-site construction workers would arrive between 06.30 to 07:30;
- 27% of on-site construction workers would arrive between 07:30 to 08:30;
- 20% of on-site construction workers would arrive between 09:15 to 10:00;
- 8 HGVs would arrive and depart during each hourly period; and
- 16 LGVs would arrive and depart during each hourly period.

Table 11-4 Overall Peak Construction Staff Vehicle AM (October 2024 to December 2024)

Time Period	Construction Staff Vehicles (Cars)		
	Personnel	Supervision and Management	Total
06:30 to 07:30	254	32	286
07:30 to 08:30	109	38	147
08:30 to 09:15	0	0	0
09:15 to 10:00	49	60	109
Total Daily Inbound	**412**	**130**	**542**

Evening Peak Period

- 100% of on-site construction workers would travel by car;
- Car occupancy would be 1.8 persons per vehicle;
- Based on the information provided by Sisk, the construction traffic times will be agreed with KCC in advance to avoid coinciding with the peak time associated with Tarbert Comprehensive School;

[3] Construction of Power Plant, LNG Terminal and AGI

- 7% of on-site construction workers would depart between 14:00 to 15:45;
- 53% of on-site construction workers would depart between 16:15 to 17:30;
- 35% of on-site construction workers would depart between 17:30 to 18:30;
- 5% of on-site construction workers would depart post 18:30;
- 4 HGVs would arrive and depart during each hourly period; and
- 8 LGVs would arrive and depart during each hourly period.

Table 11-5 Overall Peak Construction Staff Vehicle PM (October 2024 to December 2024)

Time Period	Construction Staff Vehicles (Cars)		
	Personnel	Supervision and Management	Total
13:00 to 14:00	0	0	0
14:00 to 15:45	24	10	37
15:45 to 16:15	0	0	0
16:15 to 17:30	210	75	285
17:30 to 18:30	150	40	190
Post 18:30	25	5	30
Total Daily Outbound	**412**	**130**	**542**

Traffic Distribution

The anticipated distribution of construction traffic has been based on the OCTMP provided by Sisk. The following assumptions have been made in regard to both deliveries and site operative vehicle trips arriving to and departing the Proposed Development site:

- 100% of HGV traffic would arrive from the N69 of which:
  - 80% of traffic would arrive from the N69, Limerick direction; and
  - 20% of traffic would arrive from the N69, Listowel direction;
- 100% of General Delivery (LGV) traffic would arrive from Tarbert of which:
  - 4% of traffic would arrive from the N67 direction via the Tarbert ferry crossing;
  - 70% of traffic would arrive from the N69, Limerick direction; and
  - 26% of traffic would arrive from the N69, Listowel direction.
- 100% of site operatives (cars) would arrive from the Tarbert Town direction as follows:
  - 5% of traffic would arrive from the N67 direction via the Tarbert ferry crossing;
  - 70% of traffic would arrive from the N69, Limerick direction; and
  - 25% of traffic would arrive from the N69, Listowel direction.

Network Flow Diagram

Using the proposed trip generation and proposed traffic distribution the traffic generation as a result of the Proposed Development during the Construction Phase has been illustrated from Figure 11-10 to Figure 11-13 at the various junctions.

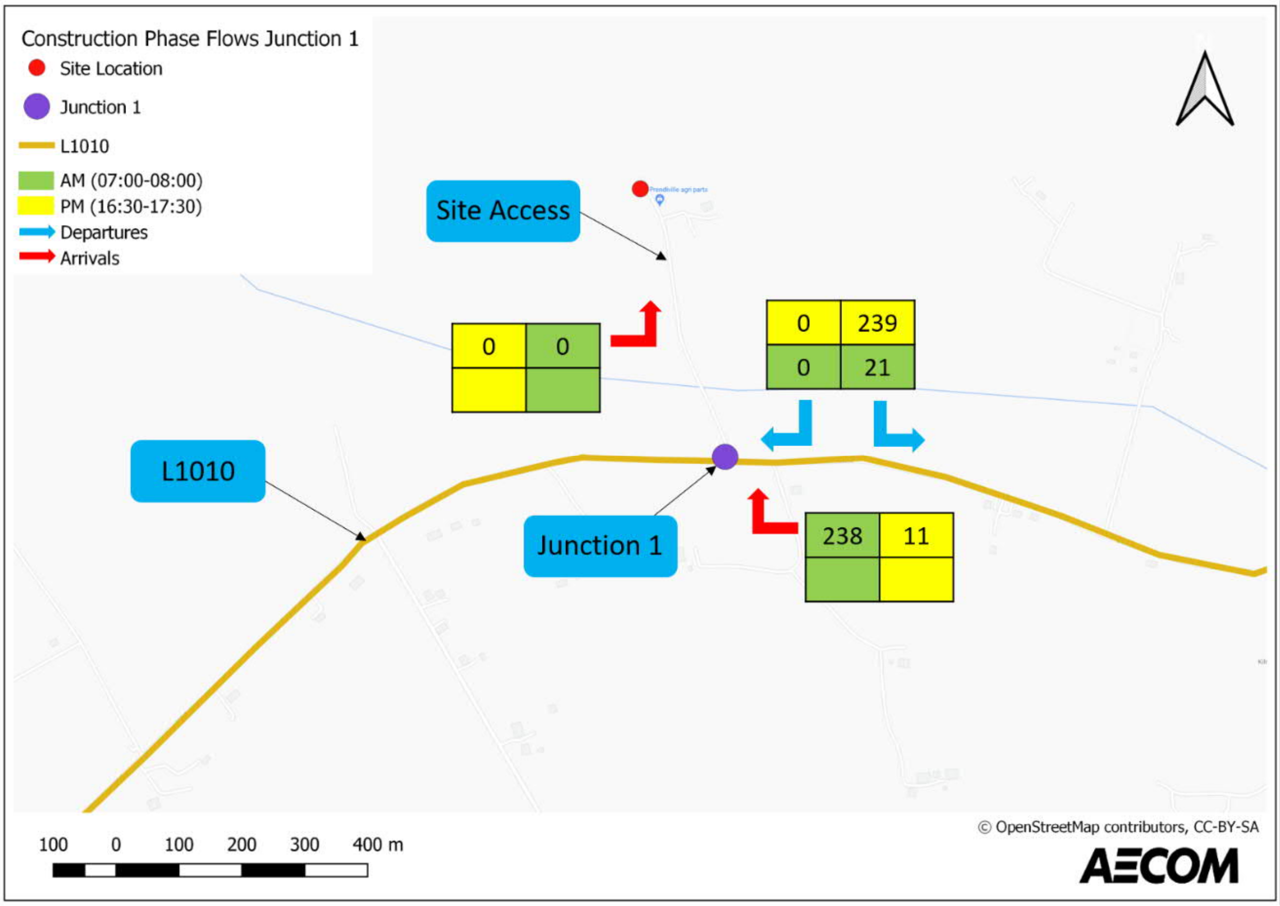


Figure 11-10 Proposed Construction Traffic Flows at Site Access

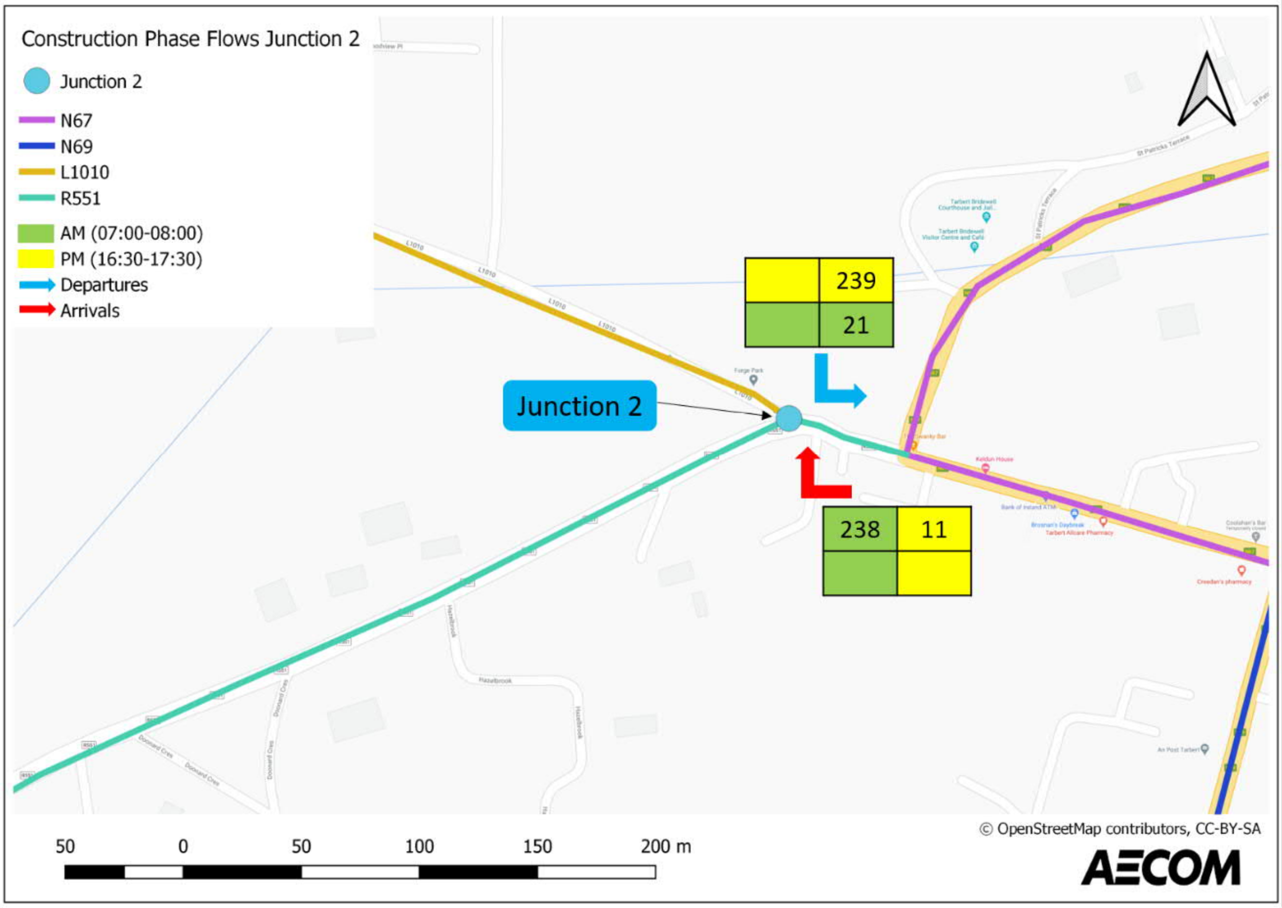


Figure 11-11 Proposed Construction Traffic Flows at R551/ L1010

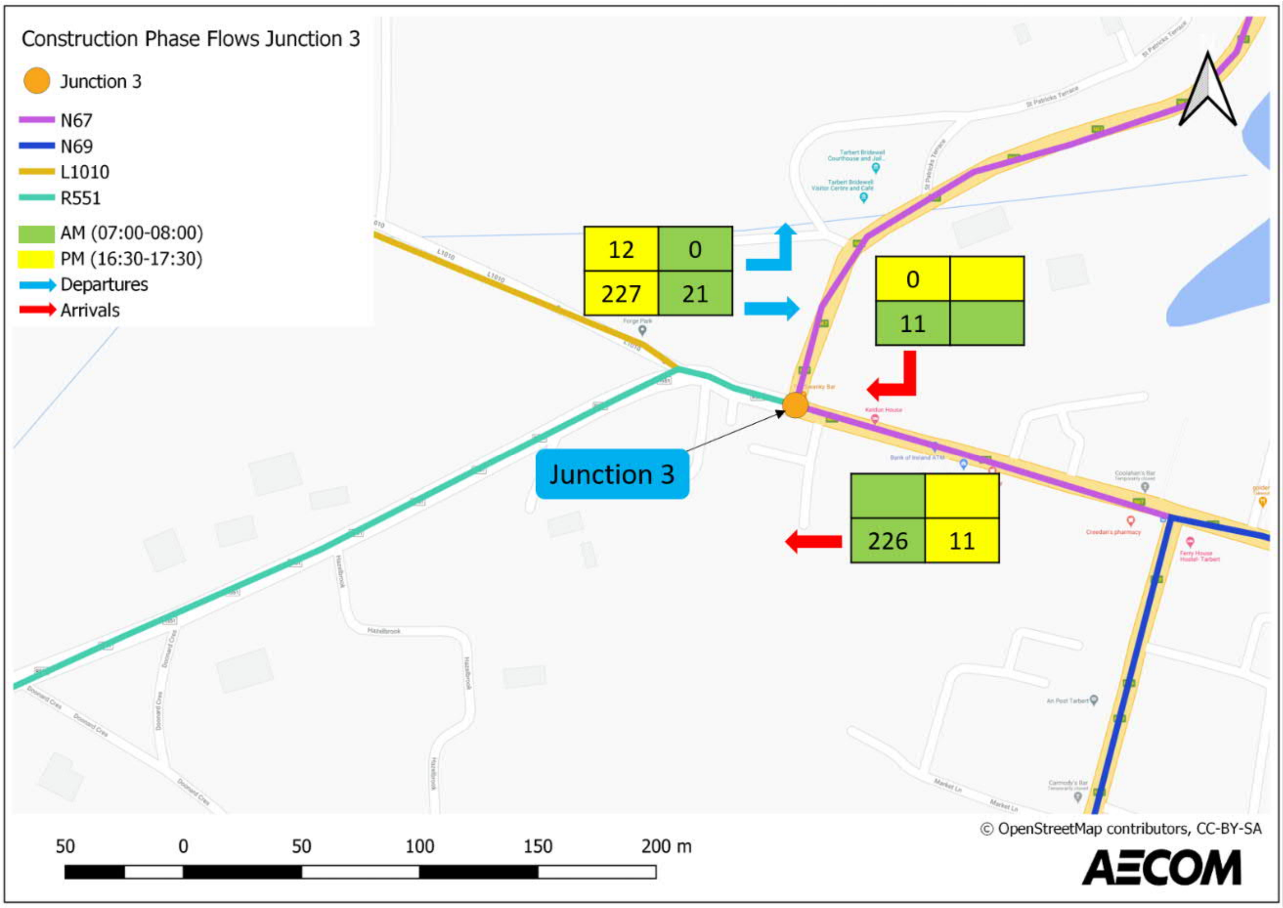


Figure 11-12 Proposed Construction Traffic Flows at N67/ N69/ R551

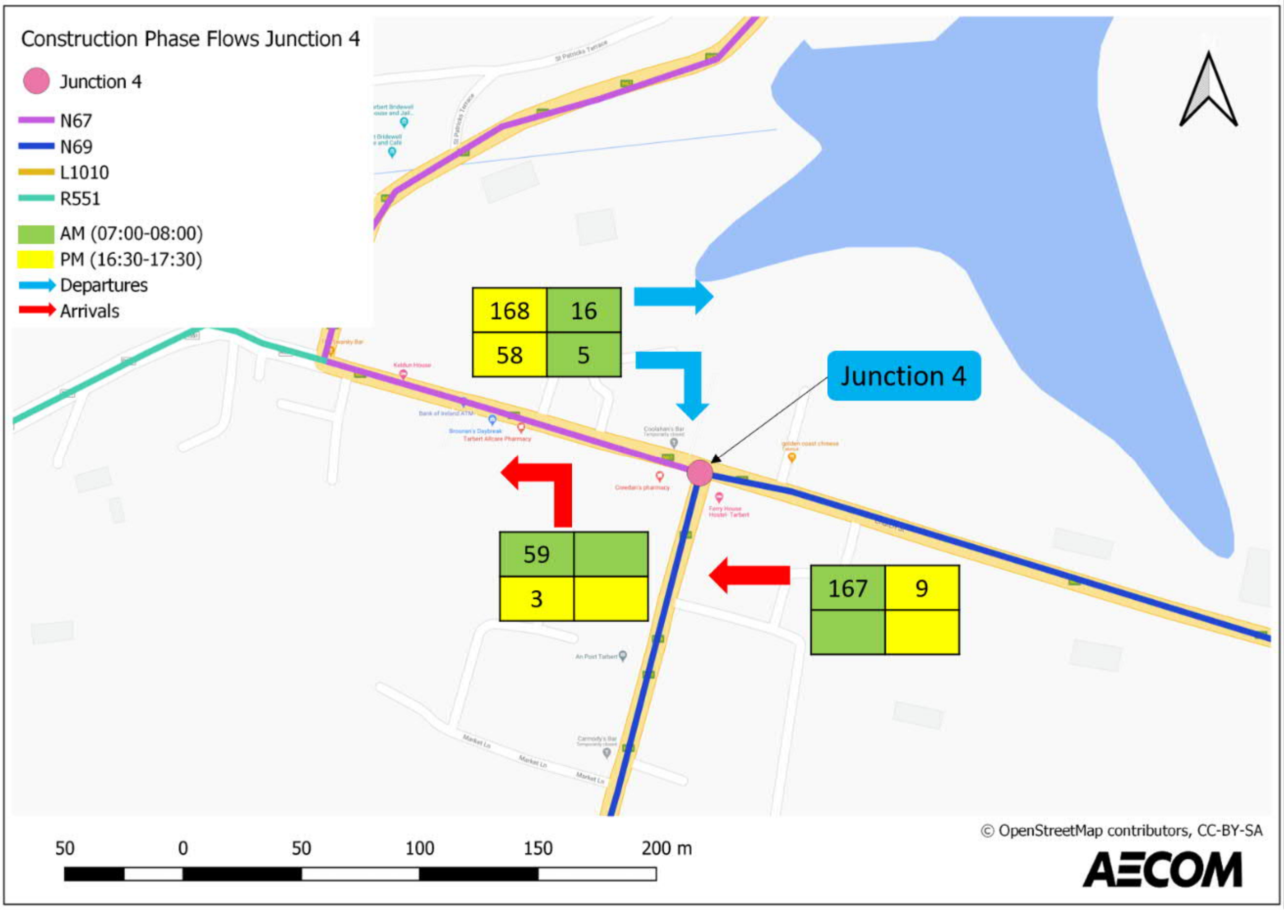


Figure 11-13 Proposed Construction Traffic Flows at N69

Proposed Development Impacts

Applying the construction flows from the Proposed Development onto the surrounding junctions in the study area a percentage impact analysis has been undertaken in accordance with the TII Travel Demand Projections (Unit 5.3) for the peak year of construction (2024). The 2020 base traffic flows have been factored to 2024:

- 4.51% uplift from 2020 to 2024 (Peak year of construction).

The EPA guidelines do not provide specific guidance in relation to the criteria for junction assessments. On this basis and from other schemes AECOM have prepared, the guidelines which are included within the TII Traffic and Transport Assessment Guidelines have been used to identify the thresholds for junction analysis, which are as follows:

- '*Traffic to and from the development exceeds 10% of the existing two-way traffic flow on the adjoining highway*'; and
- '*Traffic to and from the development exceeds 5% of the existing two-way traffic flow on the adjoining highway, where traffic congestion exists or will exist within the assessment period or in other sensitive locations*.'

It should be noted that the impact presented below from the construction phase will be temporary for the peak months of construction. The projected percentage impact of construction traffic within the study area during the peak year of construction (2024) is set out in Table 11-6.

Table 11-6 Percentage Impact of Construction Phase (2024)

Junction	Time Period (Weekday)	Existing Flows	Proposed Flows	Percentage Increase
J1: Site Access	AM	11	259	2,451%
	PM	26	249	944%

Junction	Time Period (Weekday)	Existing Flows	Proposed Flows	Percentage Increase
J2: R551/ L1010	AM	165	259	157%
	PM	264	249	95%
J3: N67/ N69/ R551	AM	216	259	120%
	PM	368	249	68%
J4: N69	AM	330	247	75%
	PM	502	237	47%
J5: R551/ R552/ L1010	AM	154	0	0%
	PM	261	0	0%

It should be noted that the significant increase in traffic anticipated at Junction 1 is due to the relatively low levels of traffic on the existing network at present. As a result of this percentage impact analysis it is deemed that all junctions, except for Junction 5, require junction modelling in line with the Traffic and Transport Assessment Guidelines for the construction phase.

Network Analysis

Junction modelling has been undertaken using the Transport Research Laboratory (TRL) computer package Junctions 9 for priority-controlled junctions. When considering priority-controlled junctions, a Ratio of Flow to Capacity (RFC) of greater than 85% (0.85) will indicate a junction to be approaching capacity, as operation above this RFC value is poor and deteriorates quickly.

The results for the junction analysis for the peak month of construction (April 2024) at the five junctions within the study area are shown in Table 11-7 to Table 11-10.

Table 11-7 Junction 1 Results

Assessment Year	Arm	AM		PM	
		Queue (PCU)	RFC	Queue (PCU)	RFC
2020 Baseline	**Site Access**	0	0	0	0
	L1010 (Eastern Arm)	0	0	0	0
2024 Without Construction Traffic	**Site Access**	0	0	0	0
	L1010 (Eastern Arm)	0.	0	0	0
2024 With Construction Traffic	**Site Access**	0	0.03	0.4	0.34
	L1010 (Eastern Arm)	0.6	0.36	0	0.02

Table 11-8 Junction 2 Results

Assessment Year	Arm	AM		PM	
		Queue (PCU)	RFC	Queue (PCU)	RFC
2020 Baseline	**L1010**	0.1	0.04	0.1	0.08
	R551 (Eastern Arm)	0	0.01	0.1	0.09
	L1010	0.1	0.05	0.1	0.09

Assessment Year	Arm	AM		PM	
		Queue (PCU)	RFC	Queue (PCU)	RFC
2024 Without Construction Traffic	R551 (Eastern Arm)	0	0.01	0.1	0.09
2024 With Construction Traffic	L1010	0.1	0.08	1.0	0.49
	R551 (Eastern Arm)	1.0	0.46	0.2	0.11

Table 11-9 Junction 3 Results

Assessment Year	Arm	AM		PM	
		Queue (PCU)	RFC	Queue (PCU)	RFC
2020 Baseline	N67	0	0.02	0.2	0.14
	Bridewell Street	0.1	0.06	0.1	0.06
2024 Without Construction Traffic	N67	0	0.03	0.2	0.15
	Bridewell Street	0.1	0.06	0.1	0.07
2024 With Construction Traffic	N67	0.1	0.06	0.2	0.17
	Bridewell Street	0.1	0.07	0.1	0.08

Table 11-10 Junction 4 Results

Assessment Year	Arm	AM		PM	
		Queue (PCU)	RFC	Queue (PCU)	RFC
2020 Baseline	N69 (Southern Arm)	0.4	0.27	0.3	0.24
	Bridewell Street (Western Arm)	0.1	0.04	0.2	0.14
2024 Without Construction Traffic	N69 (Southern Arm)	0.4	0.29	0.4	0.25
	Bridewell Street (Western Arm)	0.1	0.04	0.2	0.15
2024 With Construction Traffic	N69 (Southern Arm)	0.8	0.43	0.4	0.28
	Bridewell Street (Western Arm)	0.1	0.05	0.6	0.28

From the network analysis at each of the junctions it is noted that there is a notable increase in the RFC value of Junction 2 (R551/ L1010) from 0.01 (1%) in the morning peak to 0.46 (46%) with a corresponding increase of 1.0 PCU on the R551 Eastern Arm and 0.09 (9%) in the afternoon peak to 0.49 (49%) with a corresponding increase of 0.9 on the L1010 arm of the junction.

In terms of junction capacity due to the increased volume of construction traffic on the network as a result of the Proposed Development this will indicate that there will be a **slight effect** on junction capacity, but this will be a **temporary effect.** Similarly, the increased construction traffic will lead to an increase in queuing at the junctions but the effect will be **not significant** and **temporary** in nature.

Overall, from the analysis undertaken this suggests that the junctions will remain within capacity for the duration of the construction phase and as a result no mitigation would be required at Junction 2 or the remainder of the junctions. The impacts and their effects described, will be a **negative effect** but **temporary** to the surrounding environment, as the above analysis has considered the peak months of the construction phase, which is anticipated to last for three months, the remaining months of the construction phase do not experience a higher volume of construction traffic. Upon completion of construction the junctions would return to pre-development levels with the addition of the operational traffic. Although not necessary in terms of junction capacity, mitigation is proposed to manage construction related traffic impacts through an OCTMP.

11.7.2 Do Something Operational Scenario

The Do Something Operational Scenario will outline the impact that the Proposed Development may have on the receiving environment, as detailed in Section 11.3. The schedule has yet to be finalised; however, it is anticipated that the staff numbers and shift schedule will be as follows:

11.7.2.1 LNG Terminal

- Excluding FSRU and tug crews, the LNG Terminal onshore receiving facility will have 20-day staff (08:30 - 17:00);
- In additional to the 20 day staff, the LNG Terminal will also have 24 hr shift staff, consisting of 5 shifts of 3 staff. (08:00 - 16:00; 16:00 - 00:00; 00:00 – 08:00);
- The AGI will be normally unmanned.
- It is anticipated the FSRU vessel will have a crew of approximately 35 persons, length of service onboard for the officers is generally 3 months on and 3 months off, while the crew typically serve 6 months onboard and 6 months off. Due to the need for the FSRU to be seaworthy at all times in case of emergency, all crew would be onboard for the full time of their contract and will not normally come onshore. Hence the FSRU crew will not contribute to daily traffic volumes.
- Tugs will normally have a crew of 4 onboard. Tug 1’s crew will be permanently onboard for immediate response. Tug 2’s crew will always be within 30 min of tug 2. The crew for tugs 3 and 4 will be within 2 hours’ notice of the Proposed Development site. Therefore, there would be 16 tug crews onsite at most.

11.7.2.2 Power Plant

- The Power Plant will have 26 day staff (08:30 - 17:30); and
- Plus additional 24 hr shift staff. Consisting of 5 shifts of 8 employees (08:00 - 16:00; 16:00 - 00:00; 00:00 – 08:00).

Table 11-11 below details the proposed traffic generation during the peak operational period for vehicles arriving to and departing from the site. Please note that these values are in vehicles and will be converted to PCUs for the traffic analysis.

Table 11-11 Projected Operational Phase Traffic Generation

	Morning Peak			Evening Peak		
	07:00 – 08:00	08:00 – 09:00	09:00 – 10:00	16:00 – 17:00	17:00 – 18:00	18:00 – 19:00
Arriving	12	48	1	1	2	1
Departing	1	13	1	12	48	1
Total	**13**	**61**	**2**	**13**	**50**	**2**

Traffic Distribution

For the purposes of this assessment it has been assumed that the same trip distribution used for construction staff would be used for the operational phase of the Proposed Development.

Network Flow Diagram

Using the proposed trip generation and proposed traffic distribution the traffic generation as a result of the Proposed Development during the operational phase has been illustrated from Figure 11-14 to Figure 11-17 at the various junctions.

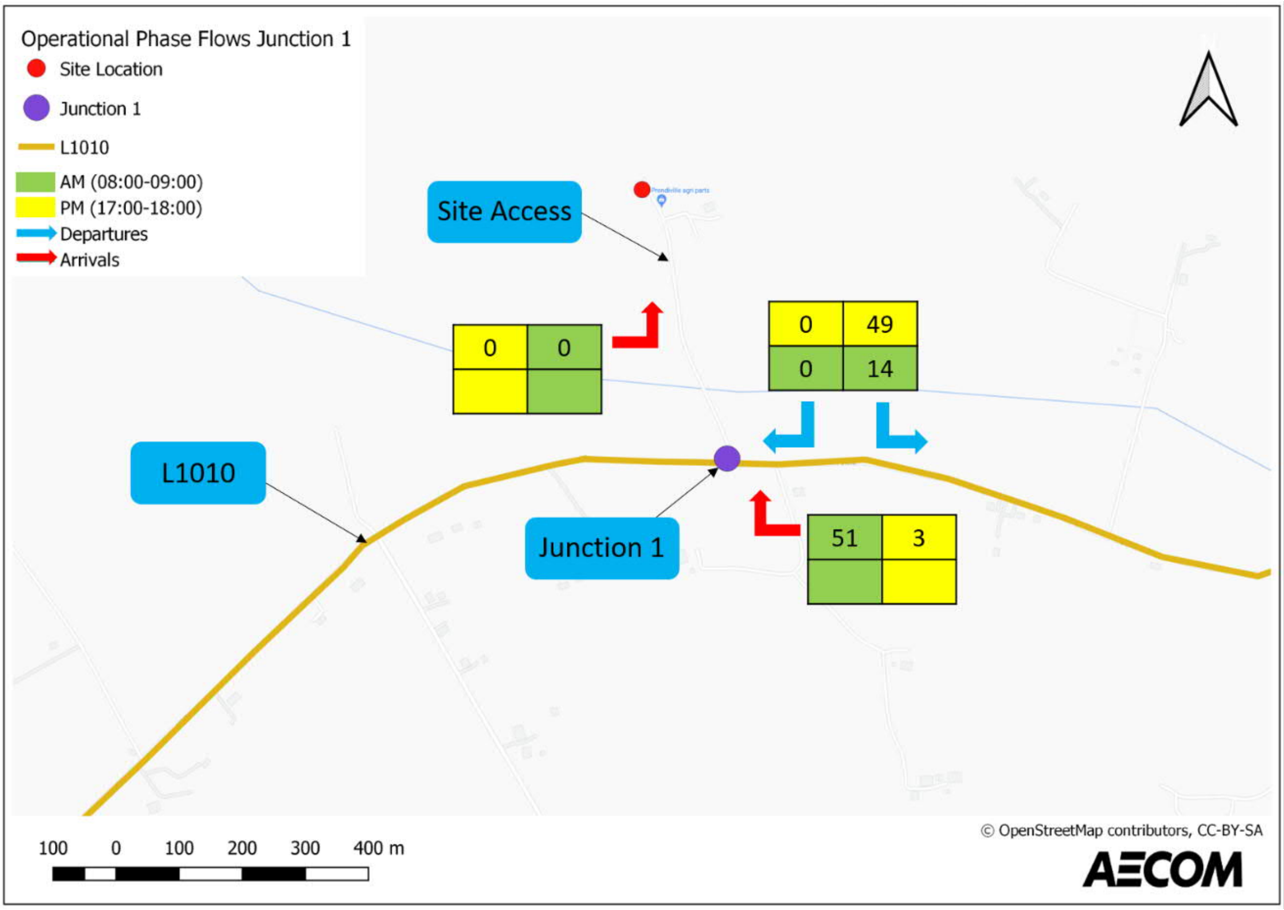


Figure 11-14 Proposed Operation Traffic Flows at Site Access

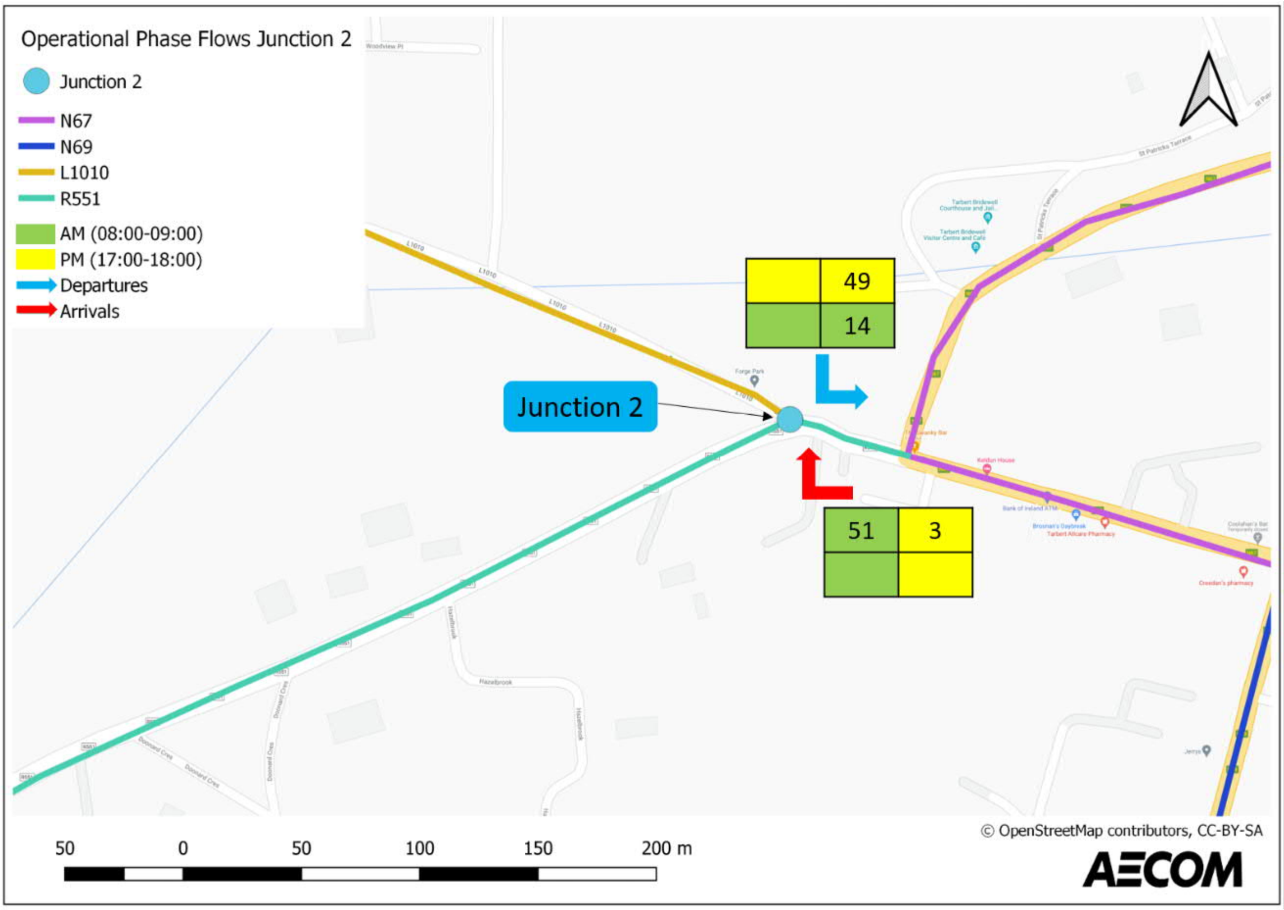


Figure 11-15 Proposed Operation Traffic Flows at R551/ L1010

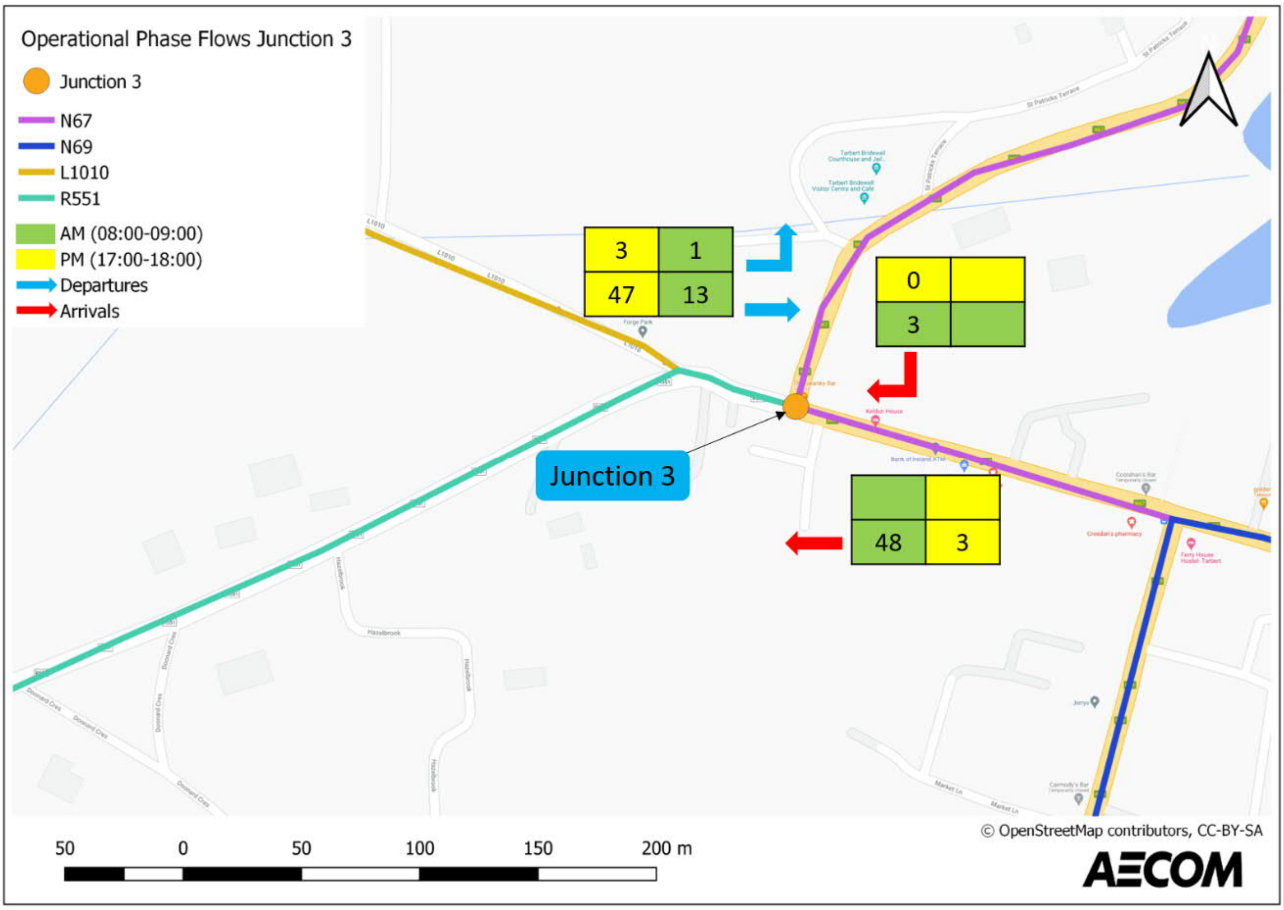


Figure 11-16 Proposed Operation Traffic Flows at N67/ N69/ R551

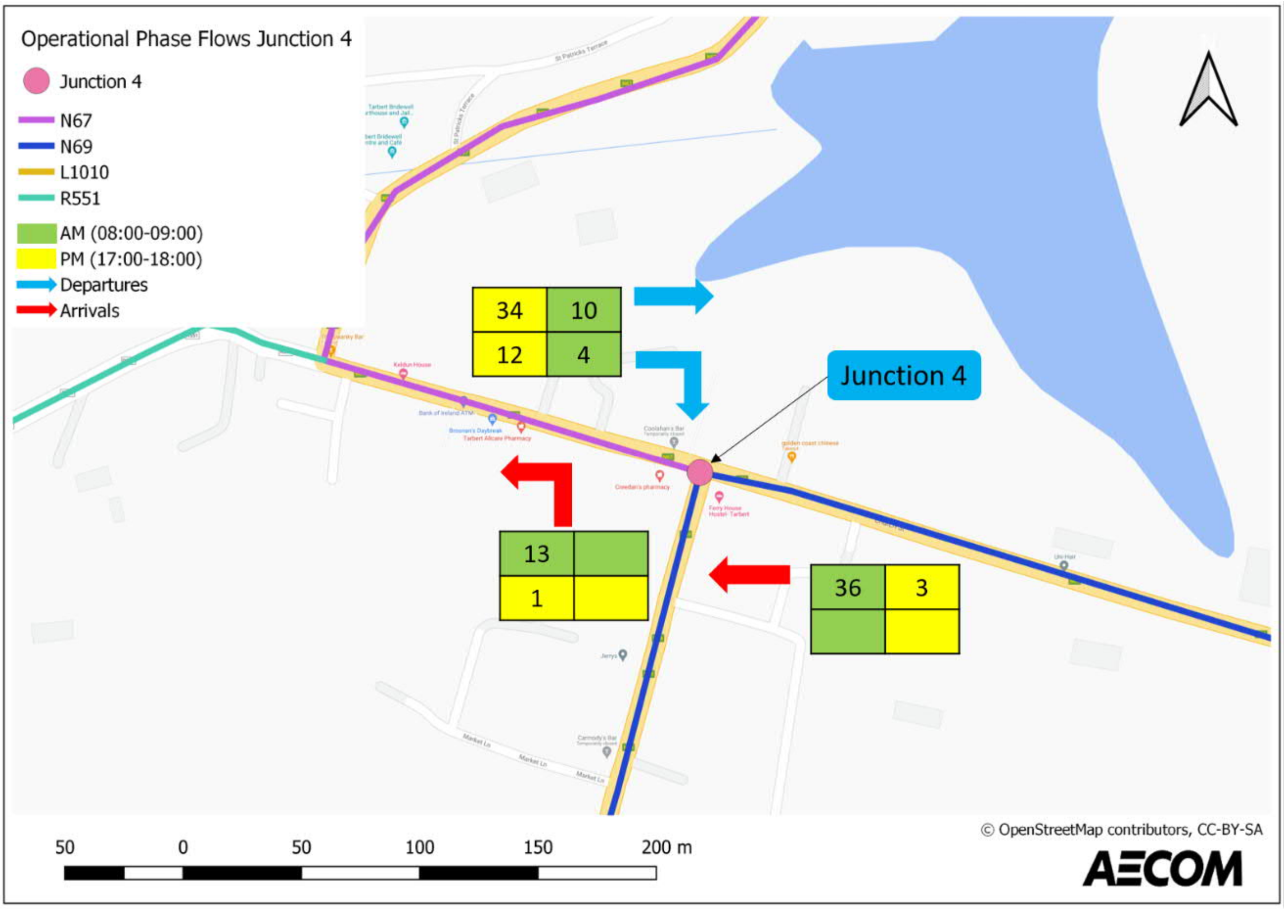


Figure 11-17 Proposed Operation Traffic Flows at N69

Proposed Development Impacts

This section presents the potential impacts associated with the Proposed Development during its operational phase. The 2020 base traffic flows have been factored to the 2025 (Opening Year), 2030 (+5 Year Future Scenario) and 2040 (+15 Year Future Scenario).

The projected percentage impact of operational traffic in the study area in the year of operation (2025), is set out in Table 11-12.

Table 11-12 Percentage Impact of Operational Phase (2025)

Junction	Time Period (Weekday)	Existing Flows	Proposed Flows	Percentage Increase
J1: Site Access	AM	20	65	320.2%
	PM	27	52	194.7%
J2: R551/ L1010	AM	321	65	20.2%
	PM	276	52	18.8%
J3: N67/ N69/ R551	AM	383	65	17.0%
	PM	354	52	14.9%
J4: N69	AM	476	62	13.0%
	PM	515	50	9.8%
J5: R551/ R552/ L1010	AM	198	0	0%
	PM	280	0	0%

It should be noted that the significant increase noted at the site access (Junction 1) is due to the relatively low levels of traffic on L1010 Coast Road. As a result of the percentage impact analysis it was determined that Junctions 1, 2, 3 and 4 require junction modelling.

Network Analysis

Junction modelling has been undertaken using the TRL computer package Junctions 9 for priority-controlled junctions. When considering priority-controlled junctions, an RFC of greater than 85% (0.85) would indicate a junction to be approaching capacity, as operation above this RFC value is poor and deteriorates quickly.

The results for the junction analysis for the opening years (2025), opening year + 5 (2030) and opening year + 15 (2040) for Junctions 1, 2 3 and 4 are shown in Table 11-13 to Table 11-16.

Table 11-13 Junction 1 Results

Assessment Year	Arm	AM		PM	
		Queue (PCU)	RFC	Queue (PCU)	RFC
2020 Baseline	Site Access	0	0	0	0
	L1010 (Eastern Arm)	0	0	0	0
2025 Without Dev	Site Access	0	0	0	0
	L1010 (Eastern Arm)	0	0	0	0
2025 With Dev	Site Access	0	0.02	0.1	0.07
	L1010 (Eastern Arm)	0.1	0.08	0	0
2030 Without Dev	Site Access	0	0	0	0
	L1010 (Eastern Arm)	0	0	0	0
2030 With Dev	Site Access	0	0.02	0.1	0.07
	L1010 (Eastern Arm)	0.1	0.08	0	0
2040 Without Dev	Site Access	0	0	0	0
	L1010 (Eastern Arm)	0	0	0	0
2040 With Dev	Site Access	0	0.02	0.1	0.07
	L1010 (Eastern Arm)	0.1	0.08	0	0

Table 11-14 Junction 2 Results

Assessment Year	Arm	AM		PM	
		Queue (PCU)	RFC	Queue (PCU)	RFC
2020 Baseline	L1010	0.2	0.15	0.1	0.08
	R551 (Eastern Arm)	0.3	0.20	0.2	0.11
2025 Without Dev	L1010	0.2	0.15	0.1	0.08
	R551 (Eastern Arm)	0.3	0.21	0.2	0.11
2025 With Dev	L1010	0.2	0.18	0.2	0.17

Assessment Year	Arm	AM		PM	
		Queue (PCU)	RFC	Queue (PCU)	RFC
	R551 (Eastern Arm)	0.5	0.31	0.2	0.12
2030 Without Dev	L1010	0.2	0.16	0.1	0.09
	R551 (Eastern Arm)	0.3	0.22	0.2	0.12
2030 With Dev	L1010	0.3	0.19	0.2	0.17
	R551 (Eastern Arm)	0.5	0.32	0.2	0.13
2040 Without Dev	L1010	0.2	0.17	0.1	0.09
	R551 (Eastern Arm)	0.3	0.22	0.2	0.12
2040 With Dev	L1010	0.3	0.19	0.2	0.17
	R551 (Eastern Arm)	0.5	0.32	0.2	0.13

Table 11-15 Junction 3 Results

Assessment Year	Arm	AM		PM	
		Queue (PCU)	RFC	Queue (PCU)	RFC
2020 Baseline	N67	0.1	0.07	0.1	0.12
	Bridewell Street	0.1	0.08	0.1	0.06
2025 Without Dev	N67	0.1	0.07	0.2	0.12
	Bridewell Street	0.1	0.08	0.1	0.06
2025 With Dev	N67	0.1	0.08	0.2	0.13
	Bridewell Street	0.2	0.08	0.1	0.06
2030 Without Dev	N67	0.1	0.08	0.2	0.13
	Bridewell Street	0.2	0.09	0.1	0.07
2030 With Dev	N67	0.1	0.08	0.2	0.13
	Bridewell Street	0.2	0.09	0.1	0.07
2040 Without Dev	N67	0.1	0.08	0.2	0.13
	Bridewell Street	0.2	0.09	0.1	0.07
2040 With Dev	N67	0.1	0.08	0.2	0.14
	Bridewell Street	0.2	0.09	0.1	0.07

Table 11-16 Junction 4 Results

Assessment Year	Arm	AM		PM	
		Queue (PCU)	RFC	Queue (PCU)	RFC
2020 Baseline	N69 (Southern Arm)	0.4	0.27	0.3	0.24
	Bridewell Street (Western Arm)	0.1	0.04	0.2	0.14

Assessment Year	Arm	AM		PM	
		Queue (PCU)	RFC	Queue (PCU)	RFC
2025 Without Dev	N69 (Southern Arm)	0.4	0.29	0.4	0.26
	Bridewell Street (Western Arm)	0.1	0.04	0.2	0.15
2025 With Dev	N69 (Southern Arm)	0.5	0.32	0.4	0.26
	Bridewell Street (Western Arm)	0.1	0.05	0.3	0.18
2030 Without Dev	N69 (Southern Arm)	0.5	0.31	0.4	0.27
	Bridewell Street (Western Arm)	0.1	0.04	0.2	0.16
2030 With Dev	N69 (Southern Arm)	0.6	0.34	0.4	0.28
	Bridewell Street (Western Arm)	0.1	0.05	0.3	0.19
2040 Without Dev	N69 (Southern Arm)	0.5	0.31	0.4	0.27
	Bridewell Street (Western Arm)	0.1	0.04	0.2	0.16
2040 With Dev	N69 (Southern Arm)	0.6	0.34	0.4	0.28
	Bridewell Street (Western Arm)	0.1	0.05	0.3	0.19

From the network analysis at each of the junctions it is noted that there is a minor increase to each of the RFCs value for each junction. The greatest increase is to Junction 2 (R551/ L1010) from 0.01 (1%) in the morning peak to 0.09 (9%) with a corresponding increase of 0.1 PCU on the R551 Eastern Arm and 0.09 (9%) in the afternoon peak to 0.16 (16%) with no corresponding increase to the queueing on the L1010 arm of the junction.

In terms of junction capacity due to the increased volume of operational traffic on the network as a result of the Proposed Development this would indicate that there will be a **not significant effect** on junction capacity, but this will be a **long term** effect. Similarly, the increased operational traffic will lead to an increase in queuing at the junctions, but the effect will be **imperceptible** and **long term** in nature.

Overall, from the analysis undertaken this suggests that the junctions will remain within capacity for the duration of the operational phase and as a result no mitigation would be required at Junction 2 or the remainder of the junctions. The impacts and their effects described, will be a **neutral effect** but **long term** to the surrounding environment.

11.8 Cumulative Impact Assessment

AECOM have reviewed KCCs online planning applications to establish the permitted applications within the vicinity of the Site that may overlap with the Proposed Developments construction and/ or operational traffic. From the KCC online planning portal it has been found that there have been 11 no. applications in the vicinity of the Proposed Development which may impact the Proposed Development. A summary of each development along with when they received planning permission are presented in Table 11-17 which also describes the potential impact from a traffic and transport perspective.

Table 11-17 Developments Considered for Cumulative Impacts

KCC/ ABP Ref. No.	Location	Received Date	Decision Date	Decision	Description	Traffic and Transport Context
PL08B.PA0002	Ralappane and Kilcolgan Lower, Co. Kerry	24.9.2007	31.3.2008	Granted	Proposed LNG regasification terminal.	Superseded by this application
PL08.GA0003	26 km pipeline from Shannon LNG to Foynes Port	14.08.2008	17.02.2009	Granted	Construction of an approximate 26 km below ground pipeline from Shannon LNG to Foynes Port.	This scheme was consented in 2009 and follows the completion of the Shannon Technology and Energy Park. It is anticipated that the pipeline would take approximately 8 months to build. It is envisioned that the scheme will be constructed outside of the peak construction periods associated with the Proposed Development. This application assessed the cumulative impact of the previous Shannon LNG scheme and it was found that the scheme would result in an increase of 13% and 10.5% during the respective AM and PM peak periods at the N69 junction (junction 4 as per this application). Taking into consideration that the previous scheme was more onerous in terms of site and HGV traffic on the road network and that the pipeline construction would not coincide with the peak months of construction associated with the Proposed Development, it is envisioned that this would not pose a significant impact on the surrounding road network.
PL08.PM0002	Ralappane and Kilcolgan Lower, Co. Kerry	01.11.2012	04.12.2013	Granted	Amendment to the phasing of the construction of the permitted LNG Terminal (condition no. 3) and other minor modifications	Superseded by this application
PL08.PA0028	Ralappane and Kilcolgan Lower, Co. Kerry	21.12.2012	09.7.2013	Granted	10 year permission for a combined Heat and Power (CHP) Plant	Superseded by this application
13138	Kilpaddoge, Tarbert, Co. Kerry	13.03.2013	17.09.2013	Granted	Construct an electricity peaker power generating plant.	This was consented in 2013 so if now operational will be considered as part of the baseline traffic flow data collected and where relevant

KCC/ ABP Ref. No.	Location	Received Date	Decision Date	Decision	Description	Traffic and Transport Context
						to the study area for this chapter. Irrespectively this type of development is anticipated to have a low volume of operational traffic.
13477	Tarbert Island, Tarbert, Co. Kerry	31.07.2013	23.09.2013	Granted	Alter existing 220 kV station consisting of new single storey control building, new diesel generator building, 3 no. single storey modular buildings, 6 no. gantry support structures, 8 no. control and protection kiosks, 6 no. surge arrestors, 6 no. cable sealing ends, existing compound chain link fence and gates to be replaced with new palisade fence and gates, new holding tank.	This was consented in 2013 so if now operational will be considered as part of the baseline traffic flow data collected and where relevant to the study area for this chapter. Irrespectively this type of development is anticipated to have a low volume of operational traffic.
14816	Gurteenavallig, Tarbert, Co. Kerry	28.11.2014	28.04.2015	Granted	The extension of a portion of the permitted access road, the provision of a new substation compound with a single storey substation building and associated underground services.	This was consented in 2015 so if now operational will be considered as part of the baseline traffic flow data collected and where relevant to the study area for this chapter. Irrespectively this type of development is anticipated to have a low volume of operational traffic.
155	Kilpaddoge, Tarbert, Co. Kerry	08.01.2015	03.03.2015	Granted	Alterations to the existing station consisting of 1 no. 110/ 20 kV transformer, 3 no. 110 kV surge arrestor, 3 no. 110 kV cable sealing ends, 1 no. neutral earth resistor, 1 no. lightning mast, new retaining wall with handrail, new single story mv switchgear building and associated drainage and site works.	This was consented in 2015 so if now operational will be considered as part of the baseline traffic flow data collected and where relevant to the study area for this chapter. Irrespectively this type of development is anticipated to have a low volume of operational traffic.
17466	Meelcon and Gurteenavallig, Ballylongford, Co. Kerry	22.05.2017	14.07.2017	Granted	The modification of the permitted northern access, junction to Leanamore wind farm.	This was consented in 2017, if implemented any associated traffic will be included as part of the baseline traffic flow. Moreover the nature of this type of project is not anticipated to generate

KCC/ ABP Ref. No.	Location	Received Date	Decision Date	Decision	Description	Traffic and Transport Context
						significant construction or operational traffic.
PL08.PM0014	Ralappane and Kilcolgan Lower, Co. Kerry	22.9.2017	13.7.2018	Granted	Amendment to the length of the permission for the permitted LNG Terminal (condition no. 2) from 10 years to 15 years. This decision was quashed by the High Court in November, 2020	None
18392	Tarbert Island, Tarbert, Co. Kerry	27.04.2018	15.01.2019	Granted	For a 10 year permission to construct a battery storage facility within a total site area of up to 2.278ha.	This was consented in 2019, if implemented any associated traffic will be included as part of the baseline traffic flow. Moreover the nature of this type of project is not anticipated to generate significant construction or operational traffic.
18878	Kilpaddoge, Tarbert, Co. Kerry	10.09.2018	23.09.2019	Granted	For a 10 year permission to construct a battery energy storage system (BESS) facility on a total site area of up to 0.6ha that will provide gird balancing services to the Irish electrical grid. Third Party Appeal to Appeal to ABP (305739-19). ABP granted permission.	This was consented in 2019, if implemented any associated traffic will be included as part of the baseline traffic flow. Moreover the nature of this type of project is not anticipated to generate significant construction or operational traffic.
19115	Kilpaddoge, Tarbert, Co. Kerry	12.02.2019	07.02.2020	Granted	For a 10 year permission for a grid stabilisation facility comprising of: the construction up to 4 no. rotating stabilisers, 5 no. battery storage containers, 1 no. control room, 2 transformers and ancillary equipment within a site area of approximately 1.46 hectares.	This was consented in 2020, if implemented any associated traffic will be included as part of the baseline traffic flow. Moreover the nature of this type of project is not anticipated to generate significant construction or operational traffic.
304807-19	Townlands of Aghanagran Middle, Aghanagran Lower, Ballyline	02.07.2019	06.01.2020	Granted	Construction of a Windfarm consisting of up to 6 Wind Turbines. Previously refused by KCC (19381)	This was consented in 2020, if implemented any associated traffic will be included as part of the baseline traffic flow. Moreover the nature of this type of project is not

KCC/ ABP Ref. No.	Location	Received Date	Decision Date	Decision	Description	Traffic and Transport Context
	West, Tullahennell South, Ballylongford, Co. Kerry					anticipated to generate significant construction or operational traffic.
20850	Kilpaddoge, Tarbert, Co. Kerry	18.09.2020	12.11.2020	Granted	For changes to the previously permitted peaker power plant development (planning ref. 13/ 138). It is proposed to change the energy source for the charging of the battery energy storage system (BESS) containers from diesel to charging off the national grid and to change the permitted layout for electrical equipment.	This was consented in 2020, if implemented any associated traffic will be included as part of the baseline traffic flow. Moreover the nature of this type of project is not anticipated to generate significant construction or operational traffic.

The programming and impact of the developments listed in Table 11-17 are not anticipated to impact the study area and thus a cumulative quantitative assessment is not required. Further to this the traffic numbers associated with the construction of the 220 kV and medium voltage (MV) (10/ 20 kV) Substations occur during the peak period of construction associated with the Proposed Development but the increase in traffic is minor in comparison to the Proposed Developments traffic generation (45 additional vehicles per month of construction). As demonstrated by the detailed traffic modelling undertaken as part of this chapter, the surrounding junctions are able to cater for this additional traffic on the road network and as a result a cumulative quantitative assessment is not required. Any potential mitigation to consider cumulative construction traffic can be addressed via the final Construction Traffic Management Plan (CTMP).

11.9 Mitigation and Monitoring Measures

11.9.1 Construction Phase

Should consent be granted mitigating measures would need to be agreed with KCC and relevant stakeholders prior to any works being undertaken. The following list of measures could be adopted to minimise the impacts associated with the construction phase upon the peak periods on the surrounding road network:

- Logistic manager will be put in place.
- Potential hazards associated with the interaction of road traffic and work site personnel have been eliminated by excluding such traffic from entering the work site.
- Traffic control will be in place for all vehicles entering and exiting the site.
- Parking will be allowed only in designated parking areas onsite.
- Segregated pedestrian walkways will be introduced.
- Public pedestrian access will be restricted throughout the proposed works.
- Access to the site will be strictly controlled with all personnel being required to have a Solas Safe Pass and to have undergone a specific Sisk Site Safety Induction before being allowed into the site.

- Traffic on the Proposed Development site will remain on hardcore areas wherever possible. Where this is unavoidable, traffic exiting the site would go through a wheel wash.
- All plant and equipment will be fitted with flashing amber warning lamps and hazard lights and will be required to have reversing alarms for operations within the work site.
- The need for reversing vehicles, will be reduced by introduction of one way system.
- Speed limit of 15 km/h will be put in place on the construction site.
- Safe working procedures will be followed by plant and vehicles required to enter and leave the construction site into trafficked lanes.
- All workers will be required to wear high visibility reflective protective clothing.
- Site foreman and supervisors will be in two-way communication with each other and the traffic controllers for the duration of the work shift.
- The Construction Health and Safety Plan will set out how health and safety is to be managed during the construction stage.
- Site equipment within the work area that may have an impact on any emergency services requiring access to an incident will be cleared from the area as quickly as necessary.
- HGV trips are anticipated to arrive and depart the site at a uniform rate throughout the day, to avoid pressure on the morning and evening peak hour periods. Further to this it is proposed that as per the previous application '*No HGV traffic will be allowed pass the existing school on the Coast Road at Tarbert for 20 minutes before and 10 minutes after the opening and closing times of the school. The elimination of passing HGV traffic during these time periods will ensure the continued safe delivery and collection of children at the school*.'

11.9.2 Operational Phase

Based on the network analysis it was found that the effect that the operational traffic has on the road network is negligible and as such no mitigation measure would be required on the road network to accommodate the operational traffic. Despite this a Mobility Management Plan (MMP) will be prepared for the staff of the Development to help encourage sustainable modes of transport over single private vehicle trips. A Framework for a MMP has been prepared by AECOM which is to assist with promoting more sustainable modes of transport to staff at the Proposed Development. This framework MMP has been included in Appendix A11-3, Vol. 4 of this report.

11.10 Do Nothing Scenario

The do-nothing scenario will discuss the receiving environment as it would be if the Proposed Development was not realised.

Should the Proposed Development not take place, the surrounding road network would remain in the current conditions. Background traffic growth is anticipated on the surrounding road network at a rate of 1.11% per annum from 2016 to 2030 which reduces to 0.11% per annum from 2030 to 2040, as indicated with the TII Travel Demand Projections (Unit 5.3) for Kerry. These rates have been determined based on current industry practice and do not consider the short, medium- or long-term potential impacts of Covid-19 on traffic. The rates have been applied to the baseline traffic flows and are summarised below:

- 5.67% uplift from 2020 to 2025 (Opening Year);
- 11.67% uplift from 2020 to 2030 (Opening Year + 5); and
- 12.67% uplift from 2020 to 2040 (Opening Year +15).

11.11 Residual Impacts and Effects

Once the identified mitigation and monitoring measures, appropriate design standards and operational management plans are adhered to it is considered that any impacts from the Proposed Development on the traffic and transport surrounding the site will result in **slight** and **short term** effects during the construction phase with any impacts during the operational phase resulting in **imperceptible** and **long term** effects.

11.12 Decommissioning

As outlined in Chapter 02 – Project Description, in the event of decommissioning, measures will be undertaken by the Applicant to ensure that there would be no significant, negative environmental effects during the decommissioning phase. Examples of the measures that would be implemented are outlined in Section 2.11, Chapter 02 – Project Description. As a result, additional potential impacts and associated effects arising during the decommissioning phase are not anticipated above and beyond those already assessed during the construction phase.

11.13 Summary

This chapter of the EIAR has assessed the potential transport impacts and effects of the Proposed Development on the surrounding environment.

The receiving environment has been assessed in terms of walking, cycling, public transport and road infrastructure. Prior to the construction phase, a section of L1010 is to be upgraded by KCC with the site to be accessed by way of a new vehicular priority junction off the L1010. The proposed site access has been designed to accommodate AILs.

As part of the assessment, the Proposed Development has been assessed with respect to the Draft EPA Guidelines (2017) and the TII Traffic and Transport Assessment Guidelines. Junction modelling was undertaken using Junctions 9 software and it was found that during both the construction and operational phases that the junctions would continue to operate within capacity for the peak months of construction (October to December 2024) and the opening year of the development, opening + 5 and opening +15 assessment years.

An OCTMP has been prepared by Sisk indicating the potential construction traffic routing, staff numbers, construction scenarios and measures that could be implemented to minimise the impact on the surrounding road network, which will be subject to agreement with KCC Roads Department. Once these measures are implemented and managed in accordance with the OCTMP it is considered that the any traffic impacts associated with the construction phase as outlined in Table 11-8 of the Proposed Development will result in **slight** and **short term** effects on the existing road network and for the operational phase they will be **imperceptible** and **long term**.

It is considered that there would be no significant traffic related effects within the study area during the construction and operation of the Proposed Development.

11.13.1 Predicted Impacts and Effects Summary

A summary of the predicted impacts and effects associated with the Proposed Development during both the construction and operational phases are detailed in Table 11-18.

Table 11-18 Predicted Effects

Mode	Impact	Effect Significance	Mitigation	Residual Effect Significance	Quality of Effects	Duration of Effect
Construction Traffic						
Traffic	Increased Construction Traffic Flows on the road network resulting in a reduction of the junction capacity and increase to	Slight	A Construction Traffic Management Plan will be prepared by the appointed contractor and agreed in writing	Slight	Negative	Short Term

	queuing at the junctions		with KCC roads department.			
Operational Traffic						
Traffic	Increased Operational Traffic Flows on the road network resulting in a reduction of the junction capacity and increase to queuing at the junctions	Not significant	Junction Analysis undertaken demonstrating existing network has ample capacity for Proposed Development	Imperceptible	Neutral	Long Term
Car Parking	Potential overspill of car park	Not significant	42 car parking spaces provided for the proposed development will be as agreed with KCC.	Imperceptible	Neutral	Long Term
Public Transport	Increased public transport patronage associated with the Proposed Development	Imperceptible	None	Imperceptible	Neutral	Long Term
Walking	Increased pedestrian movement on the local road network	Imperceptible	None	Imperceptible	Neutral	Long Term
Cycling	Increased cycle movement on local road network	Imperceptible	None	Imperceptible	Neutral	Long Term

Table 11-19 Summary

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance
Construction	Increased Construction Traffic Flows on the road network resulting in a reduction of the junction capacity and increase to queuing at the junctions.	Low	Negative	Slight	Prior to the construction phase, a section of L1010 is to be upgraded by KCC with the only access to the site to be by way of a new vehicular priority junction off the L1010. The main construction works will start after the L1010 upgrades have been completed. A Construction Traffic Management Plan is prepared by the appointed contractor and agreed in writing with KCC roads department. Based on the information provided by Sisk, the construction traffic times will be agreed with KCC in advance to avoid coinciding with the peak time associated with Tarbert Comprehensive School.	Slight
Operational	Increased Operational Traffic Flows on the road network resulting in a reduction of the junction capacity and increase to queuing at the junctions.	Low	Neutral	Not significant	Junction Analysis undertaken demonstrating existing network has ample capacity for Proposed Development.	Imperceptible
Operational	Potential overspill of car park.	Low	Neutral	Not significant	Car parking provided for the proposed land uses in agreement with KCC.	Imperceptible
Operational	Increased public transport patronage associated with the Proposed Development.	Low	Neutral	Imperceptible	None	Imperceptible
Operational	Increased pedestrian movement on the local road network.	Low	Neutral	Imperceptible	None	Imperceptible

Operational	Increased cycle movement on local road network.	Low	Neutral	Imperceptible	None	Imperceptible

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CHAPTER 12
Cultural Heritage

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park

Environmental Impact Assessment Report

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Figures

No table of figures entries found.

Tables

12. Cultural Heritage

12.1 Introduction

This chapter of the EIAR has been prepared by AECOM with input from the project team. The chapter describes the potential impacts and resultant effects upon the archaeological and architectural heritage resource of the Proposed Development site in accordance with the requirements of the relevant EIA legislation and guidance as outlined in Section 12.2 below.

12.2 Competent Expert

David Kilner has over 18 years' experience in the heritage sector. Prior to joining AECOM, David was Senior Archaeologist with a commercial archaeological company based in Belfast which involved working all over Ireland. His experience covers a range of projects, from planning advice to archaeological baseline research and EIA to procuring and managing archaeological specialists and sub-contractors undertaking field survey.

12.3 Legislation and Policy

This EIAR has been undertaken in accordance with all relevant legislation, policies and guidelines. The documents utilised in the preparation of this study include:

- National Monuments Acts (1930 – 2004);
- The Heritage Acts 1995 and 2018;
- National Heritage Plan (2002);
- Planning and Development Acts 2000 –2021; and
- Planning and Development Regulations 2001 to 2021Planning Policy.

  Local planning policy within the study area is contained within the Kerry County Development Plan 2015 – 2021 ('the County Development Plan'). There are a large number of strategic objectives providing a framework for development which may affect heritage assets. These are laid out in chapter 11 of the County Development Plan and deal with both archaeological and architectural heritage. Those archaeological strategic objectives most pertinent to this project are as follows:

  – H25 Protect and preserve the underwater archaeological heritage of the County. In assessing proposals for development, the Council will take account of the rivers, lakes, intertidal and sub-tidal environments.

  – H26 Secure the preservation of all sites, features and objects of archaeological interest within the County. In securing such preservation the Council will have regard to the advice and recommendations of the National Monuments Service, Department of Arts Heritage & the Gaeltacht, the National Museum of Ireland and the County Archaeologist.

  – H27 Ensure that proposed development (due to location, size or nature) which may have implications for the archaeological heritage of the County are subject to an Archaeological Assessment which may lead to further subsequent archaeological mitigation – buffer zones/ exclusion zones, monitoring, pre-development archaeological testing, archaeological excavation and/ or refusal of planning. This includes areas close to archaeological monuments, extensive in area (half hectare or more) or length (1 km or more) and development that requires an Environmental Impact Statement.

  – H28 Ensure the protection and preservation of archaeological monuments and features, as yet not listed in the RMP, Sites & Monuments Record (SMR) and as yet unrecorded, through on-going review of the archaeological potential of the Plan area. In securing such protection the Council will have regard to the advice and recommendations of The National Monuments Service, Department of Arts, Heritage & the Gaeltacht and the County Archaeologist.

  – H29 Ensure that development (including forestry, renewable energy developments and extractive industries) within the vicinity of a recorded monument, zone of archaeological potential or archaeological landscape does not detract from the setting of the feature and is sited and designed appropriately and sympathetically with the character of the monument/ feature/ landscape and its setting.

Those architectural strategic objectives most pertinent to this project are as follows:

– H34 Protect the architectural heritage and promote conservation-led regeneration and re-use of buildings, where appropriate.
– H35 Promote and improve the understanding of the architectural heritage of Co. Kerry.

12.4 Methodology

12.4.1 Sources of Information

The preparation of the baseline was informed by material gathered and collated from various sources, including:

- National Monuments Service (NMS) and Archaeological Survey of Ireland (ASI);
- National Inventory of Architectural Heritage (NIAH);
- County Kerry Development Plan 2015-2021, Record of Protected Structures;
- County Clare Development Plan 2017-2023, Record of Protected Structures;
- County Limerick Development Plan 2010-2016, Record of Protected Structures;
- Geological Survey of Ireland; and
- The National Map Library, Trinity College, Dublin.

Online sources were also consulted, including Ordnance Survey Ireland historic mapping, toponym information and Heritage Council of Ireland mapping.

The Proposed Development site was previously subject to an EIA Planning Permission (No. 08PA0002 which has since expired) with associated comprehensive archaeological fieldwork and testing. This information has also greatly contributed to the gathering of the baseline assessment.

In addition to the gathering of comprehensive baseline information, a preliminary visit was undertaken at the Applicants' request on 5th December 2019. This was followed by a site visit on 22nd January 2020 in order to identify any previously unidentified cultural heritage assets that might exist within the Proposed Development site, and to assess the current ground conditions and the extent of any previous ground disturbance. The visit also assessed the potential impact of the Proposed Development on the setting of selected cultural heritage assets in the settings assessment study area.

A survey of the foreshore area was undertaken on 26th March 2021 after consultation with the Development Applications Unit (DAU) of the Department of Tourism, Culture, Arts, Gaeltacht, Sport and Media. The purpose of this survey was to update the results of the Underwater Archaeological Impact Assessment previously undertaken in 2007 and assess if any cultural heritage had been revealed within the footprint of the revised Proposed Development during the intervening 14 years. In line with DAU recommendations, the survey concentrated upon the parts of the foreshore which will be the focus of disturbance either for outfall or jetty works or the movement of plant and machinery.

12.4.2 Asset Selection and Study Area

A study area of 2 km from the site boundary was employed to identify Protected Structures, Recorded Monuments, National Monuments, Monuments in State Care, Monuments with Preservation Orders and Architectural Conservation Areas. The 2 km study area was also used to identify structures and designed landscapes listed on the National Inventory of Architectural Heritage which have not been put forward as Protected Structures.

This study area is illustrated on Figure F12-1, Vol. 3 and has been utilised to produce a figure illustrating the surrounding cultural heritage assets. Heritage data from the sources listed above has been collated from this 2 km buffer. The size of this study area enabled a detailed examination of the heritage assets surrounding the site, in order to provide sufficient archaeological and historical contextual information and allow an assessment of the archaeological potential of the site to be made.

Additionally, an assessment of setting was made for designated heritage assets (Protected Structures, National Monuments, Recorded Monuments and sites on the Register of Historic Monuments, and Architectural Conservation Areas) within the 2 km study area with regard also paid to any other highly visible assets outside this (Section 12.5.2). There are no other highly visible assets outside the 2 km study area. This includes within the nearby counties of Limerick and Clare to the east and north respectively.

12.4.3 Assessment of Heritage Asset Importance

A Cultural Heritage asset is defined as a monument, building, group of buildings and sites which are the combined works of nature and man constituting the historic or built environment (World Heritage Convention 1972). A heritage asset's value is not solely expressed through any designated status but can also be exhibited through a series of values or special interests. These include architectural, historical, artistic, archaeological, cultural, scientific, social or technical interests. There is the potential for non-designated assets to display special interests equivalent to a designated asset. Therefore a 'designated' status does not necessarily confer a set level of importance on an asset, rather professional judgement and an assessment of the special interest displayed by that asset are examined and a level of importance is assigned.

Section 2 of the 1930 National Monuments Act defines a 'national monument' as '*a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic, or archaeological interest attaching thereto.*' National Monuments are considered nationally important.

National Monuments and Record of Monuments and Places (RMP) sites/ Register of Historic Monuments (RHM) sites are not clearly differentiated in the National Monuments Act 1930 – 2004. However, not all RMP and RHM sites and associated constraint areas demonstrate the same level or degree of heritage special interest as can be found in National Monuments. Therefore, they can be of either national or regional importance. An assessment of the special interest of the asset and professional judgement is used to identify the appropriate level of importance.

Some archaeological and architectural heritage assets are also included on the Record of Protected Structures (RPS) of each county or city development plan, under section 51(1) of the Planning and Development Act, 2000 (Revised). These protected structures are included in the RPS due to their special architectural, archaeological, artistic, cultural, historical, scientific, social or technical interest. Protected structures are considered to be of international, national or regional importance.

Townlands are the lowest level, officially defined geographical area in Ireland and date to before the Anglo-Norman period (12th century). The boundaries of townlands are often visible in the landscape as walls, tree-lined ditches and embankments or natural features such as streams. They provide visible physical evidence of historical territory or political boundaries and are regarded as being of local importance as historic, cultural heritage features.

12.4.4 Assessment Methodology

The assessment of baseline conditions was carried out in accordance with the following guidance:

- European Commission Guidance on the preparation of the Environmental Impact Assessment Report, 2017;
- Environmental Protection Agency (EPA), 2017, Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- EPA "Guidelines on the information to be contained in Environmental Impact Statements", 2002;
- EPA, 2003, Advice Notes on Current Practice in the Preparation of Environmental Impact Statements;
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment, Government of Ireland, 2018;
- Department of Arts, Heritage and the Gaeltacht, 1999a, Frameworks and Principles for the Protection of the Archaeological Heritage;

- Department of Arts, Heritage and the Gaeltacht, 2004 (revised 2011), Architectural Heritage Guidelines;
- Department of Arts, Heritage and the Gaeltacht, 2004, Architectural Heritage Guidelines;
- National Roads Authority (NRA) (now TII), 2006, Guidelines for the Assessment of Archaeological Heritage Impacts of National Road Schemes;
- NRA, 2007, Guidelines for the Assessment of Architectural Heritage Impacts of National Road Schemes; and
- Historic England's Historic Environment Good Practice Advice in Planning: Note 3 (Second Edition) – The Setting of Heritage Assets (HE, 2017)

12.4.5 Impact Assessment Methodology

Designated Heritage assets – Protected Structure and non-designated Heritage assets including recorded monuments, structures and designed landscapes recorded by the NIAH within 2 km of the study area were assessed.

One Protected Structure, 23 Recorded Monuments and a planned landscape were assessed using aerial/ satellite imagery and mapping. Sites which were evidently screened by intervening modern development or dense vegetation were scoped out. Other sites, which by their nature willwill not be impacted upon by development some distance away, such as archaeological sites discovered through archaeological excavation, or screened by intervening vegetation were also scoped out.

A total of two cultural heritage assets– Ralappane House (RPS KY 003-001) and Lislaughtin Abbey (NM No. 258) which were considered to be potentially sensitive to the Proposed Development were visited as closely as possible from publicly accessible locations. Their settings and how it contributes to their importance were assessed. The Proposed Development was found to be screened from these assets by topography, or multiple areas of dense vegetation. Furthermore, it was concluded that the location of the Proposed Development does not contribute to the importance of these assets.

12.4.6 Setting Assessment Methodology

This assessment has been guided by Historic England's Historic Environment Good Practice Advice in Planning: Note 3 (Second Edition) – The Setting of Heritage Assets (HE, 2017). The Setting of Heritage Assets provides guidance on setting and development management, including assessing the implications of development proposals, a counterpart to which is not available in Ireland.

A staged approach is recommended for settings assessments, the first step of which is to identify the settings of the cultural heritage assets that may be affected. The second step is to assess whether, how and to what degree these settings make a positive contribution to the importance of the heritage asset(s), i.e. '*what matters and why*.' This includes a description of the key attributes of the cultural heritage asset itself, then consider the physical surroundings of the asset, including its relationship with other heritage assets; the way the cultural heritage asset is appreciated; and the asset's associations and patterns of use. The third step (where appropriate) is to assess the effect of the proposed development on the significance of assets through the consideration of the key attributes of the proposed development in terms of its location and siting; form and appearance; additional effects; and permanence.

The assessment methodology has also been guided by the Department of the Environment, Heritage and Local Government's Architectural Heritage Protection, Guidelines for Planning Authorities which was published in 2004 and revised in 2011 (DAHG, 2011). This contains the relevant guidance which is detailed below. It is important to note that paragraph 13.8.1 of the guidance states that proposed development outside the curtilage or grounds of a protected structure or ACA should be given similar consideration as for proposed development within the attendant grounds. This methodology has been combined with the Historic England methodology (HE, 2017), in order to conduct a similar and more robust assessment of the impacts of the proposed development on recorded archaeological monuments, in addition to architectural heritage.

Paragraph 13.7.1 from the Department of the Environment, Heritage and Local Government's Architectural Heritage Protection, Guidelines for Planning Authorities (DAHG, 2011) states:

> '*Development Within the Attendant Grounds*

13.7.1 It is essential to understand the character of a site before development proposals can be considered. Where attendant grounds of particular significance are proposed for development, a conservation plan could be prepared in advance of any planning application which will identify the significance of the site and locate areas within the designed landscape, if any, which could accept change and development and those areas which could not without damaging the architectural heritage of the place.

13.7.2 When dealing with applications for works within the attendant grounds of a protected structure, a visit to the site should be considered an essential part of the assessment. The planning authority should consider:

a) Would the development affect the character of the protected structure?

b) Would the proposed works affect the relationship of the protected structure to its surroundings and attendant grounds?

c) Would the protected structure remain the focus of its setting? For example, a new building erected between a structure and a feature within the attendant grounds will alter the character of both;

d) Do the proposed works require an alteration of the profile of the landscape, for example, the creation of a golf course? How would this affect the character of the protected structure and its attendant grounds?

e) Do the proposals respect important woodland and parkland? Do they conserve significant built features and landscape features?

f) Are there important views of or from the structure that could be damaged by the proposed development? Would important vistas be obstructed by new development?

g) Would distant views of important architectural or natural landmarks be blocked or changed? Would a significant skyline be altered?

h) Even where the proposed development is at a distance from the protected structure, could it still have an impact? This could include tall or bulky buildings interrupting views of or from the protected structure and other features of the designed landscape;

i) Where the new works would not be directly visible from the protected structure, would they be visible from the approaches to the structure or from other important sites or features within the attendant grounds? If so, would this be acceptable?

j) What effect would the scale, height, massing, alignment or materials of a proposed construction have on the protected structure and its attendant grounds?

Other Development Affecting the Setting of a Protected Structure or an Architectural Conservation Area (ACA)

13.8.1 When dealing with applications for works outside the curtilage and attendant grounds of a protected structure or outside an ACA which have the potential to impact upon their character, similar consideration should be given as for proposed development within the attendant grounds. A visit to the site should be considered an essential part of the assessment.

13.8.2 New development both adjacent to, and at a distance from, a protected structure can affect its character and special interest and impact on it in a variety of ways. The proposed development may directly abut the protected structure, as with buildings in a terrace. Alternatively, it may take the form of a new structure within the attendant grounds of the protected structure. A new development could also have an impact even when it is detached from the protected structure outside the curtilage and attendant grounds but is visible in an important view of or from the protected structure.

13.8.3 The extent of the potential impact of proposals will depend on the location of the new works, the character and quality of the protected structure, its designed landscape and its setting, and the character and quality of the ACA. Large buildings, sometimes at a considerable distance, can alter views to or from the protected structure or ACA and thus affect their

> *character. Proposals should not have an adverse effect on the special interest of the protected structure or the character of an ACA.*'

The setting assessment methodology has also utilised the guidance contained within 'Cork County Council, 2006, Guidance Notes for the Appraisal of Historic Gardens, Demesnes, Estates and their Settings' (Cork Co. Council, 2006). This document was prepared by Cork Co. Council in response to increasing adaptation and redevelopment of planned landscapes within the county.

The guidance notes advise the following stepped approach:

- Identification and description of development, history, features and boundaries of the designed landscape using scoping, archival research and fieldwork;
- Evaluation & assessment of significance including Historical Landscape description, archaeological and horticultural aspects;
- Assessing development proposals through an assessment of the heritage impact; and
- Recommendations for mitigation & management including future research.

12.4.7 Consultation

Throughout the preparation of this assessment, consultation has been undertaken with the relevant statutory consultees. The general principles of the assessment, including the methodology have been agreed. The results of the consultation are presented in Table 12-1 below.

Table 12-1 Statutory Consultation

Name and Organisation	Date	Method	Outcome
Development Advice Unit, Department of Culture, Heritage and the Gaeltacht Sinead O'Brien, Executive Officer, Development Advice Unit	26th March 2021 15th April 2021	AECOM letter and request for comment on the Proposed Development via Email	Advising that a co-ordinated heritage related response will be issued within 6 weeks. No response
An Taisce	26th March 2021	AECOM letter and request for comment on the Proposed Development proposed development via Email	No response
Alison Harvey, The Heritage Council	26th March 2021	AECOM letter and request for comment on the Proposed Development via Email	No response
Dr. Michael Connolly Kerry Co. Council	29th January 2020 29th January 2020	AECOM Email request for consultation on the Proposed Development Email response from Dr Connolly outlining suggested information to be included with the planning submission	Detailed mapping of all recorded archaeological features in relation to the proposed development will be required (scaled) The testing of untested areas and excavation of all identified/ potential archaeological features and/ or strata within the development boundary will be our recommendation. The proposals to carry out this work should be detailed in the application Given the archaeology that has been uncovered and recorded Kerry Co. Council will be recommending archaeological, licensed monitoring of all topsoil stripping associated with the development

Name and Organisation	Date	Method	Outcome
	2nd February 2021	Email response from Dr Connolly outlining suggested information to be included with the planning submission for the revised application	Outline any proposals to deal with foreshore and/ or underwater archaeological potential Copies of all relevant archaeological reports, particularly the testing reports should accompany the application Details on what if any subsequent testing has been done in relation to the CHP plant (ABP 08.PA0028) where condition 24 states that further archaeological testing should be carried out prior to the resolution of features and strata identified during the Shannon LNG archaeological testing? Details of proposed/ completed compliance with archaeological conditions on the numerous An Bórd Pleanála decisions Details on any suggested arrangement for dealing with features previously identified in areas it may not now be proposed to develop particularly as the proposed development will alter the hydrology of the overall landholding Responses given are identical to those given previously in 2020 except for the following: Contact should be made with the Underwater Archaeology Unit, National Monuments Service in relation to consultation on foreshore/ underwater archaeological elements.
Underwater Archaeology Unit c/o Development Advice Unit, Department of Culture, Heritage and the Gaeltacht	19th March 2021	AECOM letter and request for comment on the Proposed Development via Email	Sinead O'Brien, Executive Officer, Development Advice Unit responded stating that the cultural heritage section submitted with a new application should include a full overview of all previous archaeological

Name and Organisation	Date	Method	Outcome
			results – to include terrestrial, foreshore and subtidal data. They should be overlaid and geo-rectified on maps/ charts showing to all known (recorded), newly identified (including results from previous testing) and potential archaeology, including underwater cultural heritage. The footprint of the new plant should be clearly defined with respect to what was previously considered and within that, a full overview of the known/ identified cultural heritage displayed and discussed. The Department also recommended that a renewed foreshore/ intertidal survey should be undertaken to assess if any cultural heritage has been revealed in the intervening time since the previous survey of 2007. The survey should concentrate particularly on any parts of the foreshore which will be the focus of disturbance, either for outfall works, plant and machinery movements

12.4.8 Determination of Sensitive Receptors

A heritage asset's value is not solely expressed through any designated status but can also be exhibited through a series of values or special interests. These include architectural, historical, artistic, archaeological, cultural, scientific, social or technical interests. In order to assess the potential effects of a development upon a heritage asset, it must first be assigned a level of importance. This can be done in accordance with a four-point scale (Table 12-2). This table has been derived with reference to the legislation, policy and guidance, and using professional judgement.

Table 12-2 Factors Determining the Value of Heritage Assets

Importance	Criteria
International/ Very High	• World Heritage Sites • Protected structures deemed to be of very high importance using legislation, EPA guidance, NIAH rating criteria and professional judgement • Structures and Designed Landscapes recorded by the NIAH • Building and Garden Survey with an International Rating
National/ High	• National Monuments • Recorded Monuments deemed to be of high importance using legislation, EPA guidance, NRA Significance Criteria and professional judgement • Protected structures deemed to be of high importance using legislation, EPA guidance, NIAH rating criteria and professional judgement • Structures recorded by the NIAH Building Survey with a National Rating or deemed to be of high importance using legislation, EPA guidance, NIAH rating criteria and professional judgement • Designed landscapes recorded by the NIAH Garden survey with main features substantially present and deemed to be of high importance using legislation, EPA guidance, NIAH rating criteria and professional judgement • ACAs containing structures and/ or designed landscapes of predominantly national importance • Undesignated archaeological remains which are rare or complex in nature, and deemed to be of high importance using legislation, EPA guidance, NRA Significance Criteria and professional judgement
Regional/ Medium	• Recorded Monuments deemed to be of medium importance using legislation, EPA guidance, NRA Significance Criteria and professional judgement • Protected structures deemed to be of medium importance using legislation, EPA guidance, NIAH rating criteria and professional judgement • Structures recorded by the NIAH Building Survey with a Regional Rating or deemed to be of medium importance using legislation, EPA guidance, NIAH rating criteria and professional judgement • Designed landscapes recorded by the NIAH garden survey with main features substantially present and deemed to be of medium importance using legislation, EPA guidance, NIAH rating criteria and professional judgement • Architectural Conservation Areas (ACAs) containing structures and/ or designed landscapes of predominantly regional importance • Undesignated architectural heritage assets which are deemed to be of medium importance using legislation, EPA guidance, NIAH rating criteria and professional judgement • Undesignated archaeological remains which are neither particularly common nor uncommon, and/ or of moderate complexity, and deemed to be of medium importance using legislation, EPA guidance, NRA Significance Criteria and professional judgement
Local/ Low	• Structures recorded by the NIAH Building Survey with a Local or Record Only Rating or deemed to be of low importance using

Importance	Criteria
	legislation, EPA guidance, NIAH rating criteria and professional judgement • Designed landscapes recorded by the NIAH garden survey with only peripheral features surviving, and deemed to be of low importance using legislation, EPA guidance, NIAH rating criteria and professional judgement • Townland Boundary Features • Undesignated architectural heritage assets which are deemed to be of low importance using legislation, EPA guidance, NIAH rating criteria and professional judgement • Undesignated archaeological features which are particularly common or in poor condition, and deemed to be of low importance using legislation, EPA guidance, NRA Significance Criteria and professional judgement • Parks/ Gardens/ Demesnes recorded by the NIAH Garden Survey which have poor historic legibility • Undesignated architectural heritage assets • Undesignated archaeological features which are particularly common or in poor condition

12.4.9 Describing Potential Effects

Having identified the value of the heritage asset, the magnitude of the effect from the Proposed Development is assessed. Potential effects are defined as a change resulting from the Proposed Development which affects a heritage asset. These effects are considered using the broad categories quality, extent and context, probability, significance and duration (EPA, 2017).

The quality can be reported on a three-point scale:

- Positive – a change which improves the quality or the special interests of the asset, for example the removal of an element of the surrounding setting which detracts from the appreciation of an asset;
- Neutral – a change which does not affect the quality or special interests of the asset; and
- Negative/ adverse – a change which reduces the quality or special interest of the asset, for example the removal of a below ground archaeological deposit through construction.

The extent and context can be assessed by the following two descriptions:

- Extent – the description of the size of the area and number of assets affected; and
- Context – the description whether the extent, duration, or frequency will conform or contrast with established baseline conditions relating to an asset.

The probability can be described by the following:

- Likely – these are effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented; and
- Unlikely – these are effects than can reasonably be not expected to occur because of the planned project if all mitigation measures are properly implemented.

The duration can be defined by the following criteria:

- Momentary – lasting from seconds to minutes;
- Brief – lasting for a day or less;
- Temporary – lasting for one year or less;
- Short-term – lasting one to seven years;
- Medium-term – lasting seven to fifteen years; and
- Long-term – lasting fifteen to sixty years.

Effects can also be identified as permanent, i.e. lasting over sixty years and reversible, i.e. can be reversed through remediation or restoration. Another consideration is the frequency, i.e. how often the effect will occur once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually.

These effects have been derived from the EPA's draft 'Guidelines for the Information to be Contained in an Environmental Impact Assessment Reports' (EPA, 2017) and as outlined in Chapter 01 – Introduction. The effect upon the setting of an asset is also taken into account.

An overall magnitude of effect is then arrived at without reference to the value of the asset. Table 12-3 provides the magnitude of effect criteria used. The magnitude of effect takes into account control measures which have been embedded within the Proposed Development as part of the design process.

Table 12-3 Factors Determining the Magnitude of Effect

Magnitude	Description
Very High	Change such that the special interests or qualities of the asset are totally altered or destroyed. Comprehensive change to setting affecting importance of asset, resulting in a serious loss in our ability to understand and appreciate the asset
High	Change such that the special interests or qualities of the asset are affected. Noticeably different change to setting affecting importance, resulting in erosion in our ability to understand and appreciate the asset
Medium	Change such that the special interests or qualities of the asset are slightly affected. Slight change to setting affecting significance resulting in a change in our ability to understand and appreciate the asset
Low	Minimal change to the asset that has little effect on its special interests or qualities. Does not affect our ability to understand and appreciate the asset

12.4.10 Significance of Effects

Once the magnitude of the effect has been identified, this can be cross-referenced with the importance of the asset to derive the overall significance of effects, or the consequence of the change resulting from the Proposed Development (Table 12-4) The significance can be judged on a seven-point scale:

- Imperceptible – a change capable of measurements but without significant consequences;
- Not significant – an effect which causes noticeable changes in the character of the asset but without significant consequences;
- Slight effect – an effect which causes a noticeable change without affecting the special interests or qualities of the asset to any particular degree;
- Moderate effect – a change which alters the character or special qualities of an asset in a manner that is consistent with existing and emerging baseline trends;
- Significant effect – an effect, which by its character, magnitude, duration or intensity, alters the special interests or qualities of an asset;
- Very significant – an effect which by its character, magnitude, duration or intensity significantly changed the special interests or qualities of an asset; and
- Profound impact – an effect which obliterates the special interest or qualities of an asset.

Table 12-4 Significance of Effect Matrix

Magnitude of Effect	Importance of Cultural Heritage Asset			
	Local	Regional	National	International
Very High	Significant	Significant	Profound	Profound
High	Moderate	Significant	Significant	Profound
Medium	Slight	Moderate	Significant	Significant
Low	Imperceptible	Slight	Slight	Moderate

This chapter considers that moderate to profound effects are classed as significant. Once a significant effect has been identified, additional mitigation can be used to offset, reduce or compensate for any significant adverse effects, or to enhance positive effects. Reassessing the significance after applying additional mitigation reflects the success rating of the mitigation and allows the level of residual effect and impact to be assessed.

12.4.11 Limitations and Assumptions

The assessment is based upon currently available information at the time of writing including the previous surveys and on a walkover survey of the study area. The previous surveys are considered relevant, robust and representative and no additional fieldwork has been undertaken as part of the assessment.

12.5 Baseline Environment

12.5.1 Site Location

The Proposed Development site is located on the south shore of the Shannon Estuary 4.5 km to the west of the Tarbert and 3.5 km to the east of the village of Ballylongford which spans the Ballyline River. It incorporates farmland and parts of the shoreline on the Shannon Estuary.

12.5.2 Site Visit and Topography

An initial visit was performed on 5th December 2019 by members of the AECOM Environment team accompanied by a representative of the Applicant. The purpose of this visit was to allow the Applicant to present the site and outline the plans for the Proposed Development.

A second and more in-depth site visit was undertaken on 22nd January 2020. The Proposed Development site had been subject to archaeological testing in 2008 with multiple areas of activity had been uncovered (Long & O'Malley, 2009). These areas of archaeological activity had been noted but remain unresolved with the archaeology remaining *in situ* within the Proposed Development site. The purpose of this site visit was to assess the current ground conditions with regard to the locations of these areas of activity ascertaining/ confirming that no subsequent disturbance had taken place.

The site had been subject to a detailed walkover in 2006 by Sheila Lane & Associates to inform previous LNG terminal EIS studies (Lane, 2006). The report from this described the topography within the Proposed Development site as generally undulating and boggy in places with the fields bordering the estuary to the north tending to slope steeply down to the shoreline. The land use in the area was described as predominantly pastoral with fields bounded by hedgerows consisting of low earthen banks planted with whitethorn hedge and trees. Pockets of wetland were also noted.

The site visit in January 2020 noted that the topography of the Proposed Development site has not changed since the 2007 EIS was prepared. There were no visible signs of the extensive archaeological trenching that had been conducted in 2008. The land use is still predominantly marginal pastoral with the fields bounded by hedgerows (Photograph 12.1; Vol. 4 Appendix A12-2). This includes the area which occupies the northeastern part of the Proposed Development site (Photograph 12.2; Vol. 4 Appendix A12-2). The Proposed Development site is bounded to the northeast by a plantation of mature fir trees. The Above Ground Installation (AGI) will be located in the southeast extent of the Proposed Development site. The terrain within this area consists of level marginal pasture (Photograph 12.3; Vol. 4 Appendix A12-2). A ringfort (KE003-004) is located on the site boundary at this location although there are no visible above ground remains (Photograph 12.4; Vol. 4 Appendix A12-2).

The terrain within the footprint of the proposed development slopes downhill to the north and the shoreline. A jetty will extend northeast from the shoreline (Photograph 12.5; Vol. 4 Appendix A12-2). The foreshore consists of exposed bedrock and boulders at this location. The foreshore between Knockfinglas Point and Ardmore Point within the Proposed Development was subject to an intertidal survey as part of the previous ES in 2007. No signs of possible intertidal archaeological features were noted. A small concrete structure with flat roof and wide aperture opening looking seawards is located adjacent to the northeast extent of the Proposed Development site and outside the red line boundary (Photograph 12.6; Vol. 4 Appendix A12-2). This structure has been identified as a searchlight chamber and part of Fort Shannon Coast Defence Artillery installation which was constructed in 1941 during the Second World War (Dargan, 2017). The searchlight chamber is located outside the Proposed Development boundary and will not be impacted by the LNG Terminal.

The foreshore between Knockfinglas Point and Ardmore Point within the Proposed Development was subject to an intertidal survey as part of the previous EIS in 2007. No signs of possible intertidal archaeological features were noted within the footprint of the Proposed Development. A renewed intertidal survey was undertaken in March 2021 to assess if any cultural heritage has been revealed during the intervening time since 2007. Nothing of archaeological significance was noted and the condition of the foreshore was similar to that observed in 2007 with no evidence for erosion or change The foreshore at the east extent, where the proposed jetty will be located, comprises exposed bedrock with the ground rising vertically at the upper foreshore (Photograph 12.7, Vol. 4 Appendix A12-2). A proposed outfall pipe will be located to the west of jetty (Photograph 12.8, Vol. 4 Appendix A12-2). A modern boat berth was noted at this location in 2007 and this is still apparent today. The foreshore has been cleared of boulders at this location and a cut has been excavated into the upper foreshore which provided shelter for a small fishing boat in 2007. The boat is no longer there, and the berth currently appears unused. The 2007 intertidal survey also noted that the remains of a small van had been abandoned on the foreshore. The remains of this vehicle are now largely gone with only an axle and several other pieces of debris apparent. The upper foreshore at this location comprises eroded earthen cliffs with the stratigraphy clearly visible consisting orange/ brown clay overlying grey/ brown clay with a high stone/ boulder content (Photograph 12.9, Vol. 4 Appendix A12-2).

The earthen cliffs forming the upper foreshore rise in height rise in height further to the west while the mid and lower foreshore is rough, consisting of boulders and cobbles (Photograph 12.10, Vol. 4 Appendix A12-2). An area of exposed bedrock forms the entire foreshore at the midpoint along the shoreline within the Proposed Development (Photograph 12.11, Vol. 4 Appendix 12-2). The west extent of the foreshore within the Proposed Development consists of a bay (Photograph 12.12, Vol. 4 Appendix A12-2). The lower and mid foreshore at this location consists of boulders and cobbles while the upper foreshore consists of eroded earthen cliffs which are heavily overgrown in parts (Photograph 12.13, Vol. 4 Appendix 12-2).

The proposed laydown area is located to the immediate west of the Power Plant. The terrain within this area mirrors that within the LNG plant consisting of marginal pasture fields that slope gently downhill to the estuary at north. Further west, outside the footprint of the LNG plant, the terrain slopes uphill to Knockfinglas Point.

The Proposed Development will be accessed by a new road which curves southwest to northeast from the L1010. The terrain within this area consists of undulating marginal pasture fields subdivided by low hedges (Photograph 12.14; Vol. 4 Appendix A12-2). Further to the southeast, the terrain opens into larger fields which slope downhill to the south (Photograph 12.15; Vol. 4 Appendix A12-2). There is evidence for a laneway which now appears unmaintained within this field. An administration building will be situated within these fields. The laneway continues south to a derelict set of buildings which now appear used as agricultural outbuildings (Photograph 12.16; Vol. 4 Appendix A12-2). These buildings were subject to Upstanding Building Survey in 2008 as conditions upon Planning Permission (Condition 32 C 08.PA0002) and are now considered resolved with the planning condition met (Lane, 2012).

The route of the proposed access road curves southwest from the buildings towards the L1010 (Photograph 12.17; Vol. 4 Appendix A12-2).

A stream runs southeast to northwest to the south of Proposed Development. It is effectively contained within a small ‘valley’ with higher ground to the south and north (Photograph 12.18; Vol. 4 Appendix A12-2). It is located outside the Proposed Development and will not be developed. The terrain within this location is low lying consisting of marginal pasture sloping gently uphill from the estuary shoreline. An area of extremely wet ground is located immediately south of the foreshore (Photograph 12.19; Vol.4 Appendix 12-2). The 2007 intertidal survey had noted exposed peat deposits on the foreshore located to the southwest to, and outside of, the scheme boundary at that time. The peat deposits were located close to the point where the stream flows into the sea and the 2007 intertidal survey observed that the peat had the potential to contain archaeological remains. The peat deposits are still apparent on the foreshore at this location although no exposed archaeological features were observed (Photograph 12.20, Vol.4 Appendix 12-2).

12.5.3 Geology

The underlying geology consists of sandstones and siltstones with thin layers of mudstone of the Shannon Group of Namurian age covered by soils comprising acid brown earths and peaty gleys locally occurring derived from Namurian era sandstones and shales (Chapter 05 – Land and Soils). Geotechnical investigations have found that bedrock generally occurs at a shallow depth beneath the site becoming increasingly shallow as it progresses eastwards across the development (Arup, 2007). Bedrock outcrops are exposed in areas within the east of the development but, in general, it is covered by glacial drift.

12.5.4 National Monuments

There are no National Monuments within the boundaries of the Proposed Development or within the wider 2 km study area. The closest National Monument is Lislaughtin Abbey (NM No. 258) which is located 2.68 km to the southwest of the Proposed Development. This Franciscan house, recorded on the Record of Monuments and Places as KE003-016, was built by John O'Connor Kerry for the monks of the strict Observantine Rule and may be located on the site of an earlier church (KE003-016003) dating to the early medieval period.

Lislaughtin Abbey was destroyed in 1580 after the fall of Carrigfoyle Castle and three aged friars were murdered before the high altar. The abbey was reoccupied in 1629 but was sacked again in 1652 by Cromwellian troops. It is claimed that monks fleeing the abbey were caught by the soldiers in a nearby glen and had their ears cut off. The glen is still known as Gleann Cluasach or the ‘glen of the ears’.

A fine processional cross (KE003-016002) was found in a field in 1871. This cross bears an inscription stating that it was made in 1479 at the bequest of Cornelius O’Connor who was the son of John O’Connor the builder of the abbey.

12.5.5 Record of Monuments and Places (RMP)

There is one asset recorded on the RMP partially within the boundary of the Proposed Development (Figure F12-1; Vol. 3). This is a ringfort (KE003-004) dating to the early medieval period and located within the northeast extent of the Proposed Development on rising ground that allows a commanding view of the surrounding ground.

It is marked on the 1st edition Ordnance Survey (OS) map sheet (1841-42) as a possible univallate ringfort which is bisected by the boundary between the townlands of Ralappane and Carhoonakineely. Subsequent OS map editions show that the majority of the asset within the townland of Carhoonakineely has been removed. This was corroborated by a site visit by the North Kerry Archaeological Survey in 1995 which found the upstanding remains to consist of a semi-circular earthen bank 22 m long, 0.4 m high and 5 m wide at its base. The ringfort has been truncated by the field bank forming the townland boundary.

The location of the ringfort was subject to archaeological testing in the form of geophysical survey (Nicholls, in Lane 2006) followed by archaeologically monitored trenching (Long & O’Malley, 2009). The geophysical survey identified an anomaly which was interpreted as the ditch of the ringfort. Subsequent archaeological trenching failed to locate this feature; however, a curvilinear feature and possible pits/ post-holes were identified. Additionally, a large deposit of small and medium stones was uncovered and tentatively identified as the basal bank deposit of the levelled ringfort. A charcoal rich feature was also identified to the west of the ringfort suggesting further activity within this area.

Twenty-one further assets are recorded on the RMP within the 2 km study area around the Proposed Development. These are discussed in chronological order starting with the sites dating to the prehistoric period.

12.5.5.1 Prehistoric Period (7000 BC to 500 AD)

The earliest recorded assets within the study area date to the Bronze Age (2000 BC to 600 BC) consisting of a standing stone (KE003-020), a burnt mound (KE003-067) and a fulacht fia (KE003-066). The standing stone (KE003-020) is located 1,538 m to the southeast of the Proposed Development and consists of an irregularly shaped stone located on low-lying pasture and standing 1.6 m high, 1.25 m wide and 0.3 m thick. Packing stones are visible around the base.

The burnt mound (KE003-067) and fulacht fia (KE003-066) are located in close proximity to one another in the townland of Reenturk to the southwest of the Proposed Development. The burnt mound (KE003-067) is the closer of the two located 1,345 m to the southwest. It was recorded in 2013 within a north face of a drain located 20 m west of the east field fence and 30 m south of the north field fence. It consists of a layer of burnt soil and stone extending for 3.05 m. No burning was evident within the south face of the drain and no further burning was observed in adjacent drains.

An asset (KE003-065001), located 1,981 m to the southwest of the Proposed Development, was originally interpreted as a fulacht fia by the RMP in 1997. However, a subsequent site visit in 2006 noted occasional low irregular-shaped mounds between 0.3 m and 0.5 m high throughout the field. These were interpreted as natural features comprised of stiff clay, and not archaeological features. Given this, the asset (KE003-065001) has been reclassified as non-archaeological and a redundant record.

An actual fulacht fia (KE003-066) is located 141 m to the west of the previous sites and 2,078 m of the southwest of the Proposed Development. It is situated within a drain 20 m south of the north field boundary and 50 m east of the west field boundary. It consists of a shallow layer 0.2 m thick of burnt soil and stone which is apparent in both the faces of the drain while the excavated spoil also contained burnt soil, heat fractured stone and small quantities of charcoal. This asset was also discovered during fieldwork in 2013 and the field surveyor noted that the drain appeared to have cut through the most northerly section of a low mound 0.25 m high which extends 5.4 m further south and 7.4 m long. It conforms to the classic horseshoe shape associated with fulacht fia.

Further possible activity relating to the prehistoric period was uncovered within the boundaries of the Proposed Development during archaeological work associated with archaeological testing. This is discussed in 12.3.11.

12.5.5.2 Early Medieval Period (500 AD to 1100 AD)

The majority of assets recorded by the RMP within the study area are associated with the early medieval period. These consist of 11 ringforts, an ogham stone (KE003-070) and a holy well (KE003-018). Ringforts are the most numerous and recognisable archaeological feature within the Irish landscape consisting of one or more circular or oval banks enclosed by external ditches.

One ringfort (KE003-004) is partially located within the boundaries of the Proposed Development and has been discussed above. Two further ringforts are recorded to the immediate northeast of the Proposed Development . Both are recorded on the 1st edition OS Map sheet (1841) with no visible traces remaining today. The closer of these, (KE003-005), is located 132 m from the Proposed Development in an area that is now densely planted with trees. The asset is marked on the OS map as a circular enclosure labelled Cahergal or ‘White Stone fort’. It is not marked on subsequent map editions.

The other ringfort (KE003-003) was located within a field overlooking the coast with excellent views in all directions. It is marked on the 1st edition OS Map sheet (1841) as a circular feature bisected with a west to east running field boundary and in an area labelled Ardmore or ‘Great Height’. It is not shown on subsequent map editions and its location has been encroached by a quarry.

A ringfort (KE003-019002) is located at Glansillagh 1.67 m to the southeast of the Proposed Development. Known as Lissyhoneen or ‘the ringfort of O Houneen’, this asset consists of an earthen bank measuring 42 m north to south by 44 m east to west set within slightly undulating pasture with good views in all directions. Two small depressions measuring 2 m by 1.6 m and 1.8 m by 1.6 m respectively, were noted during a site inspection in 1995 and are suggestive of the remains of an associated collapsed souterrain (KE003-019001). This is the only indication for a souterrain within the 2 km study area although undiscovered examples may be present associated with the other recorded ringforts within the 2 km study area.

The Holy Well (KE003-018) is located 1.64 km to the southeast of the Proposed Development. It is marked on the 1st edition OS map sheet (1841) as 'Tobernaughtin' which translates as ‘St Naughtin's Well’. The well was visited by O’Danachair in 1958 who recorded a small pool overhung by a clump of whitethorn trees (O’Danachair, 1958). However, the site now only consists of a scattering of stones at the bottom of a hill. An ogham stone (KE003-070) was recovered from the old churchyard of Kilnaughtin (KE003-008) 1.26 km to the southeast of the Proposed Development. This stone was found six feet from the south east angle of the church and is now located in the Pitt-Rivers Museum at Oxford. The dimensions of the stone are 0.75 m x 0.15 m x 0.1 m and the fragmentary inscription was read as: --MA]Q[I] BROCI.

The remaining ringforts within the 2 km study area are similar in nature to those already discussed and are detailed in Table 12-5. Further details are included in Volume 4, Appendix A12-1.

Table 12-5 Remaining Recorded Ringforts within the Study Area

RMP Number	Type	Townland	Condition	Distance from the Proposed Development
KE003-006	Rath	Carhoonakineely	Some remains	704 m
KE003-007	Rath	Coolnanoonagh	Well defined	942 m
KE003-014	Rath/ Ringfort	Reenturk	Unknown	1.66 km
KE003-015	Rath/ Ringfort	Kilclogan Upper	Well defined	648 m
KE003-017	Rath/ Ringfort	Pulleen/Glancullare	No visible remains	1.09 km

Source: https://heritagemaps.ie

Christianity was introduced in Ireland during the 4th century and was widely established by the later 6th century. Associated physical sites range from single churches to monasteries which were centres of learning around which settlements will grow up. The closest monastic site to the Proposed Development was located on Scattery Island 6 km to the northwest within the Shannon estuary.

The Franciscan friary (KE003-016) known as Lislaughtin Abbey is believed to be sited on an earlier church (KE003-016003-). This site, located outside the study area 2.68 km to the southwest, was dedicated to St Lachtin of Muskerry, Co. Cork, who died in 622 AD. There are no visible traces of the original church.

The early medieval is also the period when Viking raids commenced in Ireland culminating with settlement including the formation of important coastal towns such as Dublin, Waterford and Limerick. The village of Ballylongford is located 4.3 km to the west of the Proposed Development. The name Ballylongford is derived from Bel-atha-longphuirt or the ford/ mouth of the longphort/ fortress (Joyce, 1913). Joyce identified the fortress as Carrigafoyle Castle which is located on Carrigafoyle Island 3 km to the west of the town. This castle was constructed in the late 16th century by Conchuir Liath Ui Conchuir while the term longphort is more often associated with Viking winter camps (Lane, 2012).

These camps consisted of a fortified area generally located within the bend of a river where ships could be pulled ashore and easily defended by an enclosing bank and ditch. There are many references to Viking activity within the Shannon estuary and it is possible that Ballylongford owes its name to the presence of such a winter camp, suggesting Viking activity within the area.

12.5.5.3 Medieval Period (1100 AD to 1700 AD)

The medieval period is characterised by the arrival of the Anglo-Normans in 1169. Initially invited to support Diarmait Mac Murchada, the deposed king of Leinster, the Anglo-Normans quickly began to seize territory for themselves transforming the physical appearance of the rural landscape in the form of manorial villages with open field systems, occupied with colonists from England and Wales (Aalen et. al. 1997). The old Gaelic system of agriculture which focused on cattle and dairy was replaced by predominantly arable agriculture based on crops such as wheat, rye flax and corn, while wool from sheep became an important export (Lane, 2012).

The Anglo-Normans are mainly associated with the introduction of motte and baileys to the landscape. These defended homesteads consisted of motte or an earthen mound surmounted by a timber fortification with an adjacent settlement surrounded by a bank and ditch (bailey). In some cases, larger settlements grew up around the motte and baileys which were replaced by more permanent stone castles. There are no examples of such sites within the boundaries of the Proposed Development or the wider study area.

One asset dating to the medieval period is located within the study area. This is Kilnaughtin Church (KE003-008) which dates to the 15th century and is located 1.28 km to the southeast of the Proposed Development. This church, dedicated to St Neachtan, consists of a long rectangular building measuring 28 m by 8 m with 1 m thick walls constructed of hammered stones with lime and sand mortar.

The graveyard (KE003-008001) is located adjacent to where the ogham stone (KE003-070) was uncovered which could suggest that this site is built on an earlier church site dating to the early medieval period.

12.5.5.4 Post-Medieval Period (1700 AD to 1900 AD)

There are no assets dating to the Post Medieval period recorded on the RMP within the Proposed Development or the 2 km study area.

12.5.5.5 Record of Protected Structures

There are no Protected Structures, as noted in the County Kerry Development Plan 2015-2021 Record of Protected Structures, within the Proposed Development. One Protected Structure is located within the wider 2 km study area. This is Ralapane House (RPS KY 003-001) which is located 307 m to the south of the Proposed Development. (Figure F12-1, Vol.3). This is a two-storey, L-shaped residence of four bays and a porch to the front (south) side which is located at the end of a lane leading north from the L1010. The house is believed to date to the 18th century. During the early 19th century, a shepherd called Musgrave came to work for the Sandes family who were the local landowners (Lane, 2012). Musgrave became a trusted servant to the Sandes family who bequeathed Ralappane House and 150 acres to him. The property is still owned by the Musgrave family.

12.5.6 National Inventory of Architectural Heritage

There are no sites recorded on the National Inventory of Architectural Heritage either within the Proposed Development or within the wider 2 km study area.

12.5.7 Planned Landscapes

There is one Planned Landscape noted on the NIAH Garden Survey within the study area, although it does not extend into the boundaries of the Proposed Development (Figure F12-1, Vol.3). This is Sallowglen (2047) which is located 1.19 km to the south of the Proposed Development and extends outside the study area. It was owned by the Sandes family, who also owned Ralappane House (RPS KY 003-001) and the lands forming the development (Lane, 2012). William Sandes came to Ireland during the Cromwellian wars during the 1640s. Sandes' grandson, Thomas, built Sallowglen which Lewis (1837) described as a spacious and handsome mansion located in a finely wooded demesne of over 100 acres which extended along the Sallowglen. Other features included stables, barns and a gate lodge while the grounds also contained a large garden and orchard.

The Sandes estate was divided up between local farmers in 1929 and the house was occupied until 1942 after which it fell into disrepair and was later demolished (Lane, 2012). Today, the boundary and site footprint are still discernible with no major development having taking place. The positions of the entrances and drive have changed, and none of the architectural features are still extant.

12.5.8 Historic Cartographic Evidence

The 1st edition OS map (1841) shows the area of the Proposed Development towards the middle of the 19th century (Figure F12-2; Vol. 3). It was sub-divided into fields although large areas of open ground and marginal ground are shown. Each of the fields has straight boundaries that do not appear to deviate around physical features or possible archaeological remains. The coastline is well defined with Knockfinglas and Ardmore Points clearly marked. Exposed bedrock is marked on the shoreline at these locations. The curving bay to the southeast of the Proposed Development is labelled 'Ballylongford or Moovagh Bay'.

Activity within the Proposed Development is indicated by a few scattered buildings. Those at the east are served by an access lane leading from the main road, which and also served what will become Ralappane House (RPS KY 003-001). However, the single dwelling to the west is set within a field with no obvious access shown. The heritage assets are all clearly marked including the ringfort (KE003-004) partially within the boundaries of the Proposed Development. Ralappane House is also shown as an unidentified complex of buildings. Sallowglen Demesne with Sallowglen House is shown to the south.

The 2nd edition OS map (1896) shows the area of the Proposed Development at the end of the 19th century (Figure F12-3, Vol. 3). The field system was still well defined within the Proposed Development as is the coastline. A salmon weir is shown at Knockfinglas Point. while the areas of marginal ground are noted as being under water during Spring Tides. A river labelled 'Ballylongford Creek' is shown running into the sea to the west. The scattered buildings are still marked within the Proposed

Development, while Ralappane House is identified to the south. The heritage assets are still marked, although most are denuded, including the ringfort (KE003-004) partially within the Proposed Development.

The 3rd edition OS map (1921) shows the Proposed Development site during the first half of the 20th century (Figure F12-4, Vol.3). The location of the Proposed Development is still rural and fewer buildings are shown than previously. Ralappane House is still the largest property within the vicinity. The field systems are better defined with contour lines marked. The boundaries of these fields are still straight, while the coastline is still well defined. The Points on the coast are labelled and the salmon weir is still shown. The archaeological sites are less well defined. The ringfort (KE003-004) had been largely removed with only the half within the Proposed Development site and the townland of Ralappane remaining. The cashel of Cahergal is only shown only as a datum point.

12.5.9 Aerial Photographic Evidence

The site of the Proposed Development has been subject to detailed aerial photographic examination during previous planning applications from 2007 and 2012 which were prepared for a CHP and onshore LNG terminal. In particular, the 2007 EIS included an aerial survey of the site (O'Leary, 2007). This aerial survey comprised video footage of the Proposed Development site taken at varying heights between 300 ft and 100 ft. Examination of this video footage identified six areas of potential archaeological significance labelled Areas B, C, D, E, F and H. Of these areas, only three will be directly impacted by the Proposed Development. These three, Areas B, C and F were subject to archaeological testing in 2008 but found to be non-archaeological (Lane, 2012).

Area B is located in a field (Field 6B) at the east extent of the development. It consists of the faint trace of a possible rectangular feature situated a short distance to the northwest of a disused well. No visible above ground remains were noted during a subsequent site inspection.

Area C is located within the northwest corner of the same field (Field 6B) as Area B. It consists of two small circular areas to the north of a rock outcropping. No visible above ground remains were noted during a subsequent site inspection.

Area F is a semi-circular area located within the field (Field 1) immediately to the southwest of the location of the ringfort (KE003-004) on the east boundary of the proposed development. No remains are visible on the ground. No signs of the ringfort (KE003-004) were visible from the aerial photography.

Examination of aerial photography taken at 20,000 feet noted a further five areas of archaeological potential. These areas were all subject to archaeological testing in 2008.

Area I is a linear feature which was identified to the southwest of the recorded ringfort (KE003:004) on the northeast boundary of the Proposed Development. Archaeological test trenching was carried out in the area and several linear features were noted in the east side of the field (Field 1). However, following archaeological investigation, these features were deemed to be of no archaeological significance consisting of agricultural features such as drains and plough furrows.

Area J is a circular area which was identified in the west of a field within the northeast of the Proposed Development. Archaeological test trenching was carried out in the area. However, no features of archaeological significance were recorded. A high concentration of archaeological features was recorded to the south of this.

Area K is a circular area identified in the east of Field 6B while Area L consists of a circular area identified in the southwest of Field 6B within the northeast of the development. Archaeological test trenching was carried out in the areas and several linear features, deposits and other features were recorded. These comprised the remains of several house foundations, rubble deposits, pathways and tracks and have been interpreted as a substantial habitation site. Early post-medieval pottery recovered from one feature indicates that at least part of this settlement dates back to that period. The location of these remains corresponds with the buildings marked on the 1st edition OS map (1841) at the north end of the lane leading past Ralappane House. These buildings are not shown on subsequent map editions. Local information gleaned during the archaeological testing in 2008 revealed a folk memory of a larger settlement of 14 houses at this location.

Area M is a circular area was identified in the west of Field 6A where Area L is located. Archaeological test trenching was carried out with a curvilinear feature identified. The feature was only partially exposed within the trench and had concave sides, a gently sloping base and measured 0.5 m deep. It was filled by mid-grey, firm, sandy-silt with occasional small stones. The feature is most likely related to the post-medieval settlement activity uncovered in Areas K and L and shown on the 1st edition OS map.

12.5.10 Previous Archaeological Fieldwork

Extensive archaeological fieldwork has previously been carried out within the footprint of the Proposed Development. This included an intertidal survey, a marine archaeo-geophysical survey, a terrestrial geophysical survey and an architectural survey. (O'Leary, 2007). Archaeological testing was carried out in 2008.

12.5.10.1 Intertidal Survey

This consisted of a survey at the locations of the marine structures of the LNG Terminal between Knockfinglas Point and Ardmore Point under licence 07R0048 issued by the Maritime Unit of the then Department of the Environment, Heritage and Local Government (Boland, 2006 and Vol. 4 Appendix A12- 3). The survey methodology consisted of a walkover visual survey extending from the upper foreshore to the low water line for the length of the LNG site.

The survey found that the upper foreshore is comprised of high, earthen cliffs with areas of bedrock outcrops. The earthen cliffs show signs of erosion. The mid and lower foreshore is comprised of boulders and cobbles. No archaeological features or deposits were noted either in the eroded cliffs faces or on the foreshore. A renewed intertidal survey was undertaken in March 2021 to assess if any cultural heritage has been revealed during the intervening time since 2007. Nothing of archaeological significance was noted and the condition of the foreshore was like that observed in 2007 with no evidence for erosion or change.

12.5.10.2 Marine Archaeo-geophysical Survey

This survey was conducted in conjunction with the intertidal survey under licence 07R0048 (Boland, 2006 and Vol. 4 Appendix A12-3). No magnetic anomalies were identified during marine geophysical surveys at Ballylongford. Twelve features were interpreted from the high-resolution side-scan sonar survey although the majority were interpreted as drag marks or modern artefacts associated with drilling rigs. One feature was interpreted as anomalous in nature, appearing manmade and most likely associated with discarded fishing equipment. This feature is located approximately 200 m from the proposed works and will be protected by a 50 m exclusion zone during the construction phase of the Proposed Development.

12.5.10.3 Walkover Survey

The Proposed Development was subject to a detailed archaeological walkover survey (Lane, 2006 and Vol. 4 Appendix A12-4). This identified 15 areas which were denoted as Cultural Heritage Sites (CHS) (Figure F12-5, Vol.3). Seven of these are located within the boundaries of the Proposed Development.

CHS4 is a farm complex which was depicted on all three OS map editions (Lane, 2006). It comprises two buildings in a ruinous condition and two modern buildings. The farm complex was recorded as part of the Upstanding Building Survey carried out by Headland Archaeology (12.3.11.6 above). This asset is located within the Proposed Development.

CHS5 is a raised rock outcrop on a height against the western boundary of a large field. Covering an area 38 m north to south by 15 m east to west and occupying a commanding position with good views over the estuary to the north, this was identified as a possible archaeological feature and subject to archaeological testing that determined it may be an enclosure (see paragraph 12.3.11.5 above).

CHS6 is a disused well of 'random rubble construction' (Lane, 2006). The well is post-medieval in date and is depicted on the 1896 and 1914 editions of the OS maps. Archaeological test trenching was not carried out in the area due to the risk of contaminating or disturbing the water course. This asset is located within the Proposed Development.

CHS7 is a gun emplacement in the east extent of the site, located in the field boundary between the fields forming the northeast corner of the Proposed Development. The structure is associated with Fort Shannon which is situated to the east of the Proposed Development site in the townland of Carhoonnakineely and was built in 1941 as a defence against possible German attack. The pillbox was recorded as part of the Upstanding Building Survey carried out by Headland Archaeology (see paragraph 12.3.11.6).

CHS10 is the recorded ringfort site (KE003:004) located on the east boundary of the Proposed Development. No above ground elements of the ringfort remain; however, sub-surface elements were identified during the geophysical survey (see 12.3.11.4). Archaeological test trenching was carried out in the northeast of the surrounding field however, no remains of the enclosure ditch were discovered. A number of features were identified in the vicinity which may be related (see paragraph 12.3.11.5).

CHS14 had been identified as a mass rock and was recorded in the EIS (O' Lane, 2006) through local consultation. Known locally as Blakeney's Altar, it was located in the intertidal area within the Proposed Development and consisted of two rocks topped with a slab. It is believed that mass was said at the site during penal times. Blakeney's Altar was not noted during the 2006 or 2021 foreshore surveys and remains unlocated. This asset will not have been maintained once the requirements for its use were removed and likely no longer exists.

CHS15 represents the partial remains of a structure located to the east of the pillbox CHS 7 at the northeast of the current Proposed Development. The structure was examined as part of the Upstanding Building Survey carried out by Headland Archaeology (see paragraph 12.3.11.6).

The other 8 CHS outside the current Proposed Development comprise the following.

CHS1 – This is the same feature as Area H noted in Section 12.3.10 and comprises a semi-circular shaped mound with a central depression thought to represent a fulacht fiadh or burnt mound. It is located outside the boundaries of the current Proposed Development.

CHS2 is a complex of farm buildings set around a farmyard in the west of the site outside the boundaries of the current Proposed Development. The buildings are post-medieval in date and are present on three editions of the OS maps (1843, 1896 and 1914). The complex was examined as part of the Upstanding Building Survey carried out by Laban in 2008 (see paragraph 12.3.11.6).

CHS3 is a concrete ruin, known locally as 'the concrete' (Lane, 2006). It is believed to have been used to store nets and other fishing equipment. The structure was not examined during the Upstanding Building Survey as it was not in an area which will be impacted upon by the previously proposed development. It remains outside the boundaries of the current Proposed Development.

CHS8 is a post-medieval residential structure described as a ruined building of 'mass concrete construction' (O'Leary, 2007). The structure was not examined during the previous Upstanding Building Survey. It remains outside the boundaries of the current Proposed Development.

CHS9 is a farm complex that is depicted on three editions of the OS maps (1843, 1896 and 1914). The structures were examined as part of the Upstanding Building Survey carried out by Headland Archaeology (see paragraph 12.3.11.6). The complex is located outside the boundaries of the current Proposed Development.

CHS11 is described as 'a ruined structure of rough concrete construction' with small sheds adjoining the east gable (O'Leary, 2007). The structure was not examined during the Upstanding Building Survey and is outside the boundaries of the Proposed Development.

CHS12 is the site of an old forge that is depicted on all three editions of the OS maps. The EIS notes that there appears to be no above ground evidence for the forge though it is possible that the vegetation growth was obscuring low lying structural remains (O'Leary, 2007). The feature was not examined during the Upstanding Building Survey, and is outside the boundaries of the current Proposed Development.

CHS13 is the site of a well called Tubberagleanna which translates as 'well of the Glen' (O'Leary, 2007). The spring is now overgrown by vegetation and not apparent on the ground. This area of the site is located between a silt trap and a watercourse and has not been subject to archaeological test trenching. It is located outside the boundaries of the Proposed Development.

12.5.10.4 Terrestrial Geophysical Survey

Terrestrial geophysical survey was conducted by Target Geophysics in October 2006 (Nicholls, 2006 and Vol. 4 Appendix A12-5). The survey focussed on the eight areas of archaeological potential highlighted from the aerial photographic survey, field walkover inspections and historic cartographic research. The areas of archaeological potential included one possible archaeological feature noted during the preliminary geotechnical survey carried out in 2006- the possible burnt mound Area H/ CHS1.

Evidence for burnt or fired material was noted at this location which will correspond to the presence of a burnt mound.

Five of these areas are located within the boundaries of the Proposed Development (Areas A, B, C, G and F). Four of these are potential sites identified during aerial photographic survey- Areas A, B, C and F. These did not exhibit any definite signs of archaeological activity which, in the surveyor's opinion, will likely be readily detectable within the local soil and geology. Area G was the western zone of archaeological potential associated with the levelled ringfort (KE003-004). This was also examined revealing possible indications for its enclosing ditch and other internal features.

For the most part, the terrestrial geophysical survey revealed that the area had been intensely cultivated with significant field boundary removal having taken place.

12.5.10.5 Archaeological Testing

This is the most pertinent previous archaeological work as it provides direct evidence of the presence or absence of archaeological features within the boundaries of the Proposed Development. The testing was carried out in 2008 to fulfil conditions 32 (a), (f) and (g) of a previous Planning Permission (No. 08PA0002) and consisted of 48,860 linear metres of trenching undertaken (Long and O'Malley, 2009 and Vol. 4 Appendix A12-6). The trenches were 2 m wide and generally set 10 m apart set in a layout agreed with Dr Michael Connolly, County Archaeologist with Kerry Co. Council. Sixty areas of archaeological potential were uncovered (Figure F12-6, Vol.3). These are summarised in Table 12-6 below with those located within the current Proposed Development boundaries highlighted.

Table 12-6 Areas of Archaeological Potential Uncovered during Testing in 2008

Area Number	Field Number	Summary of Archaeological Features Identified	Within Proposed Development?
1	3	Linear features, a charcoal filled feature and a small midden pit filled with shell in the east of the field.	Yes
2	6A	Consists of two points of focus- A large burnt mound and a charcoal-rich pit.	Yes
3	1	Consists of two points of focus- A charcoal-rich curvilinear feature and several small sub-oval pits in the zone of archaeological potential for RMP KE003:004 and a sub–rectangular feature with charcoal-rich fills.	Yes
4	1	A curvilinear enclosure ditch, several postholes and pits	Yes
5	1	Some charcoal-rich features, stake holes and linear features	Yes
6	1, 2 & 6A	A large irregular area around a dense concentration of features that seem to represent a substantial habitation site. Pottery recovered in this area indicates that at least part of it dates to the 17th or 18th centuries. The location of this area is consistent with Areas K and L noted through aerial photography and the buildings shown on the 1st edition OS map (1841). However, local knowledge imparted to the excavation team suggests that a previous village of 14 houses may have existed here.	Yes
7	6C	A burnt mound and a possible trough.	Yes
8	8	A burnt mound	Yes
9	54	Charcoal rich pit	Yes
10	7	Consists of two points of focus: one cereal-drying kiln and one charcoal rich feature	Yes
11	6C & 7	A possible enclosure. This area corresponds with CHS 5 possible archaeological feature noted during the walkover survey.	Yes
12	8	A concentration of linear and curvilinear features in the west of the field.	Yes
13	8	Consists of two points of focus - A number of charcoal rich features, linears and a possible figure-of-eight shaped corn-drying kiln	Yes
14	3	Consists of two points of focus -A number of charcoal rich pits and stone filled features in the north of the field.	Yes
15	39, 42, 43 & 44	Consists of two points of focus - A number of linear features, postholes, a large sub-rectangular pit and several burnt mound deposits.	Yes
16	13, 39 & 41	Two deposits of burnt mound material in a dip in the local topography	Yes
17	37	A pit full of burnt stone and charcoal and some possible postholes in the west of the field	Yes
18	8	Consists of two points of focus - A number of stone filled pits and linear features.	Yes

Area Number	Field Number	Summary of Archaeological Features Identified	Within Proposed Development?
19	42	Consists of three points of focus - Several charcoal filled features in the north of the field	Yes
20	13	A large charcoal production pit, a possible hearth and a number of possible postholes in the east of the field.	Yes
21	Merged with area 3		Yes
22	11	A possible charcoal rich pit in the centre of the field.	Yes
23	9B & 13	Two stripped areas around several deposits of burnt mound material and associated features.	Yes
24	12	Consists of two points of focus - possible habitation area (structure) and associated pits and postholes.	Yes
25	25	A kiln/ furnace running up to the stream edge	Yes
26 & 27	12 & 27	Burnt mound deposits and associated features on either side of the stream. A series of post holes and burnt material found in the east side of the field.	Yes
28	12	A deposit of burnt mound material.	Yes
29	32	Two shallow pits filled with organic material and burnt stone in the north of the field.	No
30	28	Consists of two points of focus - A burnt mound and associated pits and linear features.	No
31	4	A linear feature and a burnt deposit	Yes
32	8	A possible hearth and several sub-oval charcoal-rich features	Yes
33	9A	Consists of three points of focus - Two small features in the south of the field A curvilinear feature further by the stream.	Yes
34	9B	Consists of three points of focus -around the isolated features identified in the south and southeast of the Field.	Yes
35	14	Consists of two points of focus -Two small burnt mound deposits	Yes
36	36	Consists of two points of focus -around a post-hole, a charcoal-rich pit and a charcoal-rich linear scattered throughout the field	Yes
37	46 & 47	A low concentration of possible features including charcoal flecked spreads and pits.	No
38	6A	A charcoal-rich pit	Yes
39	6B	Consists of two points of focus -A charcoal-rich linear feature and a deposit of heat-shattered stone and charcoal.	No

Area Number	Field Number	Summary of Archaeological Features Identified	Within Proposed Development?
40	52	A curvilinear feature	No
41	51	A possible charcoal production pit.	No
42	48	A deposit of burnt mound material.	No
43	26	A large pit	No
44	26	A possible hearth	No
45	26	A deposit of burnt mound material and a linear feature	No
46	29	A large charcoal-rich sub-oval feature	No
47	30A & 31	A charcoal spread and a possible posthole.	No
48	34	A large irregular pit.	No
49	13	Consists of two points of focus - around two stony features	Yes
50	8	A possible posthole in the southwest of the field.	Yes
51	53	A deposit of burnt mound material.	No
52	53	A deposit of burnt mound material in the north of the field.	No
53	53	Two deposits of burnt mound material in the centre of the field.	No
54	53	A charcoal-rich feature	No
55	32	A charcoal-rich feature	No
56	53	A charcoal-rich feature	No
57	53 & 55	Consists of two points of focus -A linear feature and three charcoal-rich features	No
58	56	A stony feature in the north of Field 56.	No
59	56	Four stripped areas- around three pits, a possible hearth and a stake hole	No
60	55 & 56	A dense concentration of features in the southeast of Field 56 and the northeast of Field 55 within a possible ditched enclosure.	No

Source: <Long and O'Malley, 2009>

A summary of these site types as uncovered within the Proposed Development boundaries is given below. The descriptions are taken from the archaeological testing report (Long and Malley, 2009).

Burnt Mounds (Area Number 2, 7, 8, 16, 35)

Burnt mounds (also known as fulacht fiadh) are a relatively common archaeological monument found throughout the country with a number found within the Proposed Development. They occur in the landscape as mounds of heat-shattered stone and charcoal, which vary considerably in size and shape but are often horse-shoe shaped. The mounds are often disturbed by ploughing and other agricultural practices and deposits of burnt stone and charcoal can often be dragged quite a distance from their source.

These mounds of burnt material are usually accompanied by at least one sub-soil cut trough. It is generally accepted that troughs were filled with water which was boiled by dropping heated stones into it. After a number of uses the stones will shatter and this waste material will have been cleaned out of the trough and dumped to the side where mounds gradually accumulated. The charcoal in the mounds is a result of the fuel that was used to heat the stones. As well as mounds and troughs these sites can includes various other features such as hearths, pits and structures. The use made of the boiling water is likely to have varied from site to site and the possibilities include cooking, washing, brewing, tanning etc. Some burnt mounds have been associated with structures that have been interpreted as sweat lodges while others are associated with metal working sites. It is quite common to have features associated with a burnt mound, including the troughs, located on the periphery of the mound itself or even a short distance from it.

Burnt mounds in Ireland are broadly datable to the Bronze Age, with excavated examples providing dates clustering between 1600 BC and 1000BC, with a few outliers in the later prehistoric and early historic periods (Brindley & Lanting, 1990, 56). It is likely that at least some of the burnt mounds on the site are Bronze Age in date. The discovery of two flint artefacts in association with the mound in Area 2 in the northeast of the site for the proposed development will further indicate that this is the case.

Deposits (Area Number 17, 23, 26, 27, 31)

Several small, disturbed or patchy deposits of heat shattered stone and charcoal were identified throughout the site: While these deposits do not constitute a burnt mound, they are an indication that there was burnt mound activity in the immediate vicinity. They may also represent severely disturbed or ploughed out mounds. In this case sub-soil cut features associated with the ploughed-out mounds may still exist sub-surface.

Kilns/ Furnaces/ Charcoal Production Pits (Area Number 10, 13, 25)

A number of features throughout the Proposed Development site presented as large, well-defined, and rich in charcoal. The very high charcoal content and well-defined nature of these features implied that they were archaeologically significant but in advance of full excavation it is difficult to determine their exact function. While charcoal flecks are extremely common in archaeological deposits and smaller charcoal-rich features can represent hearths or land clearance a very high charcoal content in a large pit usually indicates some kind of industrial process such as corn drying kilns.

Charcoal Production Pits (Area Number 3, 5, 9, 14, 19, 20, 22, 36, 38)

Charcoal was a valuable fuel source for many industrial processes in the past, but the production of charcoal was in itself a wide spread process. There has been little in the way of research into the methods used for charcoal production, but charcoal clamps and charcoal production pits can be identified in the archaeological record. Several of the features identified within the Proposed Development site have been provisionally interpreted as charcoal production pits, though it must be noted that further investigation may provide evidence that at least some of these features may be related to cereal-drying or metalworking. They are generally sub-rectangular in shape and contained relatively shallow deposits with very high charcoal content.

Archaeological Complexes/ Settlement Areas (Area Number 4, 6, 11, 24)

Where a significant cluster of archaeological features have been identified including linear features, pits, hearths and possible structural remains such as post-holes and foundation trenches it has been classified as an archaeological complex/ settlement. Several such complexes/ settlements have been identified. They appear to vary considerably in character and date ranging from the prehistoric to the post medieval period.

In advance of archaeological excavation, it is difficult to interpret these types of sites, but they are the largest archaeological sites so far identified within the Proposed Development site.

Clusters of Archaeological Features (Area Number 1, 12, 15, 18, 32)

Several areas of archaeological significance/ potential have been categorised as clusters of archaeological features. the nature and distribution of the features identified makes it difficult to determine what kind of site they represent. Some individual features within these sites have been discussed above but it is important to note that they occur in close proximity to less diagnostic features. The presence of a cluster of features increases the likelihood that a substantial archaeological site may exist in these areas. Some of these areas are likely to be habitation sites but there was not enough evidence to that effect from the testing process to include them in the Archaeological complexes/ settlements category of the discussion.

Isolated/ Miscellaneous Features (Area Number 33, 34, 50)

These consist of features which were found throughout the site which may be of archaeological significance, but their function remains unclear. They mainly occurred in isolation within the test trench although associated remains may exist outside the trench. In some cases, more than one feature was uncovered within the trench. However, the concentration of these was not enough to class them as a concentration of archaeological features.

The archaeological features were recorded within the trenches then covered in a breathable membrane (Teram) before the trenches were backfilled. This was done in order to protect the features and also serve as an aid to re-identifying the archaeology during excavation (Long and O'Malley, 2009).

12.5.10.6 Architectural Survey

A number of structures were noted within the previous proposed development boundary during preparation of the EIS in 2006. These structures were identified as Cultural Heritage Sites (Lane, 2006) and have been described in 12.3.11.3.

Three of these (CHS 4, 7 and 15) are located within the current Proposed Development and were fully recorded in 2008 in the upstanding building survey to fulfil Condition 32 (c) of Planning (No. 08PA0002).

CHS 4 is a small farm complex described as *'consisting of one house with three outbuildings and surrounded by a boundary wall. This complex retains much of its historic value with two of the structures being mid nineteenth century in date and two modern buildings. These buildings demonstrate two separate building periods with the first edition OS map showing an even earlier period of habitation'* (Laban, 2008 and Appendix A12-6, Vol. 4).

CHS 7 is the pillbox associated with Fort Shannon. It is described as '*a detached single-bay single-storey hexagonal pill box, built c. 1942, now derelict. Flat concrete roof. Concrete walls with rubble limestone camouflage covering. Square-headed chamfered openings. Square-headed door opening. Built within a field boundary. A typical WWII era pill box, of functional design. It remains in good condition due to its simple Design*' (Laban, 2008 and Appendix A12-6, Vol. 4).

CHS 15 represents the partial remains of a structure located to the east of the pillbox CHS 7 at the northeast of the development. The structure is described as '*an incorporated two-bay structure, built c. 1900. Square-openings now blocked. Rubble limestone walls. This structure is located near the pill box and set within a rubble limestone wall, it may be associated with it, however different building materials suggest a separate date and use*' (Laban, 2008 and Appendix A12-5, Vol. 4).

12.5.10.7 Metal Detection and Wade Survey

A water course is located to the southwest of the Proposed Development. This feature ran directly across the area of the previous proposed development and was identified as an area of archaeological potential (Long, 2006 and Vol 4. Appendix A12-6). A wade and metal detection survey of the watercourse under underwater survey licence 07R196 and detection device licence 07D63 was undertaken in accordance with the requirements of the condition on previous planning approval (Condition 32 (b) of Planning Permission No. 08PA0002).

The survey was conducted along a 750 m section of the stream with approximately 400 m of the stream inaccessible due to thick vegetation along the river banks and in the river itself (CRDS Ltd, 2008). Nothing of archaeological potential was recorded during the surveys although it was noted that much of the relevant portion which will be impacted by the previous proposed development was inaccessible.

The report recommended that any areas of the stream that will be directly impacted by construction works should be monitored by a suitably qualified archaeologist.

12.6 Embedded Mitigation Measures

12.6.1 Embedded Mitigation Measures to be adopted during Proposed Development Construction in relation to Terrestrial Archaeological Assets

There is one archaeological asset recorded on the RMP located within the boundary of the Proposed Development. This is the ringfort (KE003-004)/ CH10 which is located on the northeast boundary. There are no visible traces of this archaeological site which is clearly marked on historic OS mapping. The 2007 EIS recommended that this asset remain *in situ* within the boundaries of the previous proposed development with a buffer zone created around it. This recommendation was included as Condition 32 (f) of Planning Permission (08.PA0002). The former location of the ringfort was subject to intensive archaeological testing to inform the size and extent of a buffer zone around the monument. The results of this testing facilitated the proposal of a fence that will ensure the preservation *in situ* of the ditch identified in the geophysical survey and possibly associated features identified in testing (Long and O'Malley, 2009). This fence, located 30 m from the asset, will be included in the current Proposed Development as embedded mitigation (Figure F12-6; Vol 3).

12.6.2 Embedded Mitigation Measures to be adopted during Proposed Development Construction in relation to Marine Archaeological Assets

A site of archaeological potential was recorded during the marine geophysical survey in 2007. This was interpreted as potential debris from shipping in the Shannon Estuary. The submerged anomaly lies some 200 m to the east of the Proposed Development and is unlikely to be directly impacted by works during construction. A seabed impact exclusion zone of 50m will be maintained around the anomaly to ensure it is not impacted upon. This is in line with the Condition 32 (d) of previous Planning Permission (08.PA0002) which relates to this site of archaeological potential.

12.7 Assessment of Impact and Effect

12.7.1 Construction Phase

The construction phase will see works within the majority of the footprint of the Proposed Development including:

- Partial or total removal of heritage assets during site clearance and contractor compound areas;
- Impact of landscaping, spoil disposal and planting on the setting of heritage assets, and damage caused to archaeological deposits caused by planting or earthwork embankments;
- Compaction of archaeological deposits due to construction traffic movement or materials storage; damage through rutting of superficial deposits from construction traffic;
- Vibration and changes in air quality, causing damage to historic monuments during construction;
- Changes in groundwater levels leading to the desiccation of previously waterlogged archaeological deposits, damage caused by changes to hydrology and chemical alteration, or changes in silt deposition regimes;
- Effects on the setting of heritage assets, including visual and noise intrusion, and changes in traffic levels; and
- Severance causing dereliction or neglect of historic monuments or reduction of group value and adverse impacts on amenity as a result of construction works.

12.7.1.1 Cultural Heritage Assets

One cultural heritage asset recorded on the RMP is partially located within the boundaries of the Proposed Development. This is the ring fort (KE003-004) which is located on the east boundary (Photograph 12.4; Vol. 4, Appendix A12-2). Embedded mitigation measures have been included within the scheme design to ensure that this asset is not impacted (Para 12.4.1).

Other cultural heritage assets consist of upstanding structures and buildings and potential archaeological sites which have been identified within the Proposed Development during the preparation of this EIAR and also designated heritage assets recorded as National Monuments and Protected Structures within the wider study area.

The CHS within the Proposed Development comprise six assets – CHS4 farm complex, CHS5 possible archaeological feature, CHS6 well, CHS7 gun emplacement, CHS14 mass rock and CHS15 a two-bay ruined structure. The CHS4 farm complex, CHS7 gun emplacement and CHS15 two-bay structure were recorded as part of the upstanding building survey in 2008 and are now considered resolved with the planning condition met within that previous EIS (Lane, 2012). CHS4 farm complex, CHS7 gun emplacement and CHS15 two-bay structure are located within the footprint of the current Proposed Development and are considered to be of **local** interest and of **low** importance as defined by the criteria in Table 12-2. They will be severely impacted upon (demolished) by groundworks associated with the scheme which will alter the special interests or qualities of these assets. The magnitude of this effect will be **very high** as defined by the criterial in Table 12-3 leading to a significance of effect of **significant**, as defined by the criteria in Table 12-4. The effect is **negative** and **permanent**.

CHS5 possible archaeological feature was subject to investigation in 2008 and was determined to be an enclosure (Area of Archaeological Potential 11). This asset is of **local interest** and of **low importance** as defined by the criteria in Table 12.2. It will be impacted by groundworks associated with the construction phase of the Proposed Development. The impact will result in the permanent removal of this asset altering its special interests or qualities. The magnitude of effect is judged to be **very high**. On a site of local value, this results in a significance of effect of **significant**. The effect is **negative** and **permanent**.

CHS6 well was not investigated and recorded in 2008 due to onsite conditions to avoid polluting the watercourse. This asset remains unrecorded but is likely to be of **local interest** and of **low importance** as defined by the criteria in Table 12-2. It will be impacted by groundworks associated with the construction phase of the Proposed Development. The impact will result in the permanent removal of this asset altering its special interests or qualities. The magnitude of effect is judged to be **very high**. On a site of **local** value, this results in a significance of effect of **significant**. The effect is **negative** and **permanent**.

CHS14 is a mass rock which, according to local information, was located in the intertidal area of the Proposed Development. This asset is of **local interest** and of **low importance** as defined by the criteria in Table 12-2. CHS14 mass rock has not been located and it was not observed during the 2006 and 2021 intertidal surveys suggesting that it no longer exists. There will be **no impact** to this asset.

The designated Cultural Heritage assets within the wider Study Area comprise Ralappane House (RPS KY 003-001) and Lislaughtin Abbey (NM No. 258). While these assets will not be physically impacted by the Proposed Development, there is the possibility of negative impact to the setting of the designated assets by noise, dust and vibration from construction related traffic which could diminish the importance of these assets.

Ralappane House (RPS KY 003-001) is located to the south of the Proposed Development (Photograph 12.21; Vol 4., Appendix A12-2). It dates to the 18th century and is considered **regionally** important being formerly associated with the Sallowglen (2047) planned landscape. The house is a Protected Structure on the Kerry County Development Plan 2015-2021. It is located on a ridge overlooking the L1010 with the property's main aspect towards the road and not towards the Proposed Development which is located to the north while mature tree planting screens the rear of the property. The setting of Ralappane House (RPS KY 003-001) may be temporarily impacted by noise, dust and vibration from the construction works but these will cease as the Proposed Development is completed. The change to setting will be such that the special interests or qualities of the house are slightly affected without a noticeable change. The understanding of the asset will not be affected leading to a magnitude of effect of **low** as defined by the criteria in Table 12-3 leading to a significance of effect of **slight**, as defined by the criteria in Table 12-4. The slight significance of effect will be **short-term** and **neutral**.

Lislaughtin Abbey (NM No. 258) is located 2.72 km to the southwest of the Proposed Development (Photograph 12.22; Vol 4, Appendix A12-2). It is a National Monument and is considered **nationally** important. There are no views between this monument and the Proposed Development while there will be no impacts from noise, dust and vibration from the construction works due to the intervening distance. The special interests or qualities of the abbey will not be affected and there will be **no impact**.

Other cultural heritage sites were noted within the previous larger Proposed Development which was the subject of the 2006 EIS. These also included upstanding structures and buildings and potential archaeological sites. CHS2, and CHS9 consist of complexes of farm buildings. These were all recorded in 2008 as part of the Upstanding Building Survey in 2008 as conditions upon Planning Permission (Condition 32 C 08.PA0002) and are now considered resolved with the planning condition met (Lane, 2012).

The remaining cultural heritage assets within the previous development comprise CHS1 possible burnt mound, CHS3 concrete ruin, CHS8 modern residential structure, CHS11 ruined concrete building, CHS12 site of old forge and CHS13 Tubberagleanna well. All, with the exception of CHS13 Tubberagleanna well, were located in areas where they will not be impacted by the previous proposed development so were not subject to recording. These assets, including CHS13 Tubberagleanna well, are located outside the boundaries of the Proposed Development and will not be impacted during the construction phase. There will be **no impact**.

12.7.1.2 Areas of Archaeological Potential

The archaeological testing in 2008 revealed 60 Areas of Archaeological Potential. These relate to the wider site boundary at that time and have been listed in Table 12-6. Of these, 31 Areas of Archaeological Potential are located within the footprint of the Proposed Development. These are listed in Table 12-7 below and shown on Figure F12-7, Vol. 3.

Table 12-7 Areas of Archaeological Potential within the footprint of the Proposed Development

Area number	Summary of Archaeological Features Identified	Location within the Proposed Development
1	Linear features, a charcoal filled feature and a small midden pit filled with shell in the east of the field.	Site Pad
2	Consists of two points of focus- A large burnt mound and a charcoal-rich pit.	Site Pad
3	Consists of two points of focus: A charcoal-rich curvilinear feature and several small sub-oval pits in the zone of archaeological potential for RMP KE003:004 and a sub–rectangular feature with charcoal-rich fills.	To be left in situ within buffer zone
4	A curvilinear enclosure ditch, several postholes and pits	Above Ground Installation
5	Some charcoal-rich features, stakeholes and linear features	Above Ground Installation
6	A large irregular area around a dense concentration of features that seem to represent a substantial habitation site. Pottery recovered in this area indicates that at least part of it dates to the 17th or 18th centuries.	Site Pad/ Above Ground Installation
7	A burnt mound and a possible trough.	Site Pad
8	A burnt mound	Site Pad
10	Consists of two points of focus: one cereal-drying kiln and one charcoal rich feature	Site Pad
11	A possible enclosure	Site Pad
12	A concentration of linear and curvilinear features in the West of the field.	Laydown Area
13	Consists of two points of focus - A number of charcoal rich features, linears and a possible figure-of-eight shaped corn-drying kiln	Laydown Area
14	Consists of two points of focus. A number of charcoal rich pits and stone filled features in the north of the field.	Laydown Area
17	A pit full of burnt stone and charcoal and some possible postholes in the west of the field.	Laydown Area

Area number	Summary of Archaeological Features Identified	Location within the Proposed Development
18	Consists of two points of focus - A number of stone filled pits and linear features.	Laydown Area
20	A large charcoal production pit, a possible hearth and a number of possible postholes in the east of the field.	Laydown Area
21	Merged with area 3	Adjacent to buffer zone and boundary fence
23	Two stripped areas around several deposits of burnt mound material and associated features.	Access Road
24	Consists of two points of focus - possible habitation area (structure) and associated pits and postholes.	Access Road
26 & 27	Burnt mound deposits and associated features on either side of the stream. A series of post holes and burnt material found in the east side of the field.	Access Road
28	A deposit of burnt mound material.	Access Road
31	A linear feature and a burnt deposit	Laydown Area
32	A possible hearth and several sub-oval charcoal-rich features.	Site Pad
33	Consists of three points of focus. Two small features in the south of the field A curvilinear feature further by the stream.	Laydown Area
34	Consists of three points of focus around the isolated features identified in the south and southeast of the field.	Access Road
35	Consists of two points of focus- Two small burnt Mound deposits.	Site Pad
36	Consists of two points of focus around a posthole, a charcoal rich pit and a charcoal rich linear scattered throughout the field.	Laydown Area
38	A charcoal-rich pit	Site Pad
39	Consists of two points of focus - a charcoal rich linear feature and a deposit of heat shattered stone and charcoal.	Site Pad
50	A possible posthole in the southwest of the field.	Laydown Area

Source: <Long and O'Malley, 2009>

These assets are likely to be of **local** interest and of **low** importance and will be impacted by groundworks associated with the construction phase. The impacts will result in the permanent removal of these assets. The magnitude of effect is judged to be **very high**, the significance of which will be **significant**, **negative** and **permanent**.

Further Areas of Archaeological Potential are located outside but adjacent to the Proposed Development. There is the possibility that these could be impacted by changes in hydrology brought about by the construction works. Changes in hydrology resulting during the construction are fully discussed in Chapter 06 – Water. These changes will have a magnitude of effect of **low** as defined by the criteria in Table 12-3 leading to a significance of effect of slight, as defined by the criteria in Table 12-4. The slight significance of effect will be **short-term** and **neutral**. Any impacts to the further Areas of Archaeological Potential will be **imperceptible**.

Similarly, Areas of Archaeological Potential located within adjacent areas of the development previously consented in 2008 will not be impacted upon by the Proposed Development. These assets will remain *in situ* and there will be **no impact**.

It should be noted that subsequent planning application was granted in 2012 under planning permission (ABP 08.PA0028) in relation to the construction of a CHP plant on Knockfinglas Point. The footprint of the CHP plant was largely outside the area to be disturbed by the original LNG plant and, therefore, parts of it were not subject to archaeological trenching in 2008.

Condition 24 of the planning permission (ABP 08.PA0028) states that further archaeological testing should be carried out within the untested area prior to the resolution of the Areas of Archaeological Potential identified during the Shannon LNG archaeological testing in 2008.

The CHP plant is no longer required under the current proposals with the result that this area will not now be developed under planning permission (ABP 08.PA0028). The proposed location of the CHP plant is outside the boundaries of the Proposed Development and will not be impacted during the construction phase. There will be no impact to the previously untested areas. Given this, the requirement for further archaeological testing is unnecessary.

12.7.2 Operational Phase

All physical impacts to known and unknown heritage assets will occur during the construction phase and there is no requirement for mitigation measures during the operational Phase.

12.8 Cumulative Impacts and Effects

The footprint of the current Proposed Development was subject to a previous planning application for an LNG regassification terminal which was granted permission in 2008 (PL08B. PA0002 now expired) with an amendment to the phasing of the construction granted in 2013 (PL08.PM0002). Similarly, permission for the combined heat and power plant was granted in 2013 (PL08. PA0028). Foreshore licence applications have also been granted for the following – drainage outfall (FS006224), construction of a liquified natural gas jetty (FS006225), construction of a materials jetty (FS006227), construction of a seawater intake and outfall (FS006228),

The current Proposed Development is intended to replace the facilities granted planning permission under (PL08.PM0002) and (PL08. PA0028). There will be no cumulative impact with these planning permissions.

The Proposed Development will be connected to the existing natural gas network at Leahies in Co. Limerick by an underground gas pipeline which was granted planning permission in 2009 (PL08.GA0003). The gas pipeline is important to the operation of the LNG Terminal so will likely be constructed at the same time. This development could have the potential to cause impact to the setting of the High Value heritage assets during the construction phase. The High Value asset is the Protected Structure Ralappane House (RPS KY 003-001) which is located 170 m to the east of the route of the gas pipeline.

The laying of the gas pipeline will create noise which, when combined with construction noise from the Proposed Development will likely create a temporary cumulative impact upon the setting of Ralappane House (RPS KY 003-001). No specific mitigation for setting has been proposed in this chapter, as it is noted that this impact is temporary and limited to the construction phase. The significance of the cumulative effect is judged to be **slight**.

There are two other developments associated with the Proposed Development comprising the laying of medium voltage (10/ 20 kV) and 220 kV underground cables which will connect the Shannon Technology and Energy Park to connect to the national electrical transmission network. These cables will run 5 km east from a substation within the Proposed Development under the L1010 road to the ESBN/ EirGrid Killpaddogue 220 kV substation. The cables and substation are subject to separate planning designs and planning applications.

These developments could have the potential to cause impact to the known and unknown archaeological assets within the Proposed Development and should be subject to their own surveys and archaeological investigations carried out under licence. The construction of the substation and laying of the underground cables could impact upon the setting of the High Value heritage assets during the construction phase. The High Value asset is the Protected Structure Ralappane House (RPS KY 003-001) which is located 373 m to the north of the L1010 and 482m to the southeast of the location of the substation. The laying of the underground cables and construction of the substation will create noise and vibration which, when combined with construction noise and vibration from the Proposed

Development could create a temporary impact upon the setting of Ralappane House (RPS KY 003-001). Given the intervening distances, it is unlikely that these will combine with construction noise and vibration from the Proposed Development to create a cumulative impact upon the setting of Ralappane House during the construction phase.

The overall masterplan for the Energy Park includes plans for the future development of a data centre within the lands southwest of the Proposed Development. These lands were investigated during the previous ES in 2006 and subsequent planning conditions and are known to contain Cultural Heritage assets and Areas of Archaeological Potential. Construction works associated with the data centre will impact upon these. The data centre will be subject to a separate planning design and planning application and should be subject to their own surveys and archaeological investigations carried out under licence.

The Proposed Development and the data centre will not be constructed simultaneously and there will be no cumulative impacts during the construction phase arising from noise or vibration. The visual presence of the data centre could impact upon the setting of the High Value heritage assets during the construction and operation phases. The High Value asset is the Protected Structure Ralappane House (RPS KY 003-001) which is located 710m to the west. The visual presence of the data centre combined with the visual presence of the completed Proposed Development could combine to create a cumulative impact upon the setting of Ralappane House (RPS KY 003-001). Given the intervening distances and topography, it is unlikely that these will be visible from Ralappane House and there should not be a cumulative impact upon the setting of Ralappane House during the construction and operation phases.

Ten further planning applications are noted within approximately 5 km of the current Proposed Development over a 10-year period. Six of these applications (13138, 155, 18392, 18878, 19115 and 20850) relate to various elements of an electricity peaker power generating plant and battery energy storage system facility on a site 2.6 km to the east of the current Proposed Development. Elements of this development have already been constructed which is located on a site 2.6km to the east of the current Proposed Development. Given the distance between these two developments, which includes an intervening dense mature tree plantation, it is unlikely that construction noise will combine to create a cumulative impact upon the setting of the High Value asset is the Protected Structure Ralappane House (RPS KY 003-001).

12.8.1 Intertidal Applications/ Foreshore Applications

Planning application 14816 relates to the alteration of the existing 220 kV electricity station at Tarbert Island 4.5 km to the east of the current Proposed Development. Given the distance between these two developments, which includes an intervening dense mature tree plantation, it is unlikely that construction noise will combine to create a cumulative impact upon the setting of the High Value asset is the Protected Structure Ralappane House (RPS KY 003-001).

Planning applications 14816 and 17466 relate to alterations to the permitted accesses to Leenamore wind farm as well as the provision of a new substation compound with a single storey substation building and associated underground services. Leenamore wind farm is located 4 km to the south of the current Proposed Development. It is unlikely that construction of these alterations will combine to create a cumulative impact with the current Proposed Development given the intervening distance and topography between them.

Similarly, the last planning application (304807-19) concerns the construction of a six-wind turbine wind farm at Aghanagran to the southwest of the village of Ballylongford approximately 5 km from the current Proposed Development. It is unlikely that the construction of the wind farm will combine to create a cumulative impact with the current Proposed Development given the intervening distance and topography between them.

The following foreshore licence applications are also noted outside the 5km of the Proposed Development. These are mostly associated with the Shannon-Foynes Port company at Foynes comprising the applications FS005818, FS005790, FS006128, FS006594, FS006785, FS006837 and FS006975. Foynes is 22 km from the Proposed Development and too far away for there to be a cumulative impact. Similarly, the application FS007081 is located at Cahiracon in Co. Clare which is 24km to the northeast of the Proposed Development across the Shannon Estuary. This is too far away for there to be a cumulative impact.

12.9 Mitigation Measures

Full resolution of all archaeological sites and areas identified during archaeological testing within the Proposed Development boundary will be carried out at the pre-construction phase. All archaeological works (which will be agreed by the Archaeological Consultant and the NMS) will be carried out in compliance with the National Monuments Acts 1930 – 2004 (and Policy and Guidelines on Archaeological Excavation (Department of Arts, Heritage Gaeltacht and the Islands, 1999) and in accordance with the Outline Construction Environmental Management Plan (OCEMP).

A suitably qualified and licensed Archaeological contractor will be appointed to carry out the archaeological fieldwork. Relevant licences will be acquired from the DoCHG/ NMS and the National Museum of Ireland (NMI) for all archaeological works, which will be carried out in accordance with an Overarching Method Statement for Archaeological Works prepared by the Archaeological Consultant and agreed with the NMS. It is anticipated that all archaeological works will be completed prior to enabling works commencing on the site at the start of construction.

12.9.1 Construction Phase

It is anticipated that the archaeological mitigation programme will commence prior to the start of the main construction works pre enabling works (Figure F12-7; Vol. 3).

During Phase 1 (prior to the enabling works as soon as access is available or during if necessary) – all archaeological sites and areas that require preservation by record will be investigated. This will also determine the scope of further mitigation works. A General Watching Brief (GWB) will be carried out for ground works, such as utility diversions, road diversions and ecology works.

In line with the recommendations for mitigation outlined in the 2008 testing report (Long and O'Malley, 2009), the following specific mitigation measures are proposed for the archaeological sites located within the Proposed Development:

- Areas of excavation around the known archaeological sites and areas will include a 5 m buffer zone as a minimum between the edge of the site and any archaeological features. Should previously unknown archaeological features be identified then the excavation area will be expanded to ensure the 5 m buffer zone is maintained.
- It is noted that the archaeological deposits within Area 6 Post-Medieval Habitation site and Area 11 Enclosure are particularly close to the surface and are vulnerable to disturbance. a topographic survey will be carried out in advance of archaeological excavations to record potentially significant anomalies in the ground surface which could otherwise be damaged by plant moving over the area.
- The removal of topsoil in parts of Areas 6 Post-Medieval Habitation site and Area 11 Enclosure will be performed by mini-digger to reduce the potential of damage caused by plant tracking over the shallow archaeological features.
- A photographic survey and written description of CH6 Well will be carried out in advance of groundworks within the vicinity of this asset. The dismantling of the well will be carried out in an orderly fashion under the supervision of a suitably qualified archaeologist.

Phase 2 will take place during later enabling works and in advance of and concurrent with construction) – The GWB will be undertaken in all other areas where it is required, in particular in areas which have not been subject to previous archaeological testing. The construction of the outfall, jetty and other works on the foreshore will also be archaeologically monitored under licence by a suitably qualified and experienced maritime archaeologist.

Phase 3 – a post-excavation assessment will be undertaken in accordance with DoCHG/ NMS advice, followed by an appropriate scheme of detailed analysis and reporting. Phase 3 will commence as soon as practicable following completion of the main investigative works.

12.9.2 Operational Phase

No additional mitigation measures are required for the operational phase of the Proposed Development.

12.10 Do Nothing Scenario

The do-nothing scenario will not result in any significant changes to the baseline cultural heritage resource. The magnitude of effect will be no change leading to a significance of effect of neutral.

12.11 Residual Impacts and Effects

A summary of residual effects is provided in Table 12-8. Only those assets where an impact has been identified are discussed in this section. Those assets where no impact has been identified are not included.

Ralappane House (RPS KY 003-001) has been identified as experiencing a low impact from the Proposed Development during construction. This impact will be short term and will cease once construction is complete. The residual significance of effect will be **slight**, **long-term** and **neutral**.

CHS4 farm complex will experience a very high impact (demolition in advance of groundworks) from the Proposed Development. Based on the results of the baseline report, it is assessed that this asset is of local value. No mitigation is proposed as this asset was subject to upstanding building recording. This provides a record of the asset and the residual effect is therefore assessed to be **moderate**, **negative** and **permanent**.

CHS5 Possible Archaeological Feature will experience a very high impact from groundworks associated with the Proposed Development. Mitigation has been proposed in the form of archaeological monitoring and excavation, if appropriate, to determine the presence/ absence of such features and to preserve them by record. Based on the results of the baseline report, it is assessed that previously unrecorded archaeological assets within the Proposed Development site are likely to be of local value. The residual effect is therefore assessed to be **moderate**, **negative** and **permanent**.

CHS6 well will experience a very high impact from groundworks associated with the Proposed Development. Based on the results of the baseline report, it is assessed that this asset is of local value. Mitigation has been proposed in the form of a photographic survey and written description of CHS6 Well which should be carried out in advance of groundworks within the vicinity of this asset. It is also recommended that the dismantling of the well be carried out in an orderly fashion under the supervision of a suitably qualified archaeologist. This will provide a record of the asset and the residual effect is therefore assessed to be **moderate**, **negative** and **permanent**.

CHS7 gun emplacement will experience a very high impact (demolition in advance of groundworks) from the Proposed Development. Based on the results of the baseline report, it is assessed that this asset is of local value. No mitigation is proposed as this asset was subject to upstanding building recording. This provides a record of the asset and the residual effect is therefore assessed to be **moderate**, **negative** and **permanent**.

CHS15 two-bay structure will experience a very high impact (demolition in advance of groundworks) from the Proposed Development. Based on the results of the baseline report, it is assessed that this asset is of local value. No mitigation is proposed as this asset was subject to upstanding building recording. This provides a record of the asset and the residual effect is therefore assessed to be **moderate**, **negative** and **permanent**.

Known areas of archaeological potential will experience a very high impact from groundworks associated with the Proposed Development. Mitigation has been proposed in the form of archaeological monitoring and excavation, if appropriate, to determine the presence/ absence of such features and to preserve them by record. Based on the results of the baseline report, it is assessed that previously unrecorded archaeological assets within the site are likely to be of local value. The residual effect is therefore assessed to be **moderate**, **negative** and **permanent**.

Potential currently unrecorded archaeological deposits which are likely to be present within the Proposed Development site will experience a very high impact from the Proposed Development. Mitigation has been proposed in the form of archaeological monitoring and excavation, if appropriate, to determine the presence/ absence of such features and to preserve them by record. Based on the results of the baseline report, it is assessed that previously unrecorded archaeological assets within the site are likely to be of local value. The residual effect is therefore assessed to be **moderate**, **negative** and **permanent**.

Table 12-8 Residual Impacts

Asset Reference	Importance	Description of Impact (Type, Duration)	Magnitude of Effect	Significance of Effect	Mitigation	Residual Effect
Ralappane House (RPS KY 003-001)	Regional	Temporary negative impact upon the setting of the asset during construction of the Proposed Development.	Low	Slight Short-Term Neutral	Not applicable	Slight Long-Term Neutral
CHS 4 Farm Complex	Local	Permanent physical negative impact through construction of the Proposed Development	Very high	Significant Permanent Negative	Not applicable	Moderate Permanent Negative
CHS 5 Possible Archaeological Feature (AAP 11)	Local	Permanent physical negative impact through construction of the Proposed Development	Very high	Significant Long-Term Negative	Archaeological excavation and recording	Moderate Long-Term Negative
CHS 6 well	Local	Permanent physical negative impact through construction of the Proposed Development	Medium	Significant Permanent Negative	A photographic survey and written description of CHS6 Well should be carried out in advance of groundworks within the vicinity of this asset. It is also recommended that the dismantling of the well be carried out in an orderly fashion under the supervision of a suitably qualified archaeologist	Moderate Permanent Negative
CHS 7 Gun Emplacement	Local	Permanent physical negative impact through construction of the Proposed Development	Very high	Significant Permanent Negative	Not applicable	Moderate Permanent Negative
CHS 15 two-bay structure	Local	Permanent physical negative impact through construction of the Proposed Development	Very high	Significant Permanent Negative	Not applicable	Moderate Permanent Negative
Known areas of archaeological potential	Local	Permanent physical negative impact through construction of the Proposed Development	Very high	Significant Long-Term Negative	Archaeological excavation and recording	Moderate Long-Term Negative
Potential unrecorded archaeological assets	Local	Permanent physical negative impact through construction	Very high, if present	Significant Long-Term Negative	Archaeological testing/ monitoring, excavation and	Moderate Long-Term Negative

Asset Reference	Importance	Description of Impact (Type, Duration)	Magnitude of Effect	Significance of Effect	Mitigation	Residual Effect
		of the Proposed Development			recording, if required	

12.12 Decommissioning Phase

As outlined in Chapter 02 – Project Description, in the event of decommissioning, measures will be undertaken by the Applicant to ensure that there will be no significant, negative environmental effects from the closed LNG Terminal and Power Plant. Examples of the measures that will be implemented are outlined in Section 2.11, Chapter 02 – Project Description. As a result, additional potential impacts and associated effects arising during the decommissioning phase are not anticipated above and beyond those already assessed during the construction phase.

12.13 Summary

The Proposed Development will create an LNG Terminal and Power Plant on the Shannon Estuary to the west of Tarbert which will impact upon known and unknown archaeological and architectural assets. Mitigation has been proposed to reduce this impact which will ensure any archaeological and architectural assets are identified and recorded to best practice thereby enriching the known heritage of Co. Kerry.

Table 12-9 Summary

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Effect Significance
Construction	CHS 4 farm complex/ destruction through groundworks	Low	Very high	Significant	This asset has already been subject to recording in the form of upstanding building survey to satisfy the condition upon Planning Permission (Condition 32 C 08.PA0002). While this asset will be significantly impacted by the Proposed Development, no further mitigation is required.	Moderate
Construction	CHS 5 Possible Archaeological Feature/ destruction through groundworks	Low	Very high	Significant	Full resolution of all archaeological sites and areas identified during archaeological testing within the scheme boundary will be carried out at the pre-construction phase. All archaeological works (which will be agreed by the Archaeological Consultant and the NMS) will be carried out in compliance with the National Monuments Acts 1930 – 2004 (and Policy and Guidelines on Archaeological Excavation (Department of Arts, Heritage Gaeltacht and the Islands, 1999).	Moderate
Construction	CHS 6 Well/ destruction through groundworks	Low	Very high	Significant	It is recommended that a photographic survey and written description of CH6 Well be carried out in advance of groundworks within the vicinity of this asset. It is also recommended that the dismantling of the well be carried out in an orderly fashion under the supervision of a suitably qualified archaeologist	Moderate
Construction	CHS 7 Gun Emplacement/ destruction through groundworks	Low	Very high	Significant	This asset has already been subject to recording in the form of upstanding building survey to satisfy the condition upon Planning Permission (Condition 32 C 08.PA0002). While this asset will be significantly impacted by the Proposed Development, no further mitigation is required.	Moderate
Construction	CHS 15 Well/ destruction through groundworks	Low	Very high	Significant	This asset has already been subject to recording in the form of upstanding building survey to satisfy the condition upon Planning Permission (Condition 32 C 08.PA0002). While this asset will be significantly impacted by the Proposed Development, no further mitigation is required.	Moderate
Construction	Known Areas of Archaeological Potential/ destruction through groundworks	Low	Very high	Significant	Full resolution of all archaeological sites and areas identified during archaeological testing within the scheme boundary will be carried out at the pre-construction phase. All archaeological works (which will be agreed by the Archaeological Consultant and the NMS) will be carried out in compliance with the National Monuments Acts 1930 – 2004 (and Policy and Guidelines on Archaeological Excavation (Department of Arts, Heritage Gaeltacht and the Islands, 1999).	Moderate
Construction	Previously unknown archaeological features/ destruction through groundworks	Low	Very High	Significant	A General Watching Brief (GWB) will be carried out for ground works by a suitably qualified archaeologist in compliance with the National Monuments Acts 1930 – 2004 (and Policy and Guidelines on Archaeological Excavation (Department of Arts, Heritage Gaeltacht and the Islands, 1999).	Moderate
Construction	CHS10 Ringfort (KE003-004)	Low	Very High	Significant	Embedded mitigation in design comprising a buffer zone established around the asset to preserve in situ. The buffer zone will be defined by a permanent fence line.	No effect
Construction	Anomaly identified during marine geophysical survey	Low	Low	Low	Asset is located over 200 m from the Proposed Development construction works. Embedded mitigation in design comprising a 50 m buffer zone established around the asset to prevent incursion during construction.	No effect

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CHAPTER 13
Population and Human Health

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park

Environmental Impact Assessment Report

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13. Population and Human Health

13.1. Introduction

This chapter describes the potential effects of the Proposed Development on population and human health. It defines the study area; the methodology used for developing the baseline and impact assessment; provides a description of the baseline environment in relation to population and human health; and presents the findings of the impact assessment.

Impacts on population and human health have potential to arise from various aspects of the Proposed Development. The chapter provides an assessment of potential impacts on:

- Land use;
- Severance;
- Employment; and
- Human health.

Many of the potential population and human health effects arise from air quality, noise, visual and traffic aspects of the Proposed Development, and these are assessed in corresponding EIAR chapters, e.g. Chapter 08 – Air Quality, Chapter 09 – Airborne Noise and Groundborne Vibration, Chapter 10 – Landscape and Visual Impact, and Chapter 11 – Traffic and Transport.

13.2. Competent Expert

The assessment has been carried out under the supervision of Dave Widger (MSc Economics, BSc Economics). Dave has over 20 years' experience in the fields of economic development and socio-economics. Dave specialises in impact assessment, business cases, funding and consenting for major infrastructure schemes. He has led socio-economic impact assessments of major infrastructure schemes such as the A303/ A358 Corridor (Highways England), High Speed Phases 1 and 2b, A303 Stonehenge, Heathrow expansion and Crossrail 2.

13.3. Methodology

13.3.1. Legislation and Guidance

This chapter has been prepared with reference to the following guidance notes:

- Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2017);
- Advice Notes for Preparing Environmental Impact Statements (EPA, 2015);
- Guidelines on the Information to be contained in Environmental Impact Statements (EPA, 2002a);
- Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (EPA, 2002b); and
- HUDU Rapid Health Impact Assessment Tool Fourth Edition 2019 (NHS London Healthy Urban Development Unit, 2019).
- Health in Environmental Impact Assessment 2017 (IEMA, 2017)
- Guidance on Preparation of the Environmental Impact Assessment Report 2017 (European Commission, 2017).

13.3.2. Study Area

The site location is described in Chapter 02 Section 2.2. The study of the population and human health assessment has considered the area of land where the effects of the Proposed Development may occur. The study area used for the baseline analysis comprises the electoral divisions of Carrig, Lislaughtin, Tarmon and Tarbert, as this is where the majority of population and human health effects are likely to occur. However, there is potential for effects to occur on receptors outside of this area. For example, it is not always possible to determine the catchment area for community facilities as residents of an area may utilise facilities located within different districts, counties, or regions without regard for statutory boundaries. In addition, this assessment refers to the findings of other EIAR chapters which have different study areas. For example, the Climate chapter (Chapter 15) considers effects of the Proposed Development on the global climate.

13.3.3. Determination of the Baseline Environment

In order to assess the associated potential effects of the Proposed Development, it is necessary to determine the baseline conditions, resources and receptors in the site and surrounding area. The baseline conditions are not necessarily the same as those that exist at the current time; as they will reflect the conditions that will exist at the time that the Proposed Development is expected to start. The identification of the baseline conditions therefore involves predicting changes that are likely to happen in the intervening period, for reasons unrelated to the Proposed Development. As described in Chapter 02, the EIAR takes January 2023 as an proposed start date, with completion of all sections by August 2025, however this is an assumption for the purposes of the assessment.

The baseline section of this chapter includes a description of local communities within the study area and a profile of the people which reside within these communities. This profile comprises an analysis of population and population growth, age, demographics, and health determinants. The presence of any vulnerable groups which could be disproportionately affected by the impacts of the Proposed Scheme are also identified in the baseline. The findings of the public consultation exercise are also summarised.

The baseline also includes a description of land uses in the local area, including the presence of:

1. Private residential buildings and commercial properties;
2. Community land (e.g. common land, village greens, open green space, allotments, sports pitches etc.) and amount of land which will be required/ access affected by a project;
3. Community facilities (e.g. village halls, healthcare facilities, education facilities, religious facilities etc.); and
4. Land allocated for employment and residential development by local authorities.

A planning search of granted and pending planning applications made within the vicinity of the Proposed Development within the last five years was also completed . This was used to determine how the area may change between now and the time when the Proposed Development is expected to start.

13.3.4. Determination of Sensitive Receptors

The sensitivity of the receiving environment identifies the ability of the various receptors to respond to potential effects. Receptors in the population & human health assessment are members of the local and wider community who have potential to be impacted by any of the effects described. The methodology for defining the sensitivity of receptors for each type of potential effect identified is set out below. Terminology used to describe the sensitivity of the receptor are as per EPA guidelines (EPA, 2017).

13.3.4.1. Land Use

The value and typical descriptors which have been applied to determine sensitivity have been based on professional judgement. Examples of the sensitivities typically assigned to different land uses are identified in Table 13-1. It is important to note, however, that other criteria are also used to inform the sensitivity of a resource to potential change. This includes how often the resource is used, how many users the resources have and whether the resource is maintained.

Table 13-1 Examples of Sensitivities Assigned to Different Land Uses

Sensitivity	Description
High	• Private residential buildings, or land allocated for development of housing. • Buildings used for employment use, and land allocated for development of employment uses. • Regularly used community buildings which have only limited alternatives available nearby.

Sensitivity	Description
	• National or regional walking, cycling and horse-riding routes, and other routes regularly used by vulnerable travellers such as the elderly. • Designated public open spaces, or open spaces which attract users nationally e.g. national parks • Religious sites and cemeteries. • Regularly used agricultural land where the enterprise is dependent on the spatial relationship of the land to key agricultural infrastructure.
Medium	• Land associated with private residential buildings e.g. gardens. • Community buildings which are regularly used or where there are only limited alternatives available in the local area. • Open spaces which span over a regional area and attract visitors from a regional catchment e.g. country parks, forests. • Public rights of way and other routes close to communities which are used for recreational or utility purposes, but for which alternative routes can be taken. • Agricultural land holdings which is used semi-regularly and where the enterprise is partially dependent on the spatial relationship of land to key agricultural infrastructure.
Low	• Community buildings which are infrequently used or where there are many alternatives available in the local area. • Open spaces which are used for informal recreation (e.g. dog walking), and where there are alternative open spaces available. • Locally used community land e.g. local parks and playing fields. • Walking, cycling and horse-riding routes which have fallen into disuse through past severance or which are scarcely used because they do not currently offer a meaningful route for either utility or recreational purposes. • Agricultural land which is used semi-regularly but where the enterprise is not dependent on the spatial relationship of land to key agricultural infrastructure.
Negligible	• Derelict or unoccupied buildings • Agricultural land which is infrequently used on a non-commercial basis.

13.3.4.2. Severance

The receptors which have potential to experience severance effects are local residents who use the roads and walking/ cycling routes to travel in and around the study area to commercial properties, community facilities, places of work and educational facilities. No sensitivity values are assigned to receptors with potential to experience severance effects because local residents comprise a diverse group and so assigning a single sensitivity is not appropriate.

13.3.4.3. Employment

The receptor with potential to experience employment effects is the workforce in County Kerry. This includes the workforce in the construction industry and the local supply chain. No sensitivity values are assigned to receptors with potential to experience employment effects because the workforce of Kerry is a diverse group and so assigning a single sensitivity it is not appropriate.

13.3.4.4. Human Health

The effects on human health are assessed using guidance set out in the HUDU Rapid Health Impact Assessment Tool Fourth Edition 2019 (NHS London Healthy Urban Development Unit, 2019). The receptors are the residents of properties and users of community resources. Sensitivities are not defined for receptors as local residents and resource users are a diverse group and assigning a single sensitivity is not appropriate.

13.3.5. Describing Potential Effects

Effects on land use, severance and economic activity are described using the criteria provided in EPA guidance (EPA, 2017). The process to determine potential effects is described in Chapter 01 – Introduction. In summary, it involves combining a sensitivity of a receptor with a description of an impact on that receptor (its quality, type, frequency, duration, probability, and magnitude) to determine a significance of impact. Detail on the criteria used to determine the sensitivity of a receptor is included in the section above. This section describes, for each type of effect, the assessment criteria which informs the description of the impact. This includes the parameters which define a direct or indirect effect, and how a magnitude of effect is determined.

Since EPA do not provide extensive guidance on assessing human health, the assessment of human health is instead based on guidance set out in the London Healthy Urban Development Unit (HUDU) Rapid Health Impact Assessment Tool Fourth Edition 2019. The assessment method used to determine human health effects is also identified below. It should be noted that some other chapters within the EIAR cover effects which are potentially relevant to human health as well, for example, Chapter 14 - Major Accidents and Disasters.

13.3.5.1. Land Use

The land use assessment includes all direct and indirect effects on community resources and private assets in the study area. Direct effects include land-take and/ or impacts on access, i.e. properties and/ or facilities being cut off or split. Indirect effects include impacts on the amenity of residents of properties and/ or users of community resources in the study area. Depending on the type of land use effect being assessed, the magnitude of the impact is determined by:

- The amount of land to be taken or the number of properties to be demolished;
- The extent to which access to community resources or private property is impacted;
- The number of users and the extent to which these users experience impacts on their amenity.

This assessment draws upon the assessment findings Chapter 08 – Air Quality, Chapter 09 – Airborne Noise and Groundborne Vibration, Chapter 10 – Landscape & Visual Impact and Chapter 11 – Traffic and Transport.

13.3.5.2. Severance

Severance is defined as the separation of residents from facilities and services they use within their community caused by changes to roads and/ or walking and cycling facilities, and/ or changes in traffic flows. For example, the Proposed Development could lead to severance effects by increasing levels of traffic on existing roads and/ or introducing traffic management measures. This may lead to separation of residents from facilities and services which they use.

All severance impacts are direct impacts. The assessment of magnitude is informed by the assessment results presented in Chapter 11 – Traffic and Transport. It is determined by:

- The extent of the physical changes caused by the Proposed Development;
- The consequent changes in traffic levels on existing roads;
- The number of people whose journey will be affected;
- The type of road involved; and
- The mitigation measures implemented.

Table 13-2 outlines the criteria used to determine the magnitude of effect on severance.

Table 13-2 The Criteria Used to Assess Magnitude of Effect of Severance

Magnitude of effect	Description
High	People are likely to be deterred from making trips to an extent enough to induce reorganisation of their habits. Considerable hindrance will be caused to people who experience such severance on trips which they regularly carry out.
Medium	Some people are likely to be dissuaded from making trips. Other trips will be made longer or less attractive.
Low	In general, the current journey pattern is likely to be maintained, but there will probably be some hindrance to movement.
Negligible	There will be a very limited impact on people's movement and current journey patterns will be maintained.

13.3.5.3. Employment

This assessment includes the impact on the workforce in County Kerry and the surrounding area. The Proposed Development may provide direct and indirect job opportunities. Direct jobs include the temporary workforce required to construct the Proposed Development in the short to medium term, as well as the workforce required to operate the facility in the longer term. Indirect jobs include those created in the supply chain to provide material, specialist labour and demolition and remediation services for the workforce. There is no consolidated methodology or practice for assessing the magnitude of the impact on employment in EPA guidance. It has therefore been assessed qualitatively based on the number of jobs which the Proposed Development will create.

13.3.5.4. Human Health

The human health assessment includes potential impacts on the health of residents of properties and users of community resources in the study area. Whilst relevant guidance from the Institute of Public Health in Ireland (IPH), specifically the Health Impact Assessment Guidance (IPH, 2009), has been considered, there is no consolidated methodology or practice for describing effects on human health in EPA guidance. The impacts of the Proposed Development on human health will therefore be assessed qualitatively using the human health determinants set out in the *London* HUDU Rapid Health Impact Assessment Tool (NHS London Healthy Urban Development Unit, 2019). Whilst not designed or specifically developed for Ireland, a checklist approach will provide a broad overview of the potential health impacts and is applicable to a wide range of proposals. The checklist is split into 11 broad determinants and is based on the World Health Organisation (WHO) publication 'Healthy Urban Planning' (WHO, 2006).

The WHO Europe defines health as '*a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity*'. Consequently, public health encompasses general wellbeing, not just the absence of illness. Some effects are direct and obvious, others are indirect, while some may be synergistic, with different types of impact acting in combination. In keeping with this definition, this assessment considers the potential impacts of the Proposed Development on physical, mental, and social health.

Factors that have the most significant influence on the health of a population are called 'determinants of health'; these include an individual's genetics and their lifestyle, the surrounding environment, as well as political, cultural, and societal issues. The interrelationship between these factors is shown in Figure 13-1.

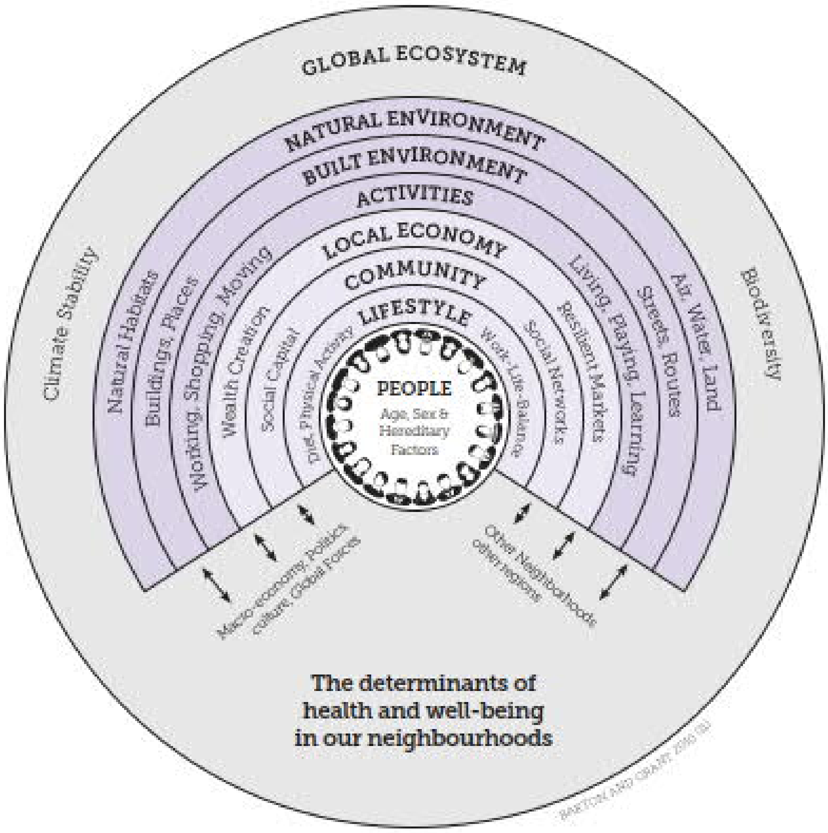

Figure 13-1 Social Determinants of Health

Source: Barton and Grant (WHO, 2006)

An initial scoping exercise was undertaken to determine the criteria within the HUDU guidance which is relevant to this assessment. The criteria which will be assessed as part of this chapter are listed below. Other criteria in HUDU guidance (NHS London Healthy Urban Development Unit, 2019) but not in the list below, have been scoped out:

- Access to healthcare services and other social infrastructure.
- Air quality, noise and neighbourhood amenity.
- Access to work and training.
- Climate change.

The assessment of human health is a qualitative rather than quantitative assessment, due to the diverse nature of health determinants and health outcomes which are assessed. Although the assessment of human health effects describes the likely qualitative health outcomes, it is not possible to quantify the severity or extent of the effects which give rise to these impacts. As such, the potential health impacts are described as outlined in Table 13-3, based on broad categories for the qualitative effects identified. Where an effect has been identified, actions have been recommended to mitigate any negative impact on health, or opportunities to enhance health benefits. It should be noted that in many cases, embedded mitigation to reduce these effects or measures to enhance certain benefits already form part of the Proposed Development and the assessment has considered these impacts as such.

Table 13-3 Effect Categories in the Assessment of Human Health

Effect Category	Effect Symbol	Description
Positive	+	A beneficial effect is identified
Neutral	0	No discernible health effect is identified
Negative	-	An adverse effect is identified

Effect Category	Effect Symbol	Description
Uncertain	?	Where uncertainty exists as to the overall impact

13.3.6. Limitations and Assumptions

This population and human health assessment is based on professional judgement and considers both the negative and positive impacts that the Proposed Development can have upon existing and surrounding receptors. It provides a broad, high level indication of effects, reporting on the potential effects to people and the local community.

The assessment draws upon other specialist topic inputs to aid the assessment of the impact of the Proposed Development on population and human health receptors.

Community resources are mentioned expressly in the environmental baseline only where they contribute to the local context or where they may be affected by the Proposed Development. Consequently, not all community resources within the study area are mentioned.

Information in the baseline related to demographics and the health profile of the population in the study area uses statistics from the Census. Five years have passed since the Census was published (2016).

13.4. Baseline Environment

13.4.1. Data Sources

The following data sources were used to inform the baseline and gain an understanding of the community in the study area:

- A review of relevant local policy documents including the Kerry County Development Plan 2015-2021 (Kerry Co. Council (KCC), 2015), the Kerry County Development Plan 2022 – 2028 Issues Paper (KCC, 2020) and the KCC Local Economic & Community Plan 2016-2022 (KCC, 2016);
- Primary data sources including that available from the Central Statistical Office relating to the 2016 census (Central Statistics Office, 2015);
- A review of secondary sources including the Regional Spatial and Economic Strategy (RSES) for the Southern Region 2020 (Southern Regional Assembly, 2020);
- Spatial information relevant to planning applications and decisions in Ireland from MyPlan.ie and An Bord Pleanála;
- The inter-jurisdictional land and marine based framework to guide the future development and management of the Shannon Estuary, the Strategic Integrated Framework Plan for the Shannon Estuary (SIFP) (Clare County Council, Kerry County Council, Limerick City and County Councils, Shannon Development and Shannon Foynes Port Company, 2013);
- Feedback on the Public Consultation undertaken by Shannon LNG Limited in June and July 2021 (see Appendix A1-4, Vol. 4).

13.4.2. Overview

The Proposed Development will be located along the Shannon Estuary in County Kerry. The nearest residential properties to the Proposed Development are located to the south of the Proposed Development along the L1010 in the townlands of Kilcolgan Lower and Rallapane. The nearest individual residential property is Rallapane House, approximately 300 m south of the red line boundary and accessed off the L1010.The area is predominantly rural and the primary land use in the study area is agricultural. There are two locations offering community resources near to the site: the town of Tarbert and the village of Ballylongford.

The town of Tarbert is located approximately 4.5 km east of the Proposed Development on County Kerry's border with County Limerick. The town is small and has a population of approximately 500. However, it has a high street offering a range of services and has community facilities including schools. The town is identified as a 'Tier 3' town in the Kerry County Development Plan 2022-2028 Issues Paper (2020) which designates towns into tiers based on population size and the range of services/ functions they provide to the surrounding hinterland.

The village of Ballylongford is located approximately 3.5 km to the south-west of the Proposed Development. The village is situated at the top of a creek of Ballylongford Bay on the tidal estuary of the River Shannon. The village is small and is home to approximately 400 people, though it does offer some services and sees a large influx of tourists which visit the range of historical sites in the local area.

Data from the 2016 Census for electoral divisions of Carrig, Lislaughtin, Tarmon and Tarbert has been analysed to inform the baseline. Residents of properties within these divisions are most likely to experience effects from the Proposed Development. The study area has a small population, with approximately 2,000 people reporting living in the area in the 2016 Census. The below analysis compares statistics regarding the population in the study area with those in County Kerry and Ireland as a whole.

13.4.3. The Local Community

This section describes information on population, age profile, social class and employment in the study area , and is primarily based on data from the latest Census in 2016.

Table 13-4 shows population change in the study area and its comparator areas between 2006 and 2016 as reported in the Census. The statistics reflect that the study area is primarily a rural area with a relatively small population which has steadily declined in recent years. There were 2,000 people in the study area in 2016, which is slightly less than the number of people in the area in 2006 (2,100). During the same period, the population in County Kerry increased by 6% (from 139,800 to 148,000) and the population in Ireland increased by 12% (from 4.24 million to 4.76 million).

Table 13-4 Population and Population Growth in the Study Area and its Comparator Areas

Area	2016	2011	2006	Change between 2006-2011 (%)	Change between 2006-2016 (%)
The study area	2,000	2,100	2,100	0	-5
County Kerry	148,000	145,500	139,800	4	6
Ireland	4,762,000	4,588,000	4,240,000	8	12

Source: CSO, Census 2016

Table 13-5 shows the age profiles of the population of the study area and its comparator areas in 2016. The age profile is representative of the available labour force and demand for the different types of community facilities in the local area.

The study area, relative to its comparator areas, has an elderly population. Approximately 21.7% of its residents are over the age of 65, compared to 16.9% of residents in County Kerry and 13.4% in Ireland. Conversely, the study area has a lower percentage of its population in working age (50.3%) than County Kerry and Ireland (52.9% and 53.3% respectively). It also has fewer young people, with only 27.9% of its population being 18 or under compared to 30.2% in County Kerry and 3.3% in Ireland.

Table 13-5 The Proportion of the Total Population in Each Age Bracket for the Study Area and its Comparator Areas

Area	% of total population by age band						
	0-4	5-12	13-18	19-24	25-44	45-64	65+
The study area	4.8	9.8	8.3	5	21.9	28.4	21.7
County Kerry	6.1	10.8	7.7	5.6	26.1	26.8	16.9
Ireland	7	11.5	7.8	7	29.5	23.8	13.4

Source: CSO, Census 2016

The census provides a breakdown of the total population by ‘social class’. These groupings are based on the level of skill and education attainment of their occupation. For the population which does not work, the social class of the person which they are deemed to depend on is attributed to them (as per guidance issued by the Central Statistics Office, see Ref 6.2). The data shows that the population of the study area is relatively better educated with a higher percentage of people in occupations which require greater skill levels than its comparator areas.

The data shows that the study area has a lower proportion of its population in the ‘Professional’, ‘Managerial/ Technical’ and ‘Non-Manual’ social classes (30.4%) compared to County Kerry (31.6%) and Ireland (36.2%). The study area is predominantly rural, and people within these social classes are likely to work in offices and higher rates are more prevalent in more urban areas.

Conversely, the proportion of people classed as ‘Skilled’ or ‘Semi-Skilled’ in the study area (20.3%) is higher in the study area than in both County Kerry (15.7%) and Ireland (14.1%). People in these social classes are likely to be in manual occupations, including in agriculture which is a major industry within the study area. The proportion of people classed as ‘unskilled’ is slightly higher in the study area (4.7%) than County Kerry (3.7%) and Ireland (3.6%).

Table 13-6 The Proportion of the Total Population in Each Social Class for the Study Area and its Comparator Areas

Area	% of total population by social class						
	Professional	Managerial/ Technical	Non-Manual	Skilled	Semi-Skilled	Un-skilled	Other
The study area	6.5	23.9	16.3	20.3	14.9	4.7	13.4
County Kerry	6.3	25.3	18.2	15.7	11.3	3.7	19.6
Ireland	8.1	28.1	17.6	14.1	10.5	3.6	18

Source: CSO, Census 2016

13.4.4. Public Engagement

Shannon LNG Limited undertook a period of public engagement from 23rd June 2021 to 10th July 2021. The purpose of the engagement was to provide information to the public on the Proposed Development. Due to COVID-19 public health restrictions, it was not possible to hold the public event in-person. Therefore, a virtual public information room was developed which was hosted on a dedicated website accessible at www.step.consultation.ai. The virtual room contained all the information that would normally be displayed at a physical event. This included details of the Proposed Development, representative views of the development and a feedback mechanism (Appendix A1-2, Vol. 4). Adverts notifying of the information event were posted in Kerry’s Eye and The Kerryman newspapers in advance of the launch on 24th June and 23rd June respectively (Appendix A1-3, Vol. 4).

36 public comments were received in total at the end of the engagement period. 97% (35) of the public comments were supportive of the development. Specifically of the 35 supportive comments, 16 were supportive due to the local employment opportunities that the Proposed Development will create, 13 were expressions of general support and 6 supportive of the development to address national energy security concerns. Only 1 comment questioned the need for the development and was not supportive (Appendix A1-4, Vol. 4).

Shannon LNG Limited also undertook direct local consultation with the Tarbert, Kilcolgan and Ballylongford Resident Associations, which expressed support for the project due to its potential economic benefits. Further detail is included in Chapter 01.

13.4.5. Land Use

The study area is rural and the primary land use is agricultural land. However, there are some community resources and commercial facilities. These are identified below.

13.4.5.1. Community Resources

In the study area, community resources are primarily located in the town of Tarbert and the village of Ballylongford.

Tarbert comprises a high street with a number of facilities for the local community, including a post office, a church (St Mary's Roman Catholic Church), a healthcare facility (a general practitioner), a community centre and three schools: a pre-school (Wishing Tree Pre-School), a primary school (Tarbert National School) and a secondary school (Tarbert Comprehensive School). There are a number of facilities which cater for tourists in the area, including a Hostel/ Bed & Breakfast, a museum (Tarbert Bridewell Courthouse and Jail Museum) and a visitor centre. There is also a Gaelic Athletic Association (GAA) facility in the town, and a children's play area known as the Tarbert playground. A national forest is located to the north of the town which contains a number of walking routes, including the popular John F Leslie Woodland Walk.

Community resources in Ballylongford include a church (St Michael's Catholic Church), a primary school (St Oliver's National School) and a GAA club. Carrigafoyle Castle is a popular tourist attraction located north of the village on Carrig Island. There is also a Bed & Breakfast (Castle View House) which caters for tourists of the castle and the surrounding coastline.

The only community resource in the study area which is located outside of Ballylongford and Tarbert is the Kilnaughtin Church and Graveyard. This is a medieval church and graveyard which dates back to the 15th century. It now serves a tourist attraction.

The Wild Atlantic Way is a defined touring route, stretching along the Atlantic coast from Donegal to West Cork, with protected viewpoints. Sections of this touring route are located in County Kerry, County Limerick and County Clare, including a section following the route of the R551 between Ballylongford and Tarbert.

13.4.5.2. Commercial Facilities

In Tarbert, there are many commercial facilities along the town's high street, including three bars, a restaurant, a post office, a pharmacy, a convenience store, a fast-food shop and a butcher. There is also a convenience store located to the east of the town near to the school.

In Ballylongford, commercial facilities are primary located to the west of the village along the R551 and include an auto parts store, a fast-food shop and a restaurant. In the centre of the village, along Main Street, there is a funeral home and a bar.

There are no commercial facilities located outside of Ballylongford and Tarbot in the study area.

13.4.6. Travel Patterns and the Existing Transport Network

13.4.6.1. Travel Patterns

Table 13-7 shows the travel time to work, school, or college for residents of the study area and its comparator areas in 2016.

Approximately 68% of residents within the study area have a journey time to work, school or college which is less than 30 minutes, which is a lower proportion than County Kerry (76.2%) but a higher proportion than Ireland (66.2%). In comparison, 9.8% of residents travel over one hour to their destination, compared to 9.1% in Ireland and only 5.7% in County Kerry.

Table 13-7 Travel Time to Work, School, or College

	Under 15 mins	15-29 mins	30-44 mins	45-60 mins	1-1.5 hours	>1.5 hours
The study area	39.6	28.4	15.2	6.9	7	2.8
County Kerry	46.3	29.9	14.8	3.4	3.5	2.2
Ireland	35	31.2	18.7	6.4	6.6	2.5

Source: CSO, Census 2016

Table 13-8 shows the modes of transport most commonly used to travel to work, school, and college for residents of the study area and its comparator areas in 2016. The results show that just over half (50.6%) of residents are either drivers or passengers in a car/ van. This is a lower proportion that use a car/ van than in Co. Kerry (51.2%) but a higher proportion than in Ireland (45.6%).

A higher proportion of residents in the study area use public transport (11.3%) compared to County Kerry, but a lower proportion travel by foot or bicycle (9.9% compared to 11.9% in County Kerry). Ireland has a higher proportion of its population travelling via both public transport (13.5%) and by foot or bicycle (17.5%).

Table 13-8 Travel Mode to Work, School, or College

Area	Foot	Bicycle	Bus or Coach	Train	Car/ Van Driver	Car Passenger	Other
The study area	9.6	0.3	11.2	0.1	50.6	18.5	9.7
County Kerry	10.5	1.4	7.6	0.2	51.2	23	6.1
Ireland	14.6	2.8	10.7	2.8	45.6	19.5	4

Source: CSO, Census 2016

The above statistics are representative of the study area and County Kerry both being rural areas. In the study area, there are schools and some employment opportunity in the villages of Ballylongford and Tarbert. However, for residents of properties not located in these villages, there are little public transport options and residents are required to own a car to access the villages and towns outside of the study area.

13.4.6.2. The Existing Transport Network

The Traffic and Transport chapter presents a description of the local transport network in the study area. This is summarised below to provide context on the existing transport infrastructure used by the local community to travel within both the local and wider area.

The L1010 is the road which will connect the Proposed Development Site to Ballylongford in the west and Tarbert in the east. The road currently facilitates access between the residential properties and farms located along the road and Tarbert and Ballylongford. However, the road is generally not used for access between Ballylongford and Tarbert as the R551, located to the south, offers a shorter and faster route between the areas.

There are two national secondary roads located in the study area: the N67 and the N69. The N67 connects the study area with County Clare in the north and includes a ferry crossing over the Shannon Estuary. To the north of the estuary, the road travels to Kilrush and leads on to Ennis. The N69 connects Tarbert with Limerick City in the east and Listowel and Tralee in the south. These locations offer both employment and educational facilities not offered within the study area and thus it is likely that residents in the study area use these roads regularly to access these locations. A bus route also travels along this road.

13.4.7. Health

The below section provides an overview of the health profile of residents in the study area using the best available data. Data on general health and the prevalence of disabilities has been taken from a self-assessment on health carried out as part of the 2016 Census. This data is available by electoral division and presented via the same areas as in the rest of the baseline. Data on prevalence on physical activity and condition of mental health has been taken from the Irish Health Survey. The Irish Health Survey is based on self-reported data from persons aged 15 years and over and gathers their view on key components of their health. This data is available only at a regional level and subsequently it has been reported as such in this section. The study area is within the south-west region.

13.4.7.1. General Health

In the study area, 88.6% of respondents identified themselves as having either 'very good' or 'good' health. This is slightly less than County Kerry (89.6% reporting 'very good' or 'good' health) and Ireland (90.1%). However, the proportion of people reporting 'Bad' or 'Very Bad' health in the study area (1.6%) was like County Kerry (also 1.6%) and Ireland (1.7%).

Table 13-9 Proportion of the Population by General Health for the Study Area and its Comparators

	Very good	Good	Fair	Bad	Very Bad
The study area	57.5	31.1	9.8	1.2	0.4
County Kerry	58.6	31	8.9	1.3	0.3
Ireland	61.5	28.6	8.3	1.4	0.3

Source: CSO, Census 2016

13.4.7.2. Disability

Table 13-10 below, shows the proportion of the population with a disability in the study area and its comparator areas from the 2016 Census. A disability has been defined as a long-lasting condition or difficulty and may be physical or mental. Approximately 14.4% of the study area's population identifies as having a disability which is slightly higher than the proportion of the population in County Kerry and Ireland (both 13.5%).

Table 13-10 Proportion of the Population with a Disability for the Study Area and its Comparators

Area	Proportion of population with a disability (%)
The study area	14.4
County Kerry	13.5
Ireland	13.5

Source: CSO, Census 2016

13.4.7.3. Physical Health

Table 13-11 shows the proportion of residents which undertake different types of physical activity for the south-west region and for Ireland as a whole. The table shows that comparatively less people in the study area undertake all types of physical activity identified. The largest difference in activity rates between the south-west and Ireland is for 'sports, fitness, or recreational physical activities'. Only 47% of residents of the south-west region partake in these activities, compared to 52% of residents in Ireland.

Table 13-11 Proportion of Residents Undertaking Types of Physical Activity by Region

Type of physical activity undertaken	South-West Region	Ireland
Walking to get to and from places	81	83
Cycle to get to and from places	10	13
Sports, fitness or recreational physical activities	47	52
Muscle strengthening activities	24	28

Source: The Irish Health Survey 2019 (Southern Regional Assembly, 2020)

13.4.7.4. Mental Health

Table 13-12 shows the mental health status of residents for the south-west region and for Ireland as a whole (aged 15 year and over). The table shows that a higher proportion of residents suffer from mild depression or moderate depression in the south-west region compared to Ireland as a whole. Approximately 72% of residents of the south-west region suffer from 'none to minimal depression', compared to 74% of residents of Ireland. The prevalence rate of 'moderately severe or severe depression' is the same (3%) in the south-west region as it is in Ireland.

Table 13-12 Proportion of Residents Undertaking Types of Physical Activity by Region

Mental Health Indicator	South-West Region	Ireland
None to minimal depression	72%	74%
Mild depression	19%	18%
Moderate depression	6%	5%
Moderately severe or severe depression	3%	3%

Source: The Irish Health Survey 2019 (Southern Regional Assembly, 2020)

13.4.8. Planning Applications

A planning search of granted and pending planning applications made within the vicinity of the Proposed Development within the last five years was completed. The relevant planning applications and outcomes for the population and health chapter are listed in Table 13-13. Withdrawn and incomplete planning applications were not included. Results are as per January 2021.

Table 13-13 Planning Applications made within the Vicinity of the Proposed Development Site

Planning Reference	Location	Received Date	Decision Date	Decision	Description
13138	Kilpaddoge, Tarbert, Co. Kerry	13.03.2013	17.09.2013	Granted	Construct an electricity peaker power generating plant.
13477	Tarbert Island, Tarbert, Co. Kerry	31.07.2013	23.09.2013	Granted	Alter existing 220 kV station consisting of new single storey control building, new diesel generator building, 3 no. single storey modular buildings, 6 no. gantry support structures, 8 no. control and protection kiosks, 6 no. surge arrestors, 6 no. cable sealing ends, existing compound chain link fence and gates to be replaced with new palisade fence and gates, new holding tank.
14816	Gurteenavallig, Tarbert, Co. Kerry	28.11.2014	28.04.2015	Granted	The extension of a portion of the permitted access road, the provision of a new substation compound with a single storey substation building and associated underground services.
155	Kilpaddoge, Tarbert, Co. Kerry	08.01.2015	03.03.2015	Granted	Alterations to the existing station consisting of 1 no. 110/ 20 kV transformer, 3 no. 110 kV surge arrestor, 3 no. 110 kV cable sealing ends, 1 no. neutral earth resistor, 1 no. lightning mast, new retaining wall with handrail, new single story mv switchgear building and associated drainage and site works.
17466	Meelcon and Gurteenavallig, Ballylongford, Co. Kerry	22.05.2017	14.07.2017	Granted	The modification of the permitted northern access, junction to Leanamore wind farm.
18392	Tarbert Island, Tarbert, Co. Kerry	27.04.2018	15.01.2019	Granted	For a 10-year permission to construct a battery storage facility within a total site area of up to 2.278 hectares (ha).
18878	Kilpaddoge, Tarbert, Co. Kerry	10.09.2018	23.09.2019	Granted	For a 10-year permission to construct a battery energy storage system (bess) facility on a total site area of up to 0.6 ha that will provide gird balancing services to the Irish electrical grid. Third Party Appeal to Appeal to ABP (305739-19). ABP granted permission.
19115	Kilpaddoge, Tarbert, Co. Kerry	12.02.2019	07.02.2020	Granted	For a 10 year permission for a grid stabilisation facility comprising of: the construction up to 4 no. rotating stabilisers, 5 no. battery storage containers, 1 no. control room, 2 transformers and ancillary equipment within a site area of approximately 1.46 ha.
304807-19	Townlands of Aghanagran Middle, Aghanagran Lower, Ballyline West, Tullahennell South, Ballylongford, Co. Kerry	02.07.2019	06.01.2020	Granted	Construction of a Windfarm consisting of up to 6 Wind Turbines. Previously refused by KCC (19381)
VA03.307798	Townland of Carrowdotia South, Co. Clare and Kilpaddoge, Co. Kerry.	30.07.2020	04.06.2021	Granted	Installation of 400 kV electricity transmission cables, extension to the existing Kilpaddoge Electrical Substation and associated works, between the existing Moneypoint 400 kV Electrical Substation in the townland of Carrowdoita South County Clare and existing Kilpaddoge 220/ 110 kV Electrical Substation in the townland of Kilpaddoge County Kerry. The development includes work in the foreshore.

Planning Reference	Location	Received Date	Decision Date	Decision	Description
20850	Kilpaddoge, Tarbert, Co. Kerry	18.09.2020	12.11.2020	Granted	For changes to the previously permitted peaker power plant development (planning ref. 13/138). It is proposed to change the energy source for the charging of the battery energy storage system (bess) containers from diesel to charging off the national grid and to change the permitted layout for electrical equipment.
11457	Carrowdotia South, Co. Clare	24.06.2011	03.08.2011	Granted	Permission for the development of electrical transmission infrastructure and associated works at the existing Moneypoint Power Station complex.
PL 03.241624 (1274)	Carrowdotia North and, Carrowdotia South, Killimer, Co Clare	19.02.2013	12.12.2013	Granted	10-year planning permission for a Wind Farm Project (5 wind turbines) at Moneypoint Generating Station refused by Clare County Council but granted by An Bord Pleanála following a first party appeal.
14190	Moneypoint Power Station, Carrowdotia South, Co. Clare	10.04.2014	28.05.2014	Granted	A new indoor Gas Insulated Switchgear (GIS) 400 kV substation building (3463 m2), 17 m high, two new 400/ 220 kV transformers with associated Switchgear, three new 30 m high lightning masts, and associated drainage and site works. The application relates to previous grant of planning permission reg. ref. P11-457.
PL 03.243842 (14373)	Carrowdotia North, and South, Killimer, Co. Clare	15.09.2014	29.01.2015	Granted	20-year planning permission for works to the existing 32 ha ash repository site located within the Moneypoint generating station complex granted by Clare County Council and granted by An Bord Pleanála following a first party appeal relating to a condition regarding a development contribution.
1581	Carrowdotia North & South, Killimer, Co. Clare	18.02.2015	10.04.2015	Granted	10-year permission primarily for an electrical transformer station. The Proposed Development is an amendment to the previously approved electrical transformer station at Moneypoint Wind Farm (CCC Ref: 12-74 APB Ref: PL03.241624)
161011	Moneypoint, Co. Clare	22.12.2016	24.08.2017	Granted	Refurbishment of the Moneypoint – Oldstreet 400 kV overhead line.
19746	Moneypoint Generating Station, Carrowdotia North, Kilimer , Co Clare	26.09.2019	20.11.2019	Granted	10-year planning permission for a synchronous condenser and supporting items of plant, with the largest building being approximately 962 sq.m and standing approximately 15 m high.
20318	Moneypoint Generating Station, Carrowdotia North and Carrowdotia South, Kilimer, Co. Clare.	20.05.2020	16.07.2020	Granted	10-year planning permission for a synchronous condenser, supporting items of plant, with the largest building being approximately 420 sq.m and standing approximately 15 m high. Permission also sought to continue the use of the existing underground cable grid connection. This application represents a relocation within Moneypoint of a similar application permitted by Clare County Council under Reg. Ref. P19/746.

Source: KCC/ Clare Co. Council/ An Bord Pleanála planning search

13.5. Assessment of Impact and Effect

13.5.1. Land Use

The Proposed Development is located in a primarily rural area and the nearest residential property is located approximately 300 m from the boundary of the site. Part of the land required is currently leased out to a number of farmers as pastureland for cattle grazing.

The Proposed Development site is currently owned by Shannon Commercial Enterprises DAC (formerly Shannon Free Airport Development Company Limited) having its registered address at Shannon Airport, County Clare. The Applicant has entered into an agreement for the purchase of the lands. The Proposed Development site is zoned for marine-related industry use by KCC (KCC, 2015).

During the construction and operational phase, farmers would no longer be able to use the relevant part of the Proposed Development site for grazing, though that part of the landbank outside the red line will continue to be leased out.

Chapter 10 - Landscape and Visual Impacts considers effects on the Wild Atlantic Way touring route. Visual effects on views from the Co. Kerry section are considered to be not significant adverse. The magnitude of visual change from Co. Clare is considered ranging between medium and high, and the resulting significance is considered ranging between moderate and significant adverse depending on the distance to the Proposed Development and the openness and panoramic quality of available views. However, while the Proposed Development will intensify the industrial nature of views, it will not be totally uncharacteristic as it will often be seen in conjunction with existing industrial developments.

Overall, the Proposed Development is expected to have a **slight negative (not significant)** impact on land use during both the construction and operation phases.

Table 13-14 Summary of Impacts on Land Use in the Construction and Operation Phase

Impact	Displacement of users of agricultural land. Indirect amenity impacts on users of the Wild Atlantic Way touring route.	
Criteria	**Effect & Significance**	**Comment**
Quality/ Nature	Negative	A number of farmers will be displaced from that part of the Proposed Development site currently leased out as pastureland for cattle grazing. Views of tourists using the Wild Atlantic Way will be negatively impacted.
Type	Direct; indirect	Direct and indirect effect of the project.
Frequency	Constant	During the proposed construction programme and the operational phase.
Extent	Local; regional (County Clare)	Farmers will be displaced from part of the Proposed Development site. Tourist views from County Clare will be affected.
Duration	Long term	During the proposed construction programme and the operational phase.
Probability	Likely	The probability of farmers being displaced and views being impacted is likely.
Magnitude	Low	A relatively small area of farmland will be affected. Views from a relatively small section of the Wild Atlantic Way will be affected.
Receptor Sensitivity	Low	There is no agricultural infrastructure on the land in question, and there are likely to be alternative local pastures which can be accessed by farmers. Views of the Proposed Development will be seen in conjunction with existing industrial developments.
Impact Significance	Slight	

Impact	Displacement of users of agricultural land. Indirect amenity impacts on users of the Wild Atlantic Way touring route.	
Criteria	**Effect & Significance**	**Comment**
Residual Impact Significance	Slight	

13.5.2. Severance

As stated in the baseline, the study area is predominantly rural with limited public transport available. Local residents rely heavily on the local and regional road network to access workplaces, educational facilities, and community facilities. The L1010 and the R551 are the primary routes used to travel between Ballylongford and Tarbert in the local area. The N69 enables access to the city of Limerick in the east and the towns of Listowel and Tralee in the south, and the N67 can be used to access towns in County Kerry via a ferry link including Kilrush and Ennis. The impact of the Proposed Development on the potential severance of these links is considered below.

13.5.2.1. During Construction

During the construction period, HGV traffic, general delivery traffic and site operatives will all be required to travel to and from the Proposed Development site. The majority of this construction traffic is likely to travel to and from the study area via the N69 between Limerick and Tarbert. The rest of the traffic will use either the stretch of the N69 south of Tarbert towards Limerick and the N67 towards the Tarbert ferry crossing. The Proposed Development site is located on the L1010 between Tarbert and Ballylongford and therefore all construction traffic will be required to use this stretch of road to access the site.

The transport assessment (see Chapter 11) finds that this construction traffic will lead to a considerable increase in the number of vehicles using many of the junctions within or near to Tarbert. For example, in the AM period (between 6.30am and 10am), there will be a 71% increase in the number of vehicles (from 213 vehicles in the Do Nothing to 365 in the Do Something) using the N67/ N69/ R551 junction and a 93% increase in the number of vehicles (from 164 in the Do Nothing to 316 in the Do Something) using the R551/ L1010 junction. The transport assessment also modelled the impact of these construction traffic flows on local junctions. It found that, due to the low existing number of vehicles using these junctions, the increase in traffic flows at these junctions due to construction traffic does not lead to any junctions becoming over capacity. There is therefore not expected to be any congestion considerable enough to deter local residents from accessing the workplaces, educational facilities, or community facilities which they use.

Therefore, the Proposed Development is assessed to have a **negligible impact** on severance between local residents in the study area and the facilities which they use during the construction period. Considering the frequency, extent, duration and probability of the impact, the significance of effect is assessed to be **imperceptible**. Table 13-15 presents a summary of the assessment.

Table 13-15 Summary of Impacts on Severance in the Construction Phase

Impact	Impact of construction traffic on severance between residents and the workplaces, community facilities and educational facilities which they frequently access.	
Criteria	**Effect & Significance**	**Comment**
Quality/ Nature	Negative	The presence of construction traffic has potential to lead to severance between residential properties and the workplaces, community facilities and educational facilities which they frequently access
Type	Indirect	An indirect effect of the project
Frequency	Hourly	Throughout the proposed construction programme

Impact	Impact of construction traffic on severance between residents and the workplaces, community facilities and educational facilities which they frequently access.	
Criteria	**Effect & Significance**	**Comment**
Extent	Local	Residential properties in the study area using local and regional roads in and around Tarbert and Ballylongford to access workplaces, community facilities and educational facilities.
Duration	Short-Term	Approximately two years and six months
Probability	Likely	The probability of haulage activities increasing congestion in the study area is likely
Magnitude	Negligible	Impact of construction traffic on congestion in the study area is negligible
Receptor Sensitivity	n/a	n/a
Impact Significance	Imperceptible	
Residual Impact Significance	Imperceptible	

13.5.2.2. During Operation

The operation of the Proposed Development will require a number of staff to travel to and from the site. This is expected to create approximately 61 trips in the AM peak hour (8am-9am) and 50 trips in the PM peak hour (5pm-6pm). This increase in vehicles on the road network is not expected to lead to any congestion which may deter local residents from accessing the workplaces, educational facilities, or community facilities which they use. Therefore, the Proposed Development is assessed to have **no impact** on severance between local residents in the study area and the facilities which they use during the operation period.

13.5.3. Employment

13.5.3.1. During Construction

As stated in Chapter 02 – Project Description, the construction of the Proposed Development is split into two primary elements: the LNG Terminal and the Power Plant. Workers will also be required for enabling works and construction of a substation and AGI.

Construction of the LNG Terminal is expected to commence in June 2023 and will occur for approximately 12 months. Construction of the LNG Terminal will require a peak of approximately 200 workers. Construction of the Power Plant will involve the construction of three CCGT blocks. As detailed in Chapter 02, the three CCGT blocks will be constructed concurrently, i.e. two CCGT blocks followed by the last CCGT block. The peak number of workers onsite will be 600 for the construction of two CCGT blocks. The enabling works will require a peak of 75 workers onsite and construction of the substation will also require a peak of 75 workers onsite.

Figure 13-2 identifies the number of workers which will be required onsite to construct all elements of the Proposed Development. The figure shows the employment scenario where all three CCGT blocks are constructed at once. It identifies that approximately 975 workers will be required onsite during the peak of the construction phase – between September 2023 and December 2023.

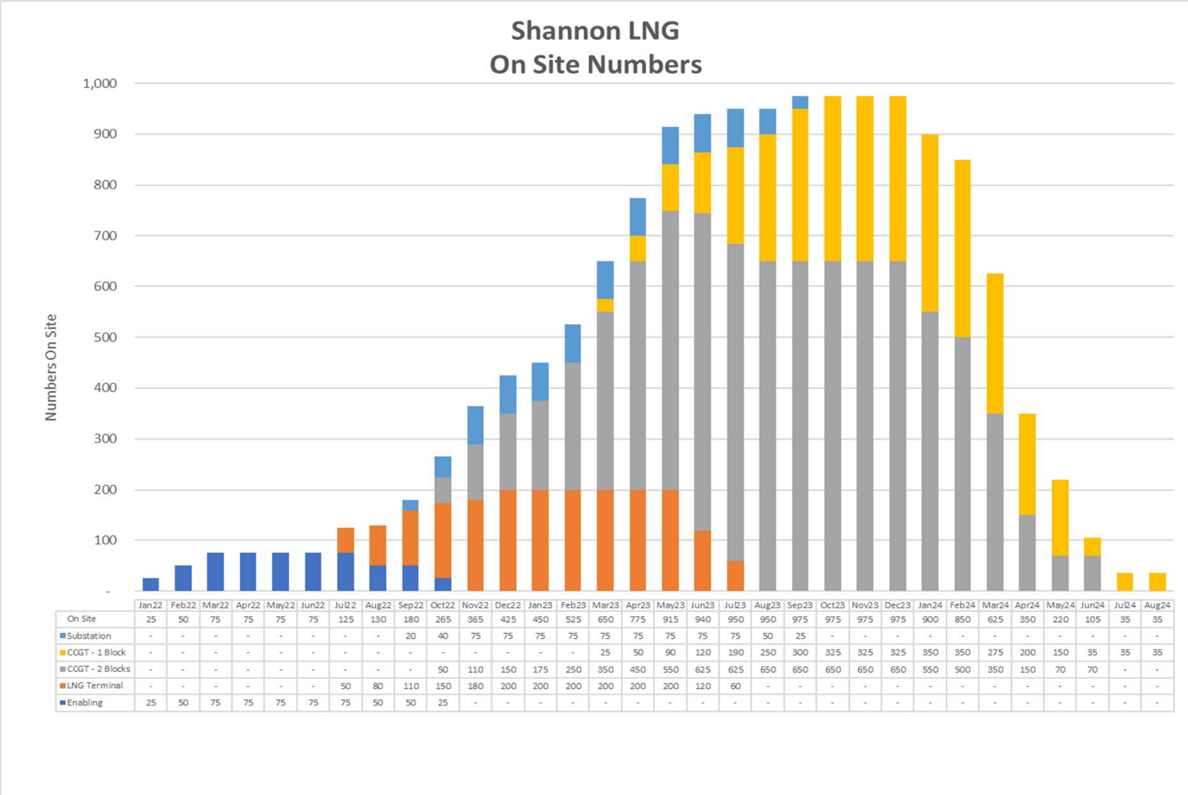

Figure 13-2 Estimated Number of Construction Workers Required onsite by Month

It is expected that temporary indirect jobs will also be created in the supply chain to provide material, specialist labour and construction services for the workforce. Based on the information available at present, it is not possible to quantify the extent of the indirect employment created, however, it could increase employment created in the order of 40 to 50% of direct employment, based on typical 'additionality' assessments of such jobs created in other projects.

The baseline section identified that the population of the study area has recently declined and is relatively elderly. During the public consultation undertaken by Shannon LNG, 16 of the 36 comments received were supportive due to the local employment opportunities that the Proposed Development will create. Therefore, the Proposed Development is assessed to have a **medium impact** on the employment workforce in County Kerry during the construction period. Considering the frequency, extent, duration and probability of the impact, the significance of effect is assessed to be **slight positive**. Table 13-16 presents a summary of the assessment.

Table 13-16 Summary of Impacts on Employment in the Construction Phase

Impact	Impact of construction works on the workforce in County Kerry	
Criteria	**Effect & Significance**	**Comment**
Quality/ Nature	Positive	The works will lead to an increase in the number of employed workers in County Kerry
Type	Direct/ Indirect	A direct and indirect effect of the project
Frequency	Hourly	Throughout the proposed construction programme
Extent	Local	The works will provide temporary employment for residents primarily in County Kerry
Duration	Short-Term	Approximately two years and six months
Probability	Likely	The probability of the works leading to an increase in employment in County Kerry is likely
Magnitude	Medium	The Proposed Development is likely to have a low impact on the number of employed workers in County Kerry

Impact	Impact of construction works on the workforce in County Kerry	
Criteria	**Effect & Significance**	**Comment**
Receptor Sensitivity	n/a	n/a
Impact Significance	Slight	
Residual Impact Significance	Slight	

13.5.3.2. During Operation

The operation of the Proposed Development will require a number of employees onsite, including:

- A crew of approximately 35 persons on the Floating Storage Regasification Unit (FSRU). This will comprise officers and crew members who will be located on the FSRU at all times during their onshore months.
- A crew of approximately 4 persons per tugboat. The Proposed Development includes provision of infrastructure to accommodate up to four tugboats (16 employees total).
- Approximately 35 employees at the onshore receiving facility, comprising day staff and shift staff/ contractors.
- Approximately 66 employees at the Power Plant, comprising day staff and shift staff/ contractors.

This translates to approximately 101 full-time employed (FTE) workers required for the operation of the onshore receiving facility and the onshore Power Plant. There will also be an additional 35 persons onboard the FSRU and 16 employees on tugboats at all times. Therefore, the Proposed Development is assessed to have a **slight impact** on the employment workforce in Co. Kerry during the operation period. Considering the frequency, extent, duration and probability of the impact, the significance of effect is assessed to be **slight positive**. Table 13-17 presents a summary of the assessment.

Table 13-17 Summary of Impacts on Employment in the Operation Phase

Impact	Impact of the operation of the Proposed Development on the workforce in County Kerry	
Criteria	**Effect & Significance**	**Comment**
Quality/ Nature	Positive	The works will lead to an increase in the number of employed workers in County Kerry
Type	Direct	A direct effect of the project
Frequency	Hourly	Throughout the operational phase of the Proposed Development
Extent	Local	The works will provide permanent employment for residents primarily in County Kerry
Duration	Long-Term	The duration of the operational phase of the Proposed Development (28 years)
Probability	Likely	The probability of the works leading to an increase in employment in County Kerry is likely
Magnitude	Low	The Proposed Development is likely to have a low impact on the number of employed workers in County Kerry
Receptor Sensitivity	n/a	n/a
Impact Significance	Slight	

Impact	Impact of the operation of the Proposed Development on the workforce in County Kerry	
Criteria	**Effect & Significance**	**Comment**
Residual Impact Significance	Slight	

13.5.4. Human Health

The tables below set out the potential human health impacts associated with the Proposed Development during the construction and operation phases.

Table 13-18 Access to Healthcare Services and Other Social Infrastructur00654:31 PMCOPY

Assessment Criteria	*Details and Evidence*	*Potential Health Impact*	*Further Action or Mitigation Recommended*
Does the proposal assess the impact on healthcare services?	There are two healthcare facilities in Tarbert: the Tarbert Medical Centre and a GP service. These are the closest healthcare services for local residents. Local residents are required to travel to Listowel to access the nearest hospital (Listowel Community Hospital). The study area is primarily rural and there are many residential properties located away from Tarbert in the study area (such as residents in Ballylongford) who are required to travel to these healthcare facilities by car. **During construction** During the construction period, HGV traffic, general delivery traffic and site operatives will all be required to travel to and from the Proposed Development site. The majority of this construction traffic is likely to travel to and from the study area via the N69 between Limerick and Tarbert. The rest of the traffic will use either the stretch of the N69 south of Tarbert towards Limerick and the N67 towards the Tarbert ferry crossing. The Proposed Development site is located on the L1010 between Tarbert and Ballylongford and therefore all construction traffic will be required to use this stretch of road to access the site. However, the transport assessment finds that though construction activity will cause an increase in traffic – it will not lead to congestion. The low existing number of vehicles using these roads means that even with traffic increases these junctions do not become congested. Therefore, there is expected to be no effect on residents' ability to access healthcare facilities in Tarbert or in Listowel. The potential health impact during construction related to access to healthcare services is therefore assessed to be **neutral**. **During operation** During the operational period, a number of staff will be required to travel to and from the site. It is expected that staff traveling to and from the site will create approximately 61 trips in the AM peak hour (8am-9am) and 50 trips in the PM peak hour (5pm-6pm). This is not expected to lead to congestion and it will not impact accessibility between local residents and the healthcare facilities they use in Tarbert or in Listowel. The potential health impact	0 during construction 0 during operation	**During construction** Ensure measures in the Outline Construction Environmental Management Plan (OCEMP) and Outline Construction Traffic Management Plan (OCTMP) related to construction traffic are implemented accordingly. **During operation** None required

Assessment Criteria	Details and Evidence	Potential Health Impact	Further Action or Mitigation Recommended
	during operation related to access to healthcare services is therefore assessed to be **neutral.**		
Does the proposal assess the capacity, location, and accessibility of other social infrastructure, e.g. schools, Social care and community facilities?	Residents in the study area are likely to use the educational facilities and community facilities located in Tarbert and Ballylongford. There are three schools in Tarbert and a variety of community resources in the town's high street. In Ballylongford, there is a primary school, a church and a GAA club. Residents are also likely to travel outside of the study area to the nearby towns of Listowel and Ballybunion to access community resources. **During Construction** During the construction period, HGV traffic, general delivery traffic and site operatives will all be required to travel to and from the Proposed Development site. The majority of this construction traffic is likely to travel to and from the study area via the N69 between Limerick and Tarbert. The rest of the traffic will use either the stretch of the N69 south of Tarbert towards Limerick and the N67 towards the Tarbert ferry crossing. The Proposed Development site is located on the L1010 between Tarbert and Ballylongford and therefore all construction traffic will be required to use this stretch of road to access the site. However, the transport assessment finds that though construction activity will cause an increase in traffic – it will not lead to congestion. The low existing number of vehicles using these roads means that even with traffic increases these junctions do not become congested. Therefore, there is expected to be no effect on residents' ability to access educational and community facilities in Tarbert or in Listowel. The potential health impact during construction related to access to other social infrastructure is therefore assessed to be **neutral**.	0 during construction 0 during operation	**During construction** Ensure measures in the OCEMP and OCTMP related to construction traffic are implemented accordingly. **During operation** None required

Assessment Criteria	Details and Evidence	Potential Health Impact	Further Action or Mitigation Recommended
	During Operation During the operational period, a number of staff will be required to travel to and from the site. It is expected that staff traveling to and from the site will create approximately 61 trips in the AM peak hour (8am-9am) and 50 trips in the PM peak hour (5pm-6pm), with an additional 2 LGVs per hour required to access the site in peak periods for deliveries and 1 LGV per hour required to access the sites outside of peak periods. This is not expected to lead to congestion and it will not impact accessibility between local residents and the community facilities they use in Tarbert/ Ballylongford and outside of the study area. The potential health impact during operation related to access to social infrastructure is therefore assessed to be **neutral**.		

Table 13-19 Air Quality, Noise, and Neighbourhood Amenity

Assessment Criteria	*Details and Evidence*	*Potential Health Impact*	*Further Action or Mitigation Recommended*
Does the proposal minimise construction impacts such as dust, noise, vibration and odours?	**During Construction** An assessment of construction noise and construction vibration is provided in Chapter 09. The noise assessment identifies two 'peaks' in construction activity across the three-year construction period: 'Peak 1' in June and July 2023 and 'Peak 2' in May to September 2024. The assessment finds that, during these peaks, there are three residential properties which have potential to experience increases in noise levels which go beyond the defined significance criteria during the daytime. However, the assessment states that if mitigation measures are followed, no noise impacts are expected at any of these residential properties due to onsite noise activities. The vibration assessment states that the primary sources of vibration associated with construction of the Proposed Development is the piling rug used to construct the jetty. However, vibration arising from this is **not expected to lead to any impacts** on any residential properties or community resources. An assessment of the impact on air quality due to site plant and non-road mobile machinery emissions is provided in Chapter 08 – Air Quality. The assessment finds that, providing that adequate dust mitigation measures are implemented onsite, there are likely to be **no significant air quality impacts** due to onsite activity during the construction phase. Overall, therefore, provided that the appropriate noise and air quality mitigation measures are followed (see Chapter 08 and Chapter 09 for more detail on these measures), the potential health impact during construction due to dust, noise, vibration, and odours is assessed to be **neutral.** **During Operation** N/A	0 during construction N/A during operation	**During construction** Ensure measures in the OCEMP and OCTMP related to onsite construction activities are implemented accordingly. **During operation** N/A

Assessment Criteria	*Details and Evidence*	*Potential Health Impact*	*Further Action or Mitigation Recommended*
Does the proposal minimise noise pollution caused by traffic and commercial uses?	**During Construction** During the construction period, HGV traffic, general delivery traffic and site operatives will all be required to travel to and from the Proposed Development site. The majority of this construction traffic (80% of HGVs, 70% of LGVs and 70% of site operates) is likely to travel to and from the study area via the N69 between Limerick and Tarbert. This means that the majority of construction traffic will travel through Tarbert. As stated in Chapter 11 Traffic and Transport, during the peak year of construction (2024), there is expected to be approximately 140 construction vehicles travelling eastbound through Tarbert along the L1010 and Church Street between 7am and 8am. A similar number of vehicles will be required to travel westbound through Tarbert during the PM peak. The presence of these vehicles will be a nuisance to residents of these properties. An assessment of the noise that this construction traffic creates is provided in Chapter 09. The assessment predicts that the presence of construction traffic will lead to a major noise impact on residential properties along the L1010 between the site entrance and Tarbert. There are approximately 50 residential properties along this link (though the noise impact will be limited to the relatively small number of noise sensitive properties located along the road). In summary, residential properties on the L1010 and Church Street in Tarbert will experience nuisance impacts due to the presence of construction traffic. Some of these properties on the L1010 will also experience noise impacts. Therefore, the potential health impact during construction due to noise pollution caused by traffic is assessed to be **negative**. **During Operation** The operation of the Proposed Development will require a number of staff to travel to and from the site. Staff and delivery vehicles travelling to and from the site is expected to create approximately 61 trips in the AM peak hour (8am-9am) and 50 trips in the PM peak hour (5pm-6pm). This means that there will be, on average, less than one additional vehicle per minute travelling through Tarbert. The majority of vehicles will be	- during construction 0 during operation	**During construction** Ensure measures in the OCEMP and OCTMP related to construction traffic are implemented accordingly. **During operation** None required

Assessment Criteria	Details and Evidence	Potential Health Impact	Further Action or Mitigation Recommended
	cars rather than HGV/ LGVs. Therefore, the operation of the Proposed Development is not expected to lead to any nuisance impacts on residents in Tarbert. Chapter 09 assesses the impact of this additional traffic on residential properties in the study area. It finds that no residential receptors will experience a noise impact due to operational traffic which is greater than negligible. The potential health impact during operation due to noise pollution caused by traffic is therefore assessed to be **neutral.**		
Does the proposal minimise air pollution caused by traffic and energy facilities?	**During Construction** During the construction period, HGV traffic, general delivery traffic and site operatives will all be required to travel to and from the Proposed Development site. The majority of this construction traffic (80% of HGVs, 70% of LGVs and 70% of site operates) is likely to travel to and from the study area via the N69 between Limerick and Tarbert. This means that the majority of construction traffic will travel through Tarbert. As stated in Chapter 11 – Traffic and Transport, during the peak year of construction (2024), there is expected to be approximately 140 construction vehicles travelling eastbound through Tarbert along the L1010 and Church Street between 7am and 8am. The air quality assessment in Chapter 12 states that the construction of the Proposed Development is not expected to result in significant effects as it will not notably alter the daily average speeds of vehicles or the alignment of the roads themselves. It has not therefore conducted any further assessment. The potential health impact during construction due to air pollution caused by construction traffic is therefore assessed to be **neutral.** **During Operation** The air quality assessment in Chapter 08 Air Quality includes a combined impact assessment of operational site activity and operational traffic. The operation of the Proposed Development will include a number of onsite sources of emissions associated with the combustion plant to enable the generation of heat and power for onsite activity. However, mitigation is embedded within the Proposed Development design (source	0 during construction 0 during operation	**During construction** Ensure measures in the OCEMP and OCTMP related to construction traffic are implemented accordingly. **During operation** None required

Assessment Criteria	Details and Evidence	Potential Health Impact	Further Action or Mitigation Recommended
	release height), and the facility's Emission Limits will be set by the EPA within its IE licence. Sources of emissions due to operational traffic are associated with the vehicles required to access the site. The assessment finds that, at the majority of residential properties assessed, there will be negligible to slight impacts on air quality due to the combined operational site activity and traffic. At two residential properties on the L1010, there will be moderate impacts. However, there are no locations where the Proposed Development causes a deterioration in air quality which exceeds recommended levels. Subsequently, the air quality assessment concludes no significant effects. The potential health impact during operation due to air pollution caused by energy facilities is therefore assessed to be **neutral**.		

Table 13-20 Access to Work and Training

Assessment Criteria	*Details and Evidence*	*Potential Health Impact*	*Further Action or Mitigation Recommended*
Does the proposal provide access to local employment and training opportunities, including temporary construction and permanent 'end-use' jobs?	Employment and income are among the most significant determinants of long-term health, influencing a range of factors including the quality of housing, education, diet, lifestyle, coping skills, access to services and social networks. Many epidemiological studies consistently show better health outcomes are associated with higher socio-economic status. **During Construction** Construction of the LNG Terminal will require a peak of approximately 200 workers and construction of each CCGT block will require a peak of between 300 and 350 workers (depending on whether construction of these blocks occurs separately or in phases). Overall, there is expected to be approximately 975 workers required onsite during the peak of the construction phase – between September 2023 and December 2023. Training will be provided to all employees in the construction workforce. There is also expected to be indirect jobs created in the supply chain to provide material, specialist labour and construction services for the workforce It is not possible to quantify the extent of the indirect employment created, however, it could increase employment created in the order of 40 to 50% of direct employment. The Proposed Development will therefore lead to employment and training opportunities and the potential health impact during construction on access to employment and training opportunities is assessed to be **positive**. **During Operation** During the operation period, there will be approximately 101 FTE workers required for the operation of the onshore receiving facility and the onshore Power Plant. There will also be an additional 51 persons onboard the FSRU and tugboats. Training will be provided to all employees in the workforce.	+ during construction + during operation	**During construction** None required **During operation** None required

Assessment Criteria	Details and Evidence	Potential Health Impact	Further Action or Mitigation Recommended
	The Proposed Development will lead to employment and training opportunities and the potential health impact during operation on access to employment and training opportunities is therefore assessed to be **positive.**		
Does the proposal include opportunities for work for local people via local procurement arrangements?	**During Construction** Construction of the Proposed Scheme will require a maximum of 975 workers onsite. While some of the construction personnel will be specialists who will travel from outside the area, it is intended that many of the jobs will be filled by personnel recruited locally, with appropriate training provided as necessary. The Proposed Development will therefore lead to employment opportunities for local people, as well as training, and the potential health impact on the local employment workforce is therefore assessed to be **positive**. **During Operation** There will be approximately 112 FTE workers required for the operation of the onshore receiving facility and the onshore Power Plant. There will also be an additional 51 persons onboard the FSRU and tugboats at all times. As far as practicable, these workers will be sourced from the local area and training opportunities will be available to them. The Proposed Development will therefore lead to employment opportunities for local people and the potential health impact on the local employment workforce is therefore assessed to be **positive**.	+ during construction + during operation	**During construction** Ensure opportunities are provided to the local workforce, to increase the scheme's local impact. **During operation** Ensure opportunities are provided to the local workforce, to increase the scheme's local impact.

Table 13-21 Climate Change

Assessment Criteria	*Details and Evidence*	*Potential Health Impact*	*Further Action or Mitigation Recommended*
Does the proposal incorporate renewable energy?	**During Construction** N/A **During Operation** The Proposed Development will generate Liquified Natural Gas (LNG) which is not a renewable energy source. However, the Proposed Development has a unique location and flexible design that can easily transition to alternative low carbon fuels, subject to future planning applications, once the technology and public policies are established. This capability has been acknowledged by the CRU in their July 7th contributions to the Oireachtas Committee on Environment and Climate Action. Ms MacEvilly said there was not necessarily a contradiction between building new gas infrastructure and quitting fossil fuels as it was expected that biomethane and green hydrogen would eventually replace natural gas in the supply chain. Commissioner Jim Gannon added: *"It's not beyond the bounds of commercial or technical possibility that gas terminals that will help us supply security and diversity of supply couldn't also be designed to be converted over time to using hydrogen."* As stated in Chapter 02, LNG supports the generation of renewable energy and without the Proposed Development Ireland will be required to import all of its natural gas from the United Kingdom. Furthermore, it is likely that, after the 28-year operational phase of the Proposed Development, the Power Plant will be transitioned to a hydrogen powered facility which will aid decarbonisation of the national grid. However, the impact of the Proposed Development on climate change during its initial 28-year operational phase is assessed in Chapter 15. The assessment states that operation of the Proposed Development will result in annual carbon emissions which will result in a major adverse climate effect. For example, emissions for the opening year for the plant running at maximum capacity are estimated at 1517 tCO2e and by 2050 these emissions are estimated to be 565 tCO2e. The potential health impact during operation due to the generation of GHGs leading to climate change is therefore assessed to be **negative**. However, the site will support the achievement of energy security for the	N/A during construction - during operation	During construction N/A During operation Ensure measures in the OCEMP related to climate change resilience are implemented accordingly.

Assessment Criteria	Details and Evidence	Potential Health Impact	Further Action or Mitigation Recommended
	country, by reducing reliance on the UK for gas supply, and by providing an alternative electricity supply to the typically intermittent electricity supply from wind power. It is important to note that the emissions associated with the Power Plant could reduce over time based upon projected running hours. Finally, the ability of the Power Plant to operate at a 50% blend of hydrogen by design, offers the potential for the Power Plant to become even more efficient in emission terms over the period to 2050 as and when the required policies and supply chains for hydrogen are implemented.		
Does the proposal maintain or enhance biodiversity?	**During Construction** Chapter 07B – Terrestrial Ecology assesses the potential impacts of the Proposed Development on terrestrial habitats, flora and fauna. During the construction phase, negative impacts are identified on numerous terrestrial and freshwater habitats, terrestrial mammals and fish due to due to loss of habitat, increased noise and disturbance, lighting and road traffic. Various measures are described to mitigate impacts on individual habitats and species. An Outline Construction Environment Management Plan (OCEMP) has been prepared (Appendix A2-4, Vol. 4) and emphases in particular the protection of habitats and species of the adjoining designated areas. A negative, significant, permanent residual impact is identified on the sedimentary sea cliffs, as well as a negative, significant and long term residual impact on badgers (at a local level). Given that all other residual impacts are not significant, and that the residual effects are not on habitats or species with which people do not directly or substantially	0 during construction 0 during operation	**During construction** N/A **During operation** N/A

Assessment Criteria	Details and Evidence	Potential Health Impact	Further Action or Mitigation Recommended
	interact, it is concluded that there is no overall human health impact and is assessed to be neutral. Chapter 07A - Marine Biodiversity assesses the potential impacts and effects of the Proposed Development on marine ecological features including habitats, marine mammals, fish and crustaceans. The marine elements of the Proposed Development overlap with the Lower River Shannon cSAC and the River Shannon and River Fergus Estuaries SPA. During construction, mitigation measures will be put in place to ensure the release of pollutants, and underwater noise, does not result in significant risk of impact to receptors. The release of spoil during piling, and seabed habitat loss, will not result in significant effects. Given this conclusion, and that these marine ecological features will not directly or substantially interact with people, it is concluded that there is no overall human health impact and is assessed to be neutral. **During Operation** Chapter 07B – Terrestrial Ecology identifies numerous potential negative impacts on various terrestrial habitats and species. The Proposed Development would operate 24 hours seven days a week and could give rise to light spill, noise or vibration and collision mortality effects. After mitigation, a negative, significant, and long-term impact on badgers at a local level is identified due to a loss of feeding territory. While this residual negative effect is acknowledged, given that residual impacts on all other terrestrial habitats and species are not significant, it is concluded that there is no overall human health impact and is assessed to be neutral. During operation, the potential for introduction of invasive species into marine environments will be managed by established protocols and biosecurity measures. Mitigation will also be put in place to reduce risk of accidental large scale oil or LNG spill. No significant effects are considered likely to result from underwater noise, seabed habitat loss, vessel physical disturbance and collision injury, or entrainment and impingement of fauna by the FSRU seawater system. The discharge of waste water and power plant process heated water effluent could affect water quality and therefore indirectly affect aquaculture activities; however it is concluded that no significant impact is likely. Given this conclusion and that these invasive species will not directly or		

Assessment Criteria	Details and Evidence	Potential Health Impact	Further Action or Mitigation Recommended
	substantially interact with people, it is concluded that there is no overall human health impact and is assessed to be neutral.		

13.6. Cumulative Impacts and Effects

This section assesses the potential impacts of the Proposed Development in combination with the potential impacts of other development schemes (referred to as ‘cumulative schemes’) within the surrounding area, as listed in Section 13.4.8 Baseline Environment.

13.6.1. Land Use

The Proposed Development results in a slight negative (not significant) impact on land use as detailed in Section 13.5.14 due to the loss of agricultural land and impacts on views from the Wild Atlantic Way. A number of the cumulative schemes also have potential to lead to loss of agricultural land and to negatively impact on views from the Wild Atlantic Way. This could lead to a negative cumulative impact on land use, though overall this impact is not considered likely to be significant.

13.6.2. Severance

The assessment of Severance is inherently cumulative as the traffic data which the assessment is based on includes the change in traffic generated by other committed developments. Cumulative impacts are therefore included in the assessment of severance in Section 1.4.

13.6.3. Employment

The construction phase of the Proposed Development is expected to generate employment. The construction phases of other committed developments are also expected to lead to employment and this could therefore lead to cumulative effects on employment in the local area. In the absence of commercially sensitive information relating to the construction costs and construction phasing of each of the committed developments, it is not possible to make a quantitative assessment of the employment likely to be generated from the construction stage of the other development schemes. However, it is expected that there will be a positive cumulative impact on construction related employment within the local area.

13.6.4. Human Health

The cumulative assessment of ‘Access to Healthcare Services and other Social Infrastructure’ is as per the cumulative assessment of ‘Severance’ set out above and the cumulative assessment of ‘Access to Work and Training’ is as per the cumulative assessment of ‘Employment’ set out above.

For the assessment of ‘Air Quality, Noise and Neighbourhood Amenity’, there are no anticipated cumulative noise or dust effects during either the construction or operational phase. Chapter 08 – Air Quality provides a cumulative assessment of the impact of the Proposed Development’s emissions during the operational phase together with potential emissions from the Moneypoint and Tarbert Power Stations. It finds that, even with the increased Predicted Environmental Concentration (PEC) of pollutants due to the inclusion of these emissions, the air quality remains well above air quality standards and therefore the slight and moderate effects which the Proposed Development leads to (see Section 1.4) remain not significant. Chapter 07B – Terrestrial Ecology and Chapter 07A - Marine Biodiversity identify no significant cumulative effects on relevant features, assuming works are appropriately phased and planned as proposed and best practice standard construction environmental measures are implemented.

The assessment of ‘Climate Change’ is based on the Greenhouse Gas emissions assessment provided in Chapter 15 – Climate. The GHG assessment is by nature a cumulative assessment as it considers whether the Proposed Development will contribute significantly to emissions on a national level. By comparing the Proposed Development against the national GHG inventory, as being representative of the global climate, the cumulative impact of the scheme is being considered on a national scale.

13.7. Residual Impacts

13.7.1. During Construction

Construction of the Proposed Development will lead to a **slight negative effect** on land use due to the loss of agricultural land currently used for grazing and impacts on views experienced by users of the Wild Atlantic Way. It will also lead to a **slight positive effect** on the local employment workforce due to the number of construction workers required and the resulting job opportunities. It will also lead to an **imperceptible negative effect** on severance between the local population and the services which they frequently use due to construction traffic travelling to and from the Proposed Development site.

The Proposed Development will also lead to the following impacts on human health during the construction phase:

- A **negative** human health impact due to the presence of construction traffic leading to nuisance and noise level increases at residential properties on the L1010 and Church Street in Tarbert.
- A **positive** human health impact due to the workforce required to construct the Proposed Development leading to increased accessibility to employment opportunities and training for the employment workforce in the local and wider community. Employment and income are among the most significant determinants of long-term health and so this project could improve the socio-economic circumstance and therefore the health and wellbeing of the workforce.

13.7.2. During Operation

Operation of the Proposed Development will lead to a **slight negative effect** on land use due to the loss of agricultural land currently used for grazing and impacts on views experienced by users of the Wild Atlantic Way. Operation of the Proposed Development will lead to a **slight positive** effect on the local employment workforce due to the number of construction workers required.

The Proposed Development will also lead to the following impacts on human health during the operation phase:

- A **positive** human health impact due to workforce required to operate the Proposed Development leading to increased accessibility to employment opportunities and training for the employment workforce in the local and wider community; and
- A **negative** human health impact due to the impact of the Proposed Development on GHG emissions and climate change.

Table 13-22 Summary

Proposed Development Stage	Aspect/Impact Assessed	Existing Environment/Receptor Sensitivity	Effect/Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance
Construction	Land Use – negative impacts due to loss of agricultural grazing land and on views from Wild Atlantic Way	Low	Slight	Slight	Mitigation and monitoring measures relating to visual impacts are detailed in Chapter 10 – Landscape and Visual Impacts.	Slight
Construction	Severance	n/a	Negligible	Imperceptible	Mitigation and monitoring measures relating to construction traffic (e.g. relating to traffic routing) are to be detailed in the Construction Traffic Management Plan prepared by the appointed contractor.	Imperceptible
Construction	Employment	n/a	Moderate	Moderate	None required	Moderate
Construction	Human Health – negative nuisance and noise impacts due to the presence of construction traffic.	n/a	n/a	n/a	Mitigation and monitoring measures are detailed in Chapter 09 – Airbourne Noise and Groundbourne Vibration, Section 9.8.1.	n/a
Construction	Human Health – positive employment and training impacts.	n/a	n/a	n/a	Ensure opportunities are provided to the local workforce, to increase the Proposed Development's local impact. See Section 2.12 of Chapter 02 – Project Description.	n/a
Operation	Land Use – negative impacts due to loss of agricultural grazing land and on views from Wild Atlantic Way	Low	Slight	Slight	Mitigation and monitoring measures relating to visual impacts are detailed in Chapter 10 – Landscape and Visual Impacts.	Slight
Operation	Employment	n/a	Slight	Slight	None required	Slight
Operation	Human Health – positive employment and training impacts.	n/a	n/a	n/a	Ensure opportunities are provided to the local workforce, to increase the Proposed Development's local impact.	n/a
Operation	Human Health – generation of GHGs leading to climate change.	n/a	n/a	n/a	Embedded mitigation measures to reduce GHG emissions are set out in Chapter 15 – Climate, Section 15.9.	n/a

13.8. References

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CHAPTER 14
Major Accidents and Disasters

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park
Environmental Impact Assessment Report

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14. Major Accidents and Disasters

14.1 Introduction

This chapter describes the potential Major Accidents and Disaster (MA&D) scenarios which are pertinent to the Proposed Development, taking into consideration the materials, operations and location of the Proposed Development and associated facilities.

This chapter contains an overview of the regulatory requirements to identify and assess major accidents and disasters. The methodology for identification of such is initially by consideration of the substances which will be present onsite, and which have the potential for major accident, by virtue of their chemical or physical properties. Substances which have the potential to initiate and/ or contribute to a major accident will be identified within this chapter for qualitative assessment.

The potential for natural disasters such as flooding and seismic events is primarily determined by the location of the facilities.

14.2 Competent Expert

This assessment has been undertaken by Alison Couley, Associate Director Process Safety, BEng (Hons) Chemical Engineering with Energy Resource Engineering. Alison has over 25 years' experience in Process Engineering and Process Safety Consultancy and is a Chartered Chemical Engineer (CEng) and Member of the Institution of Chemical Engineers (MIChemE).

Alison has worked on the process engineering design and operation of facilities within the chemicals, power, upstream and downstream oil and gas processing industries. Since 1999, Alison has worked as a Process Safety consultant and has been responsible for facilitating numerous hazard identification and risk assessment studies for clients including Upper Tier COMAH Installations, which require detailed assessment of safety and environmental hazards. This experience and knowledge is directly applicable to the identification of MA&Ds within this EIAR.

14.3 Regulatory Overview

An EIAR is defined in the EIA Regulations (Government of Ireland, 2018) as:

'*A statement of the effects, if any, which proposed development, if carried out, would have on the environment*'.

Specifically:

'*The significant effects to be identified, described and assessed include, where relevant, the expected significant effects arising from the vulnerability of the proposed development to major accidents or disasters that are relevant to that development*'.

'*A description of the expected significant adverse effects of the development on the environment deriving from the vulnerability of the development to risks of major accidents and/ or disasters, which are relevant to the project concerned'.*

An assessment of the risk of MA&D relevant to the Proposed Development is therefore required to inform decision making on the project, to ensure a high level of protection is incorporated in the design of the project and that appropriate emergency policies and procedures are prepared for the Proposed Development.

This assessment is a preliminary review, based on the current engineering design, drawings and documentation.

Further detailed hazard and risk analysis studies will be carried out throughout the project lifecycle. The engineering design of the project will be subject to formal process safety risk assessments, such as Hazard Identification (HAZID), Hazard and Operability (HAZOP) and Layers of Protection Analysis (LOPA) at the appropriate project/ design stage(s). The purpose of these studies is to subject the design to a rigorous, structured assessment by suitably qualified, experienced people, to identify potential hazards. These hazards can then be subject to analysis to identify measures to manage the hazards and to reduce the level of risk.

14.4 Overview of Proposed Development

A detailed description of the Proposed Development is contained in Chapter 02 of the EIAR and the following section lists the key features.

The facilities associated with the Shannon Technology and Energy Park include the Liquefied Natural Gas (LNG) Terminal and the Power Plant, which are summarised as follows:

- The proposed LNG Terminal will consist of:
  - A floating storage and regasification unit (FSRU), which will have an LNG storage capacity of approximately 170,000 m^3 (up to 180,000 m^3). The LNG vaporisation process equipment to regasify the LNG to natural gas shall be onboard the FSRU. The heat for LNG regasification shall be via seawater, supplemented by heat from gas fired heaters when the water temperature is inadequate. Loading of LNG onto the FSRU shall be via a ship to ship transfer from another LNG carrier (LNGC) berthed alongside.
  - Jetty and access trestle, with the jetty comprising of an unloading platform, mooring dolphins and breasting dolphins.
  - Infrastructure to accommodate four tugs moored on the proposed jetty for FSRU and LNGC mooring operations.
  - Onshore facilities including a nitrogen generation facility, a control room, a guard house, workshop and maintenance buildings, instrument air generator and fire water system.
  - An Above Ground Installation (AGI) to include an odourisation facility, gas heater building, gas metering and pressure control equipment. The AGI facilitates the connection of the LNG Terminal to the consented 26 km Shannon Pipeline.
  - It is standard practice for safety reasons to add an odorant to natural gas, as this substance has little or no smell. The gas will therefore be odorised so that any natural gas leaks are detectable by human beings. The odorisation tanks, associated pipework, and control systems will be provided to inject carefully controlled amounts of odorant into the natural gas at a rate to ensure compliance with GNI and statutory requirements (typically 6 milligrams of odorant per cubic metre of gas). The odorant storage and injection system will include bulk storage tanks containing Odourant NB liquid, which will be held under a nitrogen gas blanket.
- The proposed Power Plant will comprise of:
  - A flexible modular Power Plant design with three (3) blocks of Combined Cycle Gas Turbines (CCGT), each block with a capacity of approximately 200 MW for a total installed capacity of up to 600 MW. The multishaft arrangement of the Power Plant provides fast acting response with very low minimum stable generation and is ideally suited to support increased intermittent renewable generation.
  - Each block will comprise of two (2) gas turbine generators, two (2) heat recovery steam generator and one (1) steam turbine generator and an air-cooled condenser.
  - A 120 MW for 1 hour (120 MWhr) Battery energy storage facility (BESS). Due to its very fast response, the BESS supports intermittent renewable generation.

Figure 14-1 shows the layout of the onshore facilities.

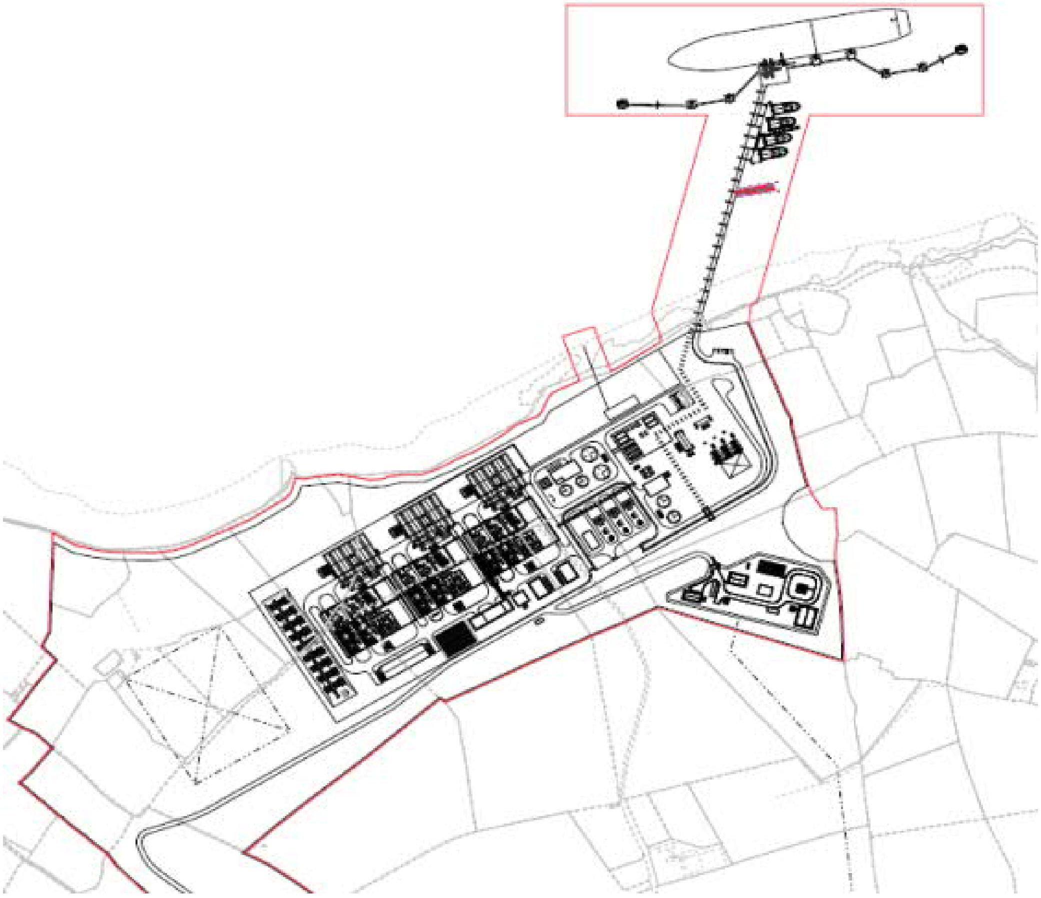

Figure 14-1 Onshore Facilities Layout

Bulk storage of LNG is within the FSRU and LNGC, there is no bulk storage of LNG or natural gas onshore. The FSRU is connected to the jetty via hydraulically operated unloading arms and a team of trained and experienced personnel will operate the facilities. Personnel will be based both onshore and on the FSRU.

The FSRU will be moored at the jetty head, which comprises a concrete unloading platform with mooring dolphins. An access trestle connects the jetty head to the onshore facilities.

The planning application boundary of the Proposed Development is shown by the red line in Figure 14-1. The quantity of LNG and natural gas present within this boundary has been assessed to be above the Upper Tier qualifying threshold at which regulation under the Chemicals Act (Control of Major Accident Hazards (COMAH) involving Dangerous Substances) Regulations 2015, S.I. 209, will apply. Compliance with the COMAH Regulations places a number of duties on the operators of installations. These include the preparation and submission of a detailed COMAH Safety Report.

Consultation with the HSA has been ongoing throughout the design development of the Proposed Development. COMAH notifications and documentation will be submitted for regulatory review at the appropriate juncture.

The COMAH Safety Report will include a detailed description of the technical standards used in the design of process, mechanical, electrical and civil engineering equipment and structures. These include International and European standards such as:

- EN 1473: Installation and equipment for liquefied natural gas - Design of onshore installations.

This European Standard gives guidelines for the design, construction and operation of all onshore liquefied natural gas (LNG) installations for the liquefaction, storage, vaporization, transfer and handling of LNG.

- BS EN ISO 28460: Petroleum and natural gas industries. Installation and equipment for liquefied natural gas. Ship-to-shore interface and port operations.
- The National Fire Protection Association (NFPA) suite of Recommended Practise (RP) documents, specifically NFPA 850: RP for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations.
- ISGOTT; International Safety Guide for Tankers and Terminals.
- Lloyds Register: Rules for the Classification of Ships for the Carriage of Liquefied Gases in Bulk; and
- Institution of Gas Engineers and Managers suite of standards, including IGEM/ SR/ 16 Edition 2 - Odorant systems for gas transmission and distribution.

14.4.1 Site Location

The Proposed Development is located on a site adjacent to the Shannon Estuary, between Tarbert and Ballylongford in Co. Kerry. The Proposed Development site is zoned as industrial by Kerry Co. Council (Kerry County Development Plan 2015 – 2021) and is owned by Shannon Commercial Enterprises DAC (formerly Shannon Free Airport Development Company Limited) having its registered address at Shannon Airport, Co. Clare. Shannon LNG has entered into an agreement for the purchase of the lands.

The Proposed Development site is located approximately 4.5 km from Tarbert and 3.5 km from Ballylongford in Co. Kerry. This area is characterised by predominantly improved grassland in an agricultural setting. Field boundaries predominantly consist of hedgerows with small drainage ditches. A small section of the Ralappane Stream which runs in a north westerly direction, discharging into the Shannon Estuary, is located in the most southern part of the site. The L1010 (Coast Road) is located to the south of the Proposed Development site.

There are a small number of residential properties located within 500 m of the onshore facilities and additional residential properties located along the L1010.

The nearest COMAH Establishments to the Proposed Development site are as follows:

- Tarbert Power Station which is an Upper Tier COMAH installation located approximately 5 km to the north east of the site,
- Moneypoint Power Generating Station which is an Upper Tier COMAH installation located on the northern shore of the Shannon Estuary, approximately 3 km to the north of the site.
- Shannon Airport Authority, fuel storage facility is an Upper Tier COMAH Installation, located approximately 60 km to the northeast.
- A Lower Tier COMAH Installation, Enva Ireland Ltd is also located approximately 60 km to the northeast, at Smithstown Industrial Estate near Shannon Airport.

Tarbert and Moneypoint power plants are scheduled to be decommissioned within the next 5 years. There are no other Upper Tier COMAH sites or significant industrial establishments within the area of the Proposed Development, therefore no potential domino effects have been identified. A domino effect is defined in the COMAH Regulations is an accident which occurs at a facility which can be the source of a major accident or increase the risk or consequences of a major accident at the Proposed Development.

There is no local Fire station within the environs of the Proposed Development. A firewater system will be installed within the Proposed Development including fire water storage and fire pumps. Additional mobilisable resources such as fire tenders will be considered along with provision of specialist training to site personnel.

There are a number of designated environmental sites in the area of the Proposed Development, including the Lower River Shannon Candidate Special Area of Conservation (cSAC) which is adjacent to the Proposed Development site, along the northern/ north-western boundary and also along part of the eastern boundary. The Ballylongford Bay proposed Natural Heritage Area (pNHA) is adjacent to a part of the north-western boundary of the Proposed Development site. The Lower River Shannon cSAC and the River Shannon and River Fergus Estuaries Special Protection Area (SPA) extend along the north-western shoreline boundary of the Proposed Development site. These sites are identified within Figures F7-1 and F7-2 in Volume 3.

The proposed jetty extends into the Lower River Shannon cSAC and the River Shannon and River Fergus Estuaries SPA.

The Proposed Development is not located within a groundwater drinking water source protection area. A search of the Geological Survey of Ireland well records found no springs and a relatively small number of low-yielding groundwater abstraction wells recorded between 1 and 2 km from the Proposed Development site. These groundwater abstractions are likely to be wells serving single houses or farms and all are hydraulically up gradient of the Proposed Development site and therefore are unlikely to be impacted by the Proposed Development.

A number of surveys and test trench excavations have been carried out to inform previous planning applications on lands owned by Shannon Commercial Enterprises DAC which includes the Proposed Development site. The surveys and test trenches were carried out to assess the presence of areas of archaeological potential. A ringfort (fortified settlement dating approximately to the Bronze Age) has been identified. These sites are constructed from earth and stone, and largely buried, therefore they are not considered to be vulnerable to the potential major accidents and disasters pertinent to this Proposed Development.

The Proposed Development will source local materials such as rock and stone for use during construction, with materials such as concrete and tarmac also being used. Lime and concrete (specifically, the cement component) is highly alkaline and any spillage which migrates through subsoil could impact groundwater quality, therefore a Construction Environmental Management Plan (CEMP) will be produced for the construction stage (See Outline Construction Environmental Management Plan (OCEMP) in Appendix A2-4 of Volume 4) and will incorporate measures for safety and environmental protection during the construction of buildings, pipelines and concrete structures such as pavements and culverts.

The jetty platform has been set at an elevation of +9 m Ordinance Datum (above sea level), to be clear of extreme water levels and waves and will be aligned in the direction of the prevailing wind and tidal stream. Detailed monitoring and modelling has been carried out in a Coastal Modelling Report to assess the current speeds, water levels and wave conditions at the jetty location (Moffat & Nichol, 2020).

The onshore operational equipment will be enclosed within a security fence provided with pedestrian and vehicular access. The AGI compound will be remotely operated and normally no personnel will be present in this area.

The drainage system has been designed so that all stormwater will be collected and discharged, where possible, to existing streams/ drainage ditches, or discharge directly to the Shannon Estuary via a discharge pipe that will extend across the foreshore to below the low water mark. All drainage falling on paved surfaces will pass through A Class 1 hydrocarbon interceptor which will be installed upstream of the discharge to the Shannon Estuary. This interceptor will collect any accidental spills of fuels or oils used in vehicles or ancillary equipment.

Spill kits will be located at strategic points around the Proposed Development. If used, these will be disposed of via a licenced waste disposal contractor and in accordance with all relevant EU and Irish waste management legislation (i.e. the Waste Management Acts 1996 – 2011 and any regulations made thereunder, and the Waste Framework Directive).

The EPA Guidance Note ‘Storage and Transfer of Materials for Scheduled Activities’ shall be taken into account when designing material storage and containment onsite.

14.5 Methodology

14.5.1 Potential Hazards

The potential hazards associated with substances present at the Proposed Installation which are described in Table 14-1 and have the potential for a major accident are summarised in the following section. All the identified hazards listed below require a loss of containment to occur, such as catastrophic damage or failure of pipework or equipment.

- Fire:
  - Flash Fire: A flash fire can occur following a loss of containment of flammable liquid, vapour or gas which results in a flame which passes through the mixture at less than sonic velocity such that explosion overpressures are negligible. A flash fire may be caused by releases at high or low pressure into an open, unconfined area which contacts an active source of ignition.
  - Jet Fire: A jet fire can occur following a loss of containment of high pressure gas, liquid or vapour released via a source such as a leak or failure of flanged pipework joints, pipework or another asset which contacts an active source of ignition.
  - Pool Fire: A pool fire involves the combustion of vapour from a pool of flammable liquid. It may occur within a clearly defined boundary or be unconfined. Flames generated by a pool fire are often accompanied by quantities of smoke with both flames and smoke orientated downwind.
- Explosion:
  - Vapour Cloud Explosion (VCE): A loss of containment of flammable gas or vapour which does not ignite immediately may form a cloud of flammable material depending on the conditions of the release. If this cloud enters an area of confinement and contacts an active source of ignition, a VCE can result and generate potentially harmful overpressures.

    Overpressures generated by explosions are related to the degree of confinement or congestion in the area in which the material is released. For example, in complex industrial structures with a lot of pipework and equipment in close proximity, the pressures generated are much larger than in open areas, due to the effect of these structures accelerating and/ or reflecting the pressure wave.
  - Boiling Liquid Expanding Vapour Explosion (BLEVE): A BLEVE can occur if a storage vessel containing a flammable liquid held under pressure is heated to a temperature above its boiling point, for example, by exposure to a fire, which eventually causes the vessel to rupture. Material released from the vessel will likely ignite, resulting in a fire and potentially harmful overpressures.
  - Rapid Phase Transition (RPT): This can occur following a loss of containment of LNG which rapidly vaporises on contact with the ground or water, releasing large amounts of energy causing potentially harmful overpressures.
- Major Accident to the Environment:
  - A loss of containment of liquids such as fuel oils which are accidentally released to water, land and/ or groundwater in significant quantities can cause harm to the environment.

Quantitative Risk Assessment (QRA) including consequence modelling carried out for the Proposed Development has analysed these hazards in greater detail. The results of this modelling have demonstrated that flash and jet fires are credible scenarios for accidental releases of LNG and natural gas, however explosion overpressures were determined to be negligible, as potential release points are in open, well ventilated areas.

A release of diesel has the potential for a pool fire if a loss of containment were to occur. The only material with the potential for a BLEVE is the odourising chemical, injected into natural gas for safety reasons.

Substances which if accidentally released have the potential to harm to the environment include diesel, marine fuel oils, black and grey water effluent generated onboard the FSRU and LNGC. Fire water which may or may not contain foam along with products of combustion may also have the potential to cause harm to the environment in the event of a loss of containment from the dedicated retention area following a fire.

A detailed description of the properties of these substances and an assessment of their potential hazards is contained in Section 14.7.

14.5.2 Definitions

For this purposes of this assessment, the definition of a MA&D is taken to be that which is contained within Article 3 of the Seveso Directive as enacted in Irish law by Regulations (Government of Ireland, 2015), which is as follows:

'*A 'major accident' means an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment covered by this Directive and leading to serious danger to human health or the environment, immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances.*'

The impact of major accidents can be significant, with the potential to effect people both on and offsite, assets and property on and offsite, and the surrounding environment.

Disasters can be naturally occurring events, such as earthquakes, landslides and flooding or can be caused by humans, such as fires and explosions.

Both natural and human causes are considered in this assessment to determine the potential impact on:

1. Population and human health, including persons employed at the Proposed Development and in the local community.
2. Biodiversity, with particular attention to species and habitats protected under Directive 92/ 43/ EEC for the protection of habitats/ flora/ fauna (EU, 1992) and Directive 2009/ 147/ EC for the protection of birds (EU, 1992).
3. Land, soil, water and groundwater, air and climate; and
4. Material assets, cultural heritage and the landscape.

14.6 Assessment Methodology

The substances associated with the Proposed Development, which are potentially dangerous and could therefore be a credible source of Major Accident Hazard (MAH) during the lifecycle of the development, are described in Table 14-1.

Substances are generally classified in accordance with the Classification, Labelling and Packaging (CLP) Regulations (EC, 2008). This is a harmonized system of identifying the hazardous properties of materials, for example those which are flammable, toxic and harmful to the environment. Where substances are not classified by CLP, for example, wastes, the general characteristics are considered in order to determine the potential for a Major Accident Hazzard (MAH).

This assessment considers the potential interactions of substances present on the FSRU and onshore areas of the Proposed Development, which could potentially create harmful materials or the release of energy.

Where substances are identified as being dangerous by their properties, the means by which they could result in harm is then considered. Where there is the potential for a MAH, this is identified for further assessment, which is contained in Table 14-2.

Where a major fire and/ or explosion could cause harm both on and offsite, this would be considered as a MAH. This aligns with the criteria for the notifiable incident referred to in Regulation 20 the COMAH Regulations, which is a fire involving a dangerous substance that may result in suspension of normal work in the establishment for more than 24 hours (Government of Ireland, 2015).

If a release of a dangerous substance resulted in significant damage to the environment or property, this would be considered an MAH. The Guideline on Environmental Risk Tolerability for COMAH Establishments (CDOIF, V2 March 2016) contains information on the severity of harm at sensitive receptors resulting from accidents which might be considered to be a Major Accident to the Environment (MATTE). This guidance has been taken into consideration in the review of releases within Table 14-1.

As the Proposed Development will be required to notify as a COMAH site, the principals of the COMAH Regulations have been used to identify and assess scenarios which could result in a MAH or MATTE. These principals present a clear and robust methodology for facilities where substances such as natural gas are present.

The vulnerability of the Proposed Development to natural disasters such as flooding, earthquakes and the impact of climate change is substantially dependant on location. These factors are considered/ assessed in Table 14-3.

Table 14-1 Dangerous Substances and Major Accident Hazard (MAH) Screening Assessment

Substance	Description	Hazard Classification and Description	Screening and Identification of Potential MAH	Included in Assessment (Y/ N)
LNG	LNG (hydrocarbon mixture predominantly methane) stored within FSRU and LNGC moored at jetty.	Extremely flammable gas (Hazard Code H220). Liquefied gas (Hazard Code H281). An accidental release of LNG from the FSRU/ LNGC could result in a fire if ignited.	A release of LNG from the FSRU could ignite and result in a fire potentially causing harm to people onboard the FSRU, LNGC and at the jetty. The potential for an explosion following a release of LNG has been assessed using QRA modelling and the overpressures generated were determined to be negligible due to the low degree of confinement. There is the potential to cause harm to the environment in the event of a major fire, for example - via damage to the FSRU and LNGC resulting in a release of fuel or other fluids stored onboard, - a release of firewater which could contain foam and other substances used for fire suppression along with products of combustion, and - thermal radiation causing harm to flora/ fauna. A fire scenario could therefore be a MAH/ MATTE and is considered further in Table 14-2.	Y

Substance	Description	Hazard Classification and Description	Screening and Identification of Potential MAH	Included in Assessment (Y/ N)
Sodium Hypochlorite (Generated by treatment of abstracted seawater)	Seawater used to regasify LNG will be subject to treatment onboard the FSRU to prevent biological fouling of the vaporising equipment. Without treatment, these systems would frequently become blocked and inoperable. An electrolysis system will be installed on the FSRU to protect the regasification system. These units are used extensively in industrial applications onboard vessels and in the offshore industry. Using this system prevents bulk storage of liquid-based chemicals being required for this purpose onboard the FSRU.	Within these systems, an electric current is passed through a tank of seawater which generates a small amount of sodium hypochlorite which is then dosed into water used for regasification. Seawater discharged from the regasification system will be monitored to ensure the concentration of sodium hypochlorite does not exceed permitted limits. Released material will be rapidly dispersed in the estuary.	Hypochlorite generation is a proven, reliable technology which produce small quantities of sodium hypochlorite. In the event of an accidental release to the estuary, the quantities which could be generated onboard the FSRU will be insufficient to cause harm to the environment due to rapid dilution and dispersion, therefore would not result in a potential MAH/ MATTE.	N
Natural Gas	Gaseous hydrocarbon mixture, predominantly methane. Natural gas is present downstream of regasification unit onboard the FSRU to the distribution pipeline and to the Power Plant. Natural gas may also be present on the LNGC in the event that LNG is released for safety purposes such as emergency venting. In the event of emergency depressurisation being required, the gas would be vented at a safe location where it would be dispersed by natural ventilation.	Extremely flammable gas (Hazard Code H220). An accidental release of natural gas from FSRU, LNGC or onshore systems, such as pipework connections, could result in a fire if ignited. The potential hazards of new gas pipework onshore are identical to the current pipeline infrastructure of GNIs gas transmission network for the movement of natural gas fuel around Ireland.	Onshore gas pipework above ground is located in an open, well ventilated area. An accidental release of natural gas could ignite and result in a jet or flash fire potentially causing harm to people in the immediate area. The potential for an explosion following a release of natural gas has been assessed using QRA modelling and the overpressures generated were determined to be negligible due to the low degree of confinement. Firewater may be applied to cool equipment and prevent the escalation of a fire to other areas. Firewater will be contained within a firewater impoundment basin, however there is the potential for harm to the environment from the fire, as a direct result of thermal radiation or soot deposition on flora and fauna. Consequently, this scenario could be a MAH/ MATTE and is therefore considered further in Table 14-2.	Y

Substance	Description	Hazard Classification and Description	Screening and Identification of Potential MAH	Included in Assessment (Y/ N)
Odorant NB	Natural gas/ methane do not have an odour. Consequently, as a safety precaution, so as to identify leaks primarily in consumer appliances and piping, an Odorant NB is added to the natural gas before distribution. This is a requirement of the grid operator. Odorant NB is a mixture of tertiary butyl mercaptan (78-82%) and dimethyl sulphide (18-22%)[1]. Odorant NB is a liquid and is stored onshore within two bulk tanks, each of 22.7 m^3 capacity. The liquid is stored under a nitrogen gas blanket at a pressure of 2 barg.	Highly flammable liquid (Hazard Code H225). Toxic to the aquatic environment (Category 2) (Hazard Code H411). Also, classified as an irritant (H319) and Skin Sensitizer (H317). An accidental release of odorant from onshore storage systems could result in a fire and/ or explosion (BLEVE) if vapour released following failure of the vessel was in contact with a source of ignition. For the failure of a vessel to occur leading to a BLEVE, heat input via direct jet fire impingement or a liquid pool fire below the storage tank p be required. An accidental release of this liquid which enters the environment, has the potential for harm to aquatic systems.	Gas chromatography systems will be installed to continuously analyse the composition of natural gas, ensuring that the concentration of odorant is at the appropriate set point. Alarms will be installed to provide a warning should the concentration deviate from this. The equipment used to inject odorant into the gas stream would be controlled and monitored by instrumentation and end elements which have been subject to Safety Integrity Levels (SIL) assessment to determine the required reliability. This material purposefully has a very low odour threshold (i.e. is very odorous) therefore there is the potential to cause a nuisance or distress to local residents in the event of minor accidental leaks, who may believe this to be odorized natural gas. Odourant is classified as flammable and harmful to the environment, therefore a scenario in which this is released accidentally could potentially be a MAH and/ or MATTE and is therefore considered further in Table 14-2.	Y

[1] 50102216-TN03: Assessment of Odorant Facility Lloyds Register April 2013

Substance	Description	Hazard Classification and Description	Screening and Identification of Potential MAH	Included in Assessment (Y/ N)
Diesel Fuel	Liquid hydrocarbon mixture, predominantly kerosene. Diesel will not be used as a source of secondary fuel in the Power Plant, therefore small quantities only will be present in the following equipment installed at the Proposed Development. The typical quantities of diesel will be as follows: • Blackstart generator: 3.2 m^3 tank. • Emergency power generator (backup Power Plant in case of electricity loss): 3.2 m^3 tank. • LNG firefighting standalone fire water pumps: 2 m^3 tank. • Power Plant firefighting standalone fire water pumps 1.4 m^3 tank. During construction, there may be small quantities of diesel present in temporary equipment such as mobile cranes and mobile power generators.	Flammable liquid and vapour (Hazard Code H226). Toxic to the aquatic environment (Category 2) (Hazard Code H411). Toxic if inhaled (H332) and Skin Sensitizer (H315). An accidental release of diesel could result in a pool fire. If diesel enters the environment, there is the potential for harm.	Bulk diesel will be stored in fully bunded tanks (110% containment) either offered by an integral bund (i.e. double skin) or exterior containment (i.e. civil bund infrastructure). In the event of an accidental leak or spillage of diesel, material will be retained onsite within bunds and containment systems (i.e. fuel interceptors), preventing material from being released to the environment. In the event of a fire within areas where diesel is present, the material would be combustible. Un-combusted material present in firewater runoff will be contained within site drainage systems, which are fitted with interceptor(s) to facilitate the recovery of oils. Taking into consideration the above factors and the relatively limited quantities of diesel onsite, this substance is not considered to have the potential to be a MAH and/ or MATTE.	N

Marine Fuel Oil (MFO)	The type of fuel which will be used in the FSRU and LNGC has not yet been confirmed, however this is likely to be MFO. Other fuels are available such as Heavy Fuel Oil (HFO) and LNG to power ships' systems. MFO is a liquid hydrocarbon mixture, predominantly kerosene. MFO is stored onboard the FSRU and LNGC in fuel tanks, typical quantities present could be approximately 600 tonnes.	Hazardous properties of MFO are similar to diesel. An accidental release of MFO could result in a pool fire and if this liquid enters the environment, there is the potential for harm to aquatic systems.	Preventing oil spills from the FSRU and LNGC is the responsibility of the ship's crew. In the event of accidental spills or leaks, there is a significant quantity of MFO which could be released to the estuary, there is therefore the potential for a MAH. The FSRU and LNGC will comply with the International Maritime Organization (IMO) convention for the prevention of pollution (MARPOL, 1973), Annex I which entered into force in 1983. This annex covers requirements for management of oil onboard including monitoring and control systems and the production of a Shipboard Oil Pollution Emergency Plan (SOPEP). An emergency spill response plan(s) will also be developed by the Harbour management organisation in consultation with managers of the Proposed Development, including maintenance of a stock of emergency equipment such as absorbent booms. Oil Spill Response Plans (OSRP) for the FSRU and LNGC will be developed and will comply with the National Contingency Plan for Oil and HNS Spills 2019. The FSRU and LNGC will contain other substances, such as grey water, which could be slightly contaminated with oils/ MFO. This could be potentially harmful to the environment, however the concentration of pollutants such as oils in grey water will be low. Consequently, a release of pure MFO from the FSRU or LNGC, through loss of primary containment represents a 'worst case' potential MAH/ MATTE scenario and is therefore considered further in Table 14-2.	Y

Substance	Description	Hazard Classification and Description	Screening and Identification of Potential MAH	Included in Assessment (Y/ N)
Black Water / Grey Water/ Ballast Water	Black, Grey and Ballast water can contain pollutants such as biological matter and are stored onboard FSRU and LNGC within dedicated tanks.	Black water consists of material from toilet facilities. Grey water is effluent generated by hand washing and showers. An accidental release of grey water, which enters the environment, could result in harm to aquatic systems. Ballast is the fluid used onboard the FSRU and LNGC to provide stability. Ballast water discharge may contain biological materials which if released, may be harmful to the environment.	Releases of ballast, grey and black water are controlled via the regulations established in Annex IV of the MARPOL convention which entered into force on 27th September 2003. MARPOL specified equipment requirements include the provision of a sewage treatment plant or disinfection systems, compliant with standards and test methods established by the IMO. Locations where the vessel can safely discharge the treated material are specified in Annex IV. Whenever the ships are in port, all black and grey water will be retained onboard and discharged ashore via vacuum lorry for safe treatment and disposal. Seawater will be taken in through seawater intakes as ballast water on the FSRU during regasifying operations and released back to the estuary during LNG loading as required. Visiting LNG carriers will not need to discharge ballast water locally; however they may take on seawater as ballast as they unload their cargo. Consequently, a release of black, grey or ballast water from the FSRU is not considered a potential MAH/ MATTE scenario.	N

Substance	Description	Hazard Classification and Description	Screening and Identification of Potential MAH	Included in Assessment (Y/ N)
Concrete	Construction material, which is applied as a paste, comprising sand aggregates and other additives.	Concrete is not classified by CLP; however, concrete paste is alkaline (pH 10-14) and therefore harmful to people if in contact with skin or eyes. If concrete enters the environment via a release to water, it can raise the pH causing harm to aquatic ecosystems. Concrete released to the environment can also cause sedimentation on aquatic beds, which could harm flora and fauna.	During construction, concrete use will be strictly controlled to prevent any wet material from entering the environment. This will be established in a CEMP produced for the Proposed Development, containing the appropriate control measures. In the event of a fire, the pH of water applied to areas where dry concrete is present may increase slightly, however firewater will be contained within the firewater impoundment basin and would not enter the environment. Consequently, no credible MAH/ MATTE scenarios are identified for concrete.	N
Nitrogen	Nitrogen is an inert gas generated onshore. A small quantity of nitrogen will be continuously injected into the natural gas pipeline in accordance with the GNI gas specification requirements. Nitrogen will also be used as a blanketing gas for the odorant storage vessel(s). Nitrogen will also be used during maintenance operations to purge equipment and pipework.	Nitrogen is not classified as dangerous but can be harmful to people if a release occurs within confined, unventilated areas.	Nitrogen gas generation systems will be located in external, well ventilated areas and therefore an accidental release would disperse readily. There will be no impact on people, or the environment, and therefore a loss of nitrogen containment would not be a MAH. Gas cylinders are not expected to be permanently present onsite, but a small number may be used as a back-up to the main nitrogen generator. Gas cylinders may explode if exposed to fire, however their use will be carefully controlled and when not in use, housed in storage cages for safety. Consequently, no credible MAH/ MATTE scenarios are identified for nitrogen.	N

Substance	Description	Hazard Classification and Description	Screening and Identification of Potential MAH	Included in Assessment (Y/ N)
Hydraulic Fluids/ Lubrication Fluids	Hydraulic fluids are synthetic oils present in the hydraulic sections of the loading arms at the jetty. Lubrication fluids are also typically synthetic oils which will be present in various items of equipment, particularly in the Power Plant which contains turbines, pumps and compressors.	Hydraulic and lubrication fluids are not classified by CLP and whilst they may be combustible, they are not generally categorised as flammable. If released to water, they could be harmful to the environment by rapidly forming a film on the surface of water and/ or land.	The quantity of hydraulic fluids contained in jetty systems such as those which will be installed at the Proposed Development is relatively low, typically less than 1 tonne will be expected. A release of this substance will be rapidly detected by site operations. The leak would be isolated, and any material released would be contained using marine booms for collection and safe disposal. The design and construction of the hydraulic loading systems for cryogenic fluids (i.e. LNG) will be to established industry standards such as BS EN 1474-3:2008 (British Standard, 2008) and all applicable National Regulations. In the event that the full inventory of this substance was released, there will be no significant effects on people or the environment, therefore the release would not be a MAH/ MATTE. Small quantities of lubrication oils are present within equipment items and maintenance storage areas, therefore no credible MAH/ MATTE scenarios associated with this material.	N

Substance	Description	Hazard Classification and Description	Screening and Identification of Potential MAH	Included in Assessment (Y/ N)
Power Plant Chemicals – Boiler Water Treatment Plant	Substances are typically be used to treat the boiler water systems within the Power Plant to control biological growth, prevent scale build up and to limit corrosion. In addition, any effluent discharges will be pH adjusted using appropriate substances.	The substances used in these applications will be specified prior to operation and may include sodium hypochlorite (biocide), which is classified by CLP as harmful to the environment. Substances present in the Power Plant could include acids and alkalis for pH adjustment of liquids. These substances are typically classified as corrosive. Acids and alkalis are incompatible and shall be stored separately to avoid the potential for hazards caused by mixing.	The quantities of these substances will be typically a maximum of a few tonnes, stored in dedicated, bunded, storage tanks. In the event of an accidental release, this material will be contained in tank bunds and rapidly detected by site personnel. If, however, the secondary containment systems (i.e. bunds) and tertiary containment systems (i.e. isolatable drains) both failed simultaneously, there will be minimal impact on people or the environment, primarily due to the small volumes of chemicals stored onsite. Consequently, no credible MAH/ MATTE scenarios for Power Plant chemicals have been identified.	N

14.7 Assessment of Major Accidents and Disasters

Identification of potential MAH/ MATTE scenarios in this assessment has been based on the application of industry standard risk assessment methodology, which considers the substances which could be present on the Proposed Development and their properties, including potential health, safety and environmental hazards.

The potential MAH/ MATTE scenarios which have been identified for the Proposed Development are presented in Table 14-2. These represent 'worst-case' events which, although they have the potential for significant consequences, they have a very low probability of occurrence. This is borne out by the historic evidence presented in Section 14.7 – Safety in Design, which contains a description of key safety systems used in the engineering design and operation of LNG and natural gas systems, similar to the Proposed Development.

A QRA will be carried out within the COMAH Safety Report for these potential MAH/ MATTE scenarios and will provide a detailed analysis of these hazards, including calculations of individual and societal risk.

The potential natural disasters identified following consideration of the location of the Proposed Development are presented in Table 14-3.

Table 14-2 Assessment of Major Accidents

Scenario Ref.	Substance	Major Accident Scenario	Risks/ Effects	Prevention/ Mitigation Measures
1	LNG	A major fire onboard the FSRU/ LNGC following loss of containment of LNG and the availability of an ignition source	A release of flammable gas or liquid could be caused by mechanical failure, impact damage or an operator error resulting in a loss of containment. Immediate ignition of the gas could lead to a flash or jet fire on the FSRU/ LNGC/ jetty depending on gas pressure. Delayed ignition could lead to an explosion and/ or fire. In the event of a fire, there is the potential for harm to people working onboard the FSRU, LNGC and at the jetty. A major fire could impact flora and fauna at the Shannon Estuary as a result of thermal radiation. Water for firefighting may be applied at the FSRU and/ or jetty. Firewater would be likely to runoff into the Shannon Estuary.	A QRA study carried out for the Proposed Development has assessed the consequences of a release of LNG and concluded that a major fire is credible, however very low overpressures would be generated by an explosion. Therefore, the credible MAH scenario is a fire only. The design and operation of the FSRU and LNGC will incorporate many safety features, primarily the robust design of the ship and cargo tanks, which typically incorporate a double-hull construction. Lloyds Register publish a list of standards for these ships, contained in 'The Rules and Regulations for the Construction and Classification of Ships for the Carriage of Liquefied Gases in Bulk', published July 2020. LNG transfer systems, including ship-to-ship bunkering, are designed to operate in a range of weather conditions and incorporate Emergency Release Systems (ERS) and Quick Connect/ Disconnect Coupling (QC/ DC) systems for safety. Control systems including Emergency Shutdown (ESD) systems, will be designed and installed to the appropriate engineering design standards, such as those published by International Electrotechnical Commission (IEC). These systems minimise the potential for human error and mitigate the consequences should an error be made, by a fast, safe shutdown of the transfer systems. Instrumentation to detect gas releases will be installed and linked to fire alarm and fire suppression systems. Firewater will be supplied at the jetty head from the onshore storage tank and pump system. The design of the fire system is being developed in consultation with the local Fire Officer. Two 1,600 m3 firewater tanks will be installed which have been sized on the worst-case fire scenario at the jetty and LNG Terminal. Contaminated firewater will not be expected to contain significant quantities of uncombusted hydrocarbons or other chemical waste residues, therefore a discharge of fire water to the environment will only contain conventional pollutants from fire damage of assets. The Regulatory Authorities will be closely involved throughout the design, construction and operation of the facilities to ensure compliance with all legislative

				requirements and to ensure compliance with design specifications and codes. This information will be presented in the COMAH Safety Report along with other documents. Implementation of the preventative and mitigation measures as described above reduce the risk associated with this MAH scenario.
2	LNG	RPT incident following loss of containment of LNG at the FSRU/ LNGC. In this scenario, liquified gas is rapidly vaporised following a loss of containment (see description in Section 14.4).	A release of LNG could be caused by mechanical failure, impact damage or operator error resulting in a loss of containment of LNG. If a release of LNG was not immediately ignited, on contact with water there is the potential for LNG to vaporise with a corresponding release of energy. This energy has the potential to cause harm to persons onboard the FSRU/ LNGC, on the jetty and fauna present within the immediate environment.	Significant quantities of LNG would have to be released to the surface of the Shannon Estuary for RPT effects to be appreciable. The measures described in Scenario 1 to prevent a release of LNG are the primary controls to mitigate this hazard and implementation of these as described will reduce the risk associated with this MAH scenario.
3	LNG and Natural Gas	Loss of containment of LNG or natural gas which does not ignite but impacts through toxicity or asphyxiation. This could be at the FSRU/ LNGC (LNG) or onshore facilities (natural gas).	A release of flammable gas or liquid could be caused by mechanical failure, impact damage or operator error resulting in a loss of containment. In the absence of a source of ignition being active, there is the potential for harm to persons nearby if LNG/ natural gas is inhaled. Contact of LNG with the skin can result in cryogenic burns. At this point in the process, the natural gas may not contain an odourising agent therefore persons onsite may be unaware a release has occurred. It is considered highly unlikely that an unignited release could reach persons offsite at a concentration which could cause harm, due to the distances involved. This risk is	The design and operation of the FSRU, LNGC, gas equipment and pipework will be to industry codes and standards to reduce the potential for a loss of containment. Welded connections rather than flanged are preferred. This is established in the Lloyds Register Rules and Regulations, Chapter 5 Process Pressure Vessels and Liquid, Vapour and Pressure Piping Systems Systems will be installed onboard the FSRU and LNGC to continuously monitor LNG pressure and will immediately detect a loss of containment, isolating the appropriate area(s) and alerting staff via alarms. Isolation of pipework and equipment will minimise the volume of gas release and prevent escalation of an emergency. If persons are present in the vicinity of the equipment/ pipework which is damaged, they will be alerted immediately via gas detection and alarm systems. Onsite training and emergency plans for this scenario will be developed prior to operation and when the development is operational, these plans will be subject to

			therefore considered only applicable to the FSRU/ LNGC and immediate onshore site personnel.	frequent testing. This is a fundamental requirement of COMAH regulated sites such as the Proposed Development. Implementation of the preventative and mitigation measures as described above reduce the risk associated with this MAH scenario.
4	MFO	Loss of containment of MFO to the estuary and surrounding beaches and land.	A release of MFO could be caused by mechanical failure, impact damage or operator error resulting in a loss of containment reaching the estuary. In the event of a release of liquid MFO, the substance would form a layer on the surface of water and land. Films formed on water may affect oxygen transfer and damage organisms. The major constituents of MFO are inherently biodegradable. Volatile constituents would oxidize rapidly by photochemical reactions in air and MFO would partly evaporate from water or soil surfaces, but a significant proportion could remain until collected by emergency systems such as absorbent booms. Large volumes of MFO released to ground may penetrate soil and could contaminate groundwater.	The fuel systems on the FSRU/ LNGC will be designed to the appropriate maritime engineering standards. These include the technical integrity of the storage systems, leakage detection and containment. Fuel leaks will be readily detected and isolated to minimise the loss of containment. Oil spillages will be dealt with using the SOPEP produced prior to operation as required by MARPOL Annex 1 Regulation 26. Procedures to prevent and respond to accidents involving a loss of containment will be developed, taking into consideration The National Maritime Oil & Hazardous Noxious Substance (HNS) Spill Contingency Plan (NMOSCP). This establishes Ireland's national framework and strategy to coordinate marine pollution preparedness and response. Implementation of the preventative (engineering design and operation) and mitigation (emergency response) measures as described will reduce the risk associated with this potential MAH scenario.
5	Natural Gas	Major fire/ explosion at the onshore facilities including gas receiving and conditioning area, AGI and the Power Plant.	A significant release of flammable gas at the onshore facilities could be caused by mechanical failure of equipment or impact damage such as a vehicle collision with pipework. Immediate ignition of natural gas would result in a fire, delayed ignition could result in an explosion and/ or fire. There is the potential for harm to people working at these facilities, however it is considered unlikely that a fire/ explosion would have an impact offsite at residential areas or environmental receptors due to the distances involved.	The QRA has concluded that a fire is a credible MAH scenario, however explosion overpressures were calculated to be negligible as a result of the open, unconfined areas of the onshore facilities. The design of the natural gas equipment and pipework will be to industry codes and standards to reduce the potential for a loss of containment, including the use of fully welded connections to avoid potential leak sources. Pipework at the AGI will be predominantly routed below ground, further reducing the potential for a loss of containment. Pipeline safety systems and gas/ liquid pressure regulation is to be installed along with operational controls and monitoring. Instrumentation and control systems will monitor the process and detect leaks. ATEX compliant equipment to be installed as required by Explosives Atmosphere Risk Assessment, to be carried out during the detailed engineering design of the Proposed Development.

				In the event of a major fire, damage to process equipment could occur which may release potentially harmful materials such as lubrication or hydraulic oils which are contained within firewater runoff. A fuel interceptor will be installed within the drainage systems on the Proposed Development, which will contain any spilt oil or hydrocarbon material within drainage and firewater runoff. This can then be collected and disposed of safely offsite. The onshore facility will be designed to contain firewater runoff within a retention area, which would prevent this material reaching unmade ground or other environmental receptors. Fire and gas detection and fire protection systems will be installed throughout the Proposed Development as appropriate, including passive and active fire suppression systems. The firewater system located onshore consists of storage tanks, firewater pumps and a ring main with a jockey pump to maintain pressure within the ringmain. Firewater will be supplied from this system via the trestle to the jetty head for the FSRU/ LNGC. This system has been specified in consultation with the local Fire Officer. In the event of a major fire, products of combustion could be generated, therefore there is the potential for emissions to air. However, gas is likely to achieve almost complete combustion, reducing the quantity of hydrocarbons and particulate matter which could be generated. Implementation of the preventative and mitigation measures as described above reduce the risk associated with this MAH scenario.
6	Odorant NB	Loss of containment, with/ or without subsequent fire/ explosion at the onshore facilities	A significant release of odorant material could be caused by mechanical failure of equipment or impact damage such as a vehicle collision with pipework resulting in a loss of containment. This material is selected for its characteristic odour, which is detectable by people at very low concentrations. Consequently, in the event of a loss of containment, there is the potential for this to create confusion to local people who may mistake this for a release of natural gas. There is also the potential for odour nuisance. Odorant is stored as a liquid in a closed, pressurised system held under a blanket of nitrogen which provides an inert atmosphere.	The design, operation and maintenance of equipment and pipework storing odorant will be to industry codes and standards to reduce the potential for a loss of containment, including the use of fully welded joints to reduce the potential for leaks. These design standards will be in alignment with the expectations of the Regulatory Authorities. The Proposed Development site is located in a predominantly rural location, therefore if a release of odorant was to occur, the number of residents who could detect an odour will be substantially less than in a more built-up location. In the event of a major fire, the emergency plans will include a firefighting strategy developed for all areas of the Proposed Development, including the odorant storage and injection system. This will potentially include using large volumes of water to cool the vessel contents. The plan will be developed in consultation with the emergency services.

Therefore, if the contents of the vessel are heated, for example in a fire to a temperature above its boiling point, this could result in a BLEVE. The likelihood of such an accident occurring is extremely low but could cause harm to people if exposed to explosion overpressure, debris and/ or thermal radiation resulting from this scenario.

A detailed analysis of this scenario will be included in the QRA and consequence analysis which will further inform the development of the firefighting strategy and emergency response procedures.

Implementation of the preventative and mitigation measures as described above reduce the risk associated with this MAH scenario.

Table 14-3 Assessment of Natural Disasters

Scenario Ref.	Description	Risks/ Effects	Preventative/ Mitigation Measures
7	Maritime navigation hazards including: • Vessel Collision in Estuary • Contact of Vessel with Infrastructure • Contact with Anchor • Grounding • Foundering • Cable Snagging • Mooring/ Breakout	The impact of a vessel colliding with the FSRU/ LNGC in the estuary could result in damage to vessels, a potential loss of containment of LNG and other fluids such as ballast, and harm to persons onboard. There are a number of submarine cables in the estuary. Impact with a cable could result in the interruption of electrical or communication supplies. The potential consequences of a release have been described in Scenarios 1 and 2.	A Navigation Risk Assessment (NRA) has been produced for the Proposed Development in consultation with stakeholders including the Port Company, Harbour Authority, the local Maritime Club, fishing clubs and environmental groups (dolphin and whale groups). This study has included a traffic analysis, gate analysis at the narrows area and a comprehensive review of historic incidents in the Shannon Estuary. An assessment of cumulative impacts has been included in the NRA, considering the impacts of future growth plans for the Shannon Estuary. The NRA has identified a number of potential hazards (56) associated with the Proposed Development associated with increased traffic frequency and other aspects. A detailed assessment of these hazards has concluded that the majority of identified risks are at a level which is considered 'Low' (38) or 'Negligible' (2). The remaining risks (15) have been reduced to a level which represents ALARP by the mitigation measures which will be implemented. These include for example, the size and depth of the estuary, low numbers of commercial shipping vessels, and the introduction of mobile control zones. The NRA concluded that mitigation measures embedded in the existing facilities and Proposed Development were suitable and sufficient to reduce risks, therefore the risk of a MAH/ MATTE as a result of a maritime navigation hazard is therefore considered to be very low.
8	Earthquake/ Seismic Event	An earthquake in the area of the development could result in damage to the FSRU, LNGC, pipelines and onshore equipment, with the potential for subsequent fires if LNG or natural gas was released.	The Irish National Seismic Network (INSN, 2021) documents a complete list of earthquakes since 1980. There have been minor, low magnitude events; however, Ireland is recognised as having a low level of seismic activity, with most earthquakes being recorded in the south-east or north-west of Ireland. Mechanical and civil engineering design codes used for the Proposed Development will take into consideration the requirement for appropriate earthquake resilient equipment and structures, for example, the structural strength of pipeline supports to accommodate natural movement and expansion. The risk of a MAH/ MATTE as a result of an earthquake is therefore considered to be very low.

Scenario Ref.	Description	Risks/ Effects	Preventative/ Mitigation Measures
9	Climate Change – Storm Water Flooding and Increasing Sea Levels	Surface water flooding from storms could result in damage to pipelines and equipment, with the potential for subsequent fires and/ or explosions if LNG or natural gas was released. An increase in the tidal range of the Shannon Estuary could result in operational instability of the FSRU, LNGC and jetty operation.	Marine studies and flood risk assessments have been undertaken for the Proposed Development, which have assessed future sea levels, storm surges and sea level rise (Halcrow, 2007; Mott MacDonald, 2013). Flooding and drainage is also considered in detail within Chapter 06. The Stage 3 – Detailed Flood Risk Assessment concluded that with the exception of crossings of the watercourses for the access road, there is no development proposed within either Flood Zone ‘A’ or Flood Zone ‘B’ and therefore the Proposed Development has a negligible impact on the existing flood regime in the area. The output of these studies and further/ updated work will be used to inform the engineering design of the development. The risk of a MAH/ MATTE as a result of flooding and increasing sea levels is therefore considered to be very low.
10	Climate Change – Temperature Extremes	Increasing atmospheric temperatures could result in operational instability of vaporisation and cooling systems. This could potentially impact the operation and efficiency of the Proposed Development but would be unlikely to result in a major accident or disaster.	The engineering design of the Proposed Development would consider the predicted ambient temperatures over the operational lifetime of the Proposed Development. This includes consideration of materials of construction suitable for expected temperature variations. The risk of a MAH/ MATTE as a result of temperature extremes is therefore considered to be very low.

Scenario Ref.	Description	Risks/ Effects	Preventative/ Mitigation Measures
11	Climate Change – Severe Winds	Potential accidents caused by severe winds could include impact damage from windblown debris and premature failure of structures, such as the jetty, loading arms and onshore process facilities. Severe winds could potentially initiate accidents such as vessel collisions or contact between vessels and infrastructure.	Wind speeds approaching hurricane force have been recorded by Met Eireann in Ireland (Met Eireann, 2021) and there is the potential for these storms to increase in frequency. Consequently, the Proposed Development recognises that appropriate engineering design, to withstand the forces generated by wind on the FSRU, jetty and all structures, must be considered. During storms, disconnection of the FSRU from the jetty and LNGC (if applicable) will be carried out, with the FSRU and LNGC moved to a designated safe mooring position. The potential for vessel collisions with infrastructure and other vessels is considered in Scenario 7 and assessed within the NRA. The risk of a MAH/ MATTE as a result of severe winds is therefore considered to be very low.
12	Increased Noise and Vibration Levels	The Shannon Estuary is home to protected species of fauna such as bottlenose dolphins. An increase in noise levels resulting from the Proposed Development, including onshore facilities and vessel movements, could potentially impact animal communications causing harm to local wildlife.	Increased noise in the Shannon Estuary associated with transiting and stationary ships both on jetties and on anchor has been considered in detail within the Noise section of the EIAR. This section also considers construction and operational phases of the onshore facilities associated with the Proposed Development, including noise associated with potential increases in traffic on local roads. There are a limited number of potential noise sources associated with the LNG Terminal, however the Power Plant will contain equipment with the potential for high noise levels if unabated. Mitigation measures to reduce noise levels will be incorporated in the design of the Power Plant, including acoustic barriers for equipment such as cooling fans and compressors and the acoustic design of buildings such as the turbine hall. All reasonably practicable measures will be adopted by the Proposed Development to minimise the noise impact of the facilities and Best Available Techniques (BAT) would be used in the selection and implementation of appropriate noise mitigation measures and controls. The risk of a MAH/ MATTE as a result of noise and vibration is therefore considered to be very low.

Scenario Ref.	Description	Risks/ Effects	Preventative/ Mitigation Measures
13	Acts of Terrorism/ Arson/ Cyber Terrorism	Acts of vandalism and/ or terrorism could have hazardous consequences, such as fire and/ or explosion. Acts of terrorism could also include unauthorised access to IT and control systems associated with the onshore process, jetty and FSRU/ LNGC. The worst-case risks and effects are as described in Scenario 1.	Security measures will be installed throughout the Proposed Development, including security guards, Closed Circuit Television (CCTV) and appropriate security fencing to deter intruders. The most up-to-date security advice will be obtained from the appropriate authorities for inclusion within a site Security Plan. IT security systems will be installed to prevent unauthorised access to control systems and the appropriate marine standards will be installed on the FSRU. The risk of a MAH/ MATTE as a result of unauthorised access to the Proposed Development is therefore considered to be very low.
14	Lightning	A lightning strike could cause a major accident, harm to people working at the Proposed Development and damage to the site infrastructure. Lightning could also present a source of ignition to flammable materials resulting in a major fire, which could harm people both onsite and offsite.	The engineering design of the Proposed Development will include the appropriate electrical earthing and bonding systems installed to provide a safe route for lightning to earth. Electrical and mechanical equipment will be specified in accordance with the requirements of the ATEX Directive 2014/ 34/ EU (EU, 2014), which defines standards for equipment. An explosion risk assessment will be carried out in accordance with ATEX Directive 1999/ 92/ EC (EC, 1999) which establishes the required standards to protect people. This will also consider the potential for lightning to be a source of ignition to flammable gases and vapours. Lightning risks will be assessed in accordance with recognised standards such as BS EN/ IEC 62305. The risk of a MAH/ MATTE as a result of a lightning strike is therefore considered to be very low.

Scenario Ref.	Description	Risks/ Effects	Preventative/ Mitigation Measures
15	Aircraft/ Drone Strike	The impact of an aircraft on the Proposed Development could result in significant asset damage, with subsequent fires and explosions from potentially released LNG/ natural gas.	The nearest airport is Shannon, located approximately 50 km in an easterly direction. The flight path to and from this airport is to the north of the Proposed Development. Personnel vigilance and security systems are the key mitigation measures to prevent drones being used in the area of the Proposed Development. The risk of a MAH/ MATTE as a result of an aircraft/ drone strike is therefore considered to be very low.
16	Road/ Rail Impact	The accidental impact of a vehicle on pipework and assets associated with the Proposed Development containing natural gas could result in asset damage and loss of containment. Ignition of gas could result in a major fire, potentially causing harm to people onsite and offsite.	The Proposed Development will be located in a rural area which has very low levels of road traffic and is not located near a railway. The local road infrastructure was not originally designed to accommodate delivery of large assets to the Proposed Development, such as major items of equipment. Therefore, an abnormal load assessment is being produced to identify potential pinch points and develop the appropriate mitigation measures and controls. The onshore pipework within the Proposed Development will connect to a major gas pipeline routed below ground for distribution to users. The risk of a MAH/ MATTE as a result of a vehicle impact is therefore considered to be very low.

14.8 Safety in Design

14.8.1 LNG Industry Safety History

Information provided by the Society of International Gas Tanker and Terminal Operators (SIGTTO) states the LNG industry is mature and well established, with LNG tankers in use around the world from around 1960 (SIGTTO, 2021). The global LNG tanker fleet continues to grow year-on-year along with regasification capacity. SIGTTO was incorporated as a non-profit making organisation in 1979, with the objective to share best practise and publish technical guidance for operators.

The safety and security of facilities is the highest priority for the LNG industry and there are a number of international organisations who share safety information, statistics and best practise, such as the International Group of Liquefied Natural Gas Importers (GIIGNL) (GIIGNL, 2021).

There have been very few major accidents involving LNG worldwide, with the last significant incident occurring over forty years ago (October 1979) at an onshore LNG storage facility in the United States. Lessons were learned following this accident, with the specification of materials for cryogenic service being reviewed and improved, along with the issue of new design codes and standards.

There have been a small number of minor accidents at LNG installations in the UK, with only small amounts of LNG being released and they did not result in any injuries to people. Operators such as National Grid in the UK maintain a register of accidents and incidents (with high potential), which are shared throughout the industry to drive continuous improvement in operations and standards.

LNG carriers must meet the required standards of the International Maritime Organisation (IMO) regulations for safety and security of shipping and the prevention of marine pollution by ships (IMO, 2021). These regulations cover the operations on the FSRU.

14.8.2 Technical Guidance

There is a significant volume of information and guidance available to developers on the identification and control of MA&D associated with the design and operation of LNG offloading and vaporisation facilities. This includes both national and international standards, such as the following which will be used in the engineering design of the facilities.

- European Norm (EN) standards - equipment and pipework design codes for cryogenic service, inspection and testing procedures.
- National Fire Protection Association (NFPA) – fire protection system design codes, general guidance on process equipment and electrical equipment specifications.
- International Electrotechnical Commission (IEC) – functional safety standards for instrumentation and control systems.

14.9 Cumulative Impacts and Effects

Cumulative impacts or effects are defined as the addition of many minor or insignificant effects, including other projects, to create larger more significant effects. The purpose of the MA&Ds assessment is to determine significant credible major accident or disaster scenarios for the Proposed Development, taking into consideration the multiple, cumulative failures which would have to happen, as a single isolated failure would not result in a major accident. The impact assessment which has been carried out for the Proposed Development as detailed in Section 14.7 takes into consideration these multiple, cumulative failures, an example of which is described below.

For a major fire to occur, a mechanical system such as an item of process equipment or a section of pipe would be required to fail, releasing flammable gas. For this failure to occur, a metal or weld defect would be required to be created and undetected during the manufacturing and installation process. Once installed, testing and routine visual inspection would have to fail to identify the presence of this defect, which over time could deteriorate via mechanisms such as fatigue caused by pressure cycling, until a catastrophic failure occurs. This results in a release of flammable gas which ignites in contact with a source of ignition such as non-ATEX compliant electrical systems resulting in a fire.

Other failure mechanisms and sources of ignition exist which could result in a loss of containment and subsequent fire. These include for example instrumentation, operational and human factors related failures.

There are multiple layers of prevention and mitigation measures in place for the Proposed Development to prevent major accidents such as the fire scenario described above from occurring which are described in Section 14.7. These include for example the emergency shutdown system which can be initiated by a number of systems including automatic fire and gas detection and manual activation.

Inherent safety principals have been adopted in the Proposed Development, principally reduction of the quantities of flammable materials present onshore and the location of systems/ equipment.

Facilities such as the Power Plant and major electrical equipment to be installed as part of this Proposed Development will be designed to incorporate a separation distance to prevent major accidents such as fires and explosions originating in one area from spreading to another area or escalating via domino effects. This separation distance is based on established engineering guidance for industrial site layout.

Inherent design measures to prevent defects include mechanical design codes for equipment and pipework, and quality assurance testing prior to installation using techniques such as x-ray examination and dye penetration. Once installed, regular inspection as required by Statutory Regulations will be carried out to identify defects. The equipment and pipework will be fitted with instrumentation to monitor the pressure and flowrate of gas, alerting operators to deviations from set points, preventing fatigue. If a failure was to occur even after all these design and operating measures were in place, mitigation measures to prevent ignition of gas which include the specification of installed ATEX compliant mechanical and electrical equipment. Process Safety ATEX specialists will be involved at all stages of the Proposed Development to assure compliance with these Directives and providing input to the layout of the facilities.

Cumulative effects also require the consideration of other projects and developments nearby which include the existing industrial infrastructure such as the Tarbert and Moneypoint power plants, scheduled for decommissioning, as described in Section 14.4.1. These facilities are located at a distance which should a major accident such as a fire or explosion occur, would not have an effect on the Proposed Development. The location of current planning applications will be considered collectively to ensure that these are located in an appropriate location such that they would not have the potential to initiate or escalate major accidents or disasters at the Proposed Development.

The risk of cumulative effects leading to potential MA&D at the Proposed Development is therefore considered to be **low** and detailed safety studies such as QRA are ongoing to identify where risks can be further reduced.

14.10 Residual Impacts and Effects

Residual effects are defined as those impacts that remain following the implementation of mitigation measures. As per the EPA draft guidelines, the effects from the residual impacts that remain after all assessment and mitigation are referred to as 'Residual Effects' (EPA, 2017). This assessment of MA&Ds has identified the potential for major hazards to occur at sensitive environmental receptors, such as a fire caused by damage or failure of systems containing gas. These events have significant consequences; however, the likelihood will be extremely low due to measures such as the engineering design of assets and protective systems.

Hazardous events such as these have been demonstrated to be extremely unlikely, however the risk cannot be entirely eliminated therefore will be reduced to ALARP. Further analysis of mitigation measures and residual effects are to be included within the QRA study report.

14.11 Summary

The assessment has reviewed the potential MA&D applicable to the Proposed Development, associated with the substances present and the operation of the Proposed Development, including the FSRU, LNGC, jetty and onshore areas including the Power Plant. Principally, these include fires following the accidental release of LNG or natural gas into the receiving environment. These incidents have an extremely low probability of occurrence but could have significant effects on people and the environment. Similar facilities have been in operation for many years across the world and the LNG industry has a very good safety record.

The engineering design of the Proposed Development will incorporate all of the appropriate standards and mitigation measures necessary to reduce the risks of accidents and disasters to an acceptable level, i.e. ALARP.

The key preventative and mitigating measures to prevent major accidents and disasters, are summarised as follows:

1. No LNG storage tanks will be installed onshore, minimising the inventory of LNG. In the event of an accidental release of natural gas from the onshore facilities such as pipework, the consequences will be significantly reduced in comparison to a release of LNG from a large onshore storage tank.
2. The natural gas pipelines will have integral isolation valves which can be closed very quickly in an emergency to isolate the inventory and reduce the consequences of an accident. Isolation valves used in this application are typically tested in accordance with International Standards such as BS EN ISO 10497:2004. This standard specifies fire type-testing requirements and a fire type-test method for confirming the pressure-containing capability of a valve under pressure during and after the fire test. Isolation valves can be closed automatically, and in the event of a problem with automatic isolation they can be closed manually. The automatic isolations are operated using highly reliable process control systems. SIS will be installed to provide highly reliable control functions, such as ESD. These systems and emergency procedures such as pipeline depressurisation will be subject to detailed safety studies during the engineering design process.
3. The FSRU can be safely disconnected from the jetty in the event of adverse weather conditions such as storms. The vessel will be moved to a safe mooring location away from the coast, reducing the risk of an accident, which could have an impact onshore. Due to the influence of climate change, serious storms could become more frequent. Storm Ophelia in October 2017 resulted in wind speeds reaching up to 156 km/h in Co. Cork (Burns, S., 2018), with a Status Red warning issued by Met Éireann. The LNG facilities will be designed to take events such as these into consideration.
4. Fires are the most significant hazards associated with natural gas and therefore the inventory has been minimised to store as little flammable material as possible at the onshore site. The facilities will be designed to take into consideration the ATEX Directives (EU, 2014; EC, 1999), which place controls on the use of electrical and mechanical equipment where flammable materials are present to prevent sources of ignition being available in the unlikely event of a release of flammable gas. Operational procedures including access controls will be in place to control potential ignition sources within all areas of the Proposed Development, but in particular, the trestle area.

5. Climate change may have an impact on atmospheric temperatures and increase the frequency of storms, however the engineering design of the Proposed Development will take these impacts into consideration. For example, the height of the jetty considers the potential for a rise in sea level. The majority of gas pipework will be below ground, therefore storms and increasing wind speeds will not have an appreciable impact on these structures. Overall, there are no changes to the identified major accidents or disasters as a result of the currently predicted climate changes.

6. Appropriate segregation distances will be provided onshore between the natural gas systems and other operators, including the Power Plant. This reduces the potential for an incident at one site to have an impact on another site nearby, commonly referred to as a 'domino effect'.

7. In the event of a release of LNG, rapid vaporisation and dispersion will result in very limited potential for this material to enter environmental receptors, such as the protected areas encompassing the estuaries, mudflats and other features along the coast. Compared with substances such as crude oil and fuels, such as diesel, the environmental impact of a release of LNG or natural gas will be significantly lower.

8. Shannon Airport is located approximately 80 km north east of the Proposed Development and the Proposed Development site is below the flight path used by national and international flights, particularly to the United States and Canada. An aircraft crash into the facilities would have catastrophic consequences, but the probability is extremely low and the design of facilities to withstand such a crash is not required.

Table 14-4 Summary

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance
Operation	Fires following the accidental release of LNG or natural gas into the receiving environment	Low	Very High	Significant	The key preventative and mitigating measures to prevent major accidents and disasters, are summarised as follows: • No LNG storage tanks will be installed onshore, minimising the inventory of LNG. • The natural gas pipelines will have integral isolation valves which can be closed very quickly in an emergency to isolate the inventory and reduce the consequences of an accident. • The FSRU can be safely disconnected from the jetty in the event of adverse weather conditions such as storms. • Fires are the most significant hazards associated with natural gas and therefore the inventory has been minimised to store as little flammable material as possible at the onshore site. • Appropriate segregation distances will be provided onshore between the natural gas systems and other operators, including the Power Plant. • In the event of a release of LNG, rapid vaporisation and dispersion will result in very limited potential for this material to enter environmental receptors, such as the protected areas encompassing the estuaries, mudflats and other features along the coast.	Minor adverse

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CHAPTER 15
Climate

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park

Environmental Impact Assessment Report

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15. Climate Change

15.1 Introduction

This section considers the impact of the proposed development on the climate and the impact of climate change on the proposed development. The Climate Action and Low Carbon Development (Amendment) Bill 2021, passed by the Oireachtas in April 2021, commits Ireland to becoming a carbon-neutral economy by no later than 2050. To reach this milestone a series of five-year carbon budgets, setting out a carbon reduction trajectory for Ireland, are to be embedded into law. The first two budgets must demonstrate a 51% reduction against a 2018 baseline by 2030.

A key component of meeting this reduction target is the decarbonisation of electricity generation in Ireland. To drive this change Ireland has set a target to generate 70% of grid electricity from renewable sources by 2030, largely from wind. To allow this uptake of renewable energy to happen it is necessary to have in place sources of energy generation that can be efficiently dispatched to cover any imbalances in supply and demand. As the use of coal and peat for electricity generation is reduced, natural gas has been identified as a relatively lower-carbon option to provide security of supply.

15.2 Competent Expert

This assessment has been led and verified by Ian Davies, an Associate Director Climate Change Consultant, B.A. (Hons.). Ian has over 20 years of experience in environmental sustainability assessments and specialises in greenhouse gas and climate change assessments.

15.3 Scope of Assessment

The assessment of climate impacts is divided into three categories:

- Lifecycle Greenhouse Gas (GHG) Assessment: to identify the magnitude of GHG emissions arising over the life of the Proposed Development on the climate.
- In-combination Climate Change Impact (ICCI) assessment: the combined impacts of the Proposed Development and future climate change on receptors in the surrounding environment.
- Climate Change Resilience (CCR): the vulnerability of the Proposed Development to the impacts of future climate change.

15.4 Legislation and Guidance

This section identifies and briefly describes the legislation, policy, and guidance of relevance to the assessment of potential impacts associated with the construction and operation of the Proposed Development on the climate and the impacts of climate change on the Proposed Development.

Legislation, policy and other relevant guidance has been considered on an international, national and local level. The following is relevant to the GHG assessment as it has either influenced the sensitivity of receptors and requirements for mitigation or the scope and/ or methodology of the assessment.

15.4.1 International Legislation and Policy

- **EIA Directive 2014/52/EU** (Official Journal of the European Union, 2014) amending Directive 2011/92/EU: on the assessment of the effects of certain public and private projects on the environment. Annex IV specifically requires that EIAs require information to be included on '*the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change*';
- **Kyoto Protocol**: An international agreement linked to the United Nations Framework Convention on Climate Change (UNFCCC), which commits its Parties by setting internationally binding emission reduction targets. Ireland is a Party to the Kyoto Protocol and its emission reductions targets are now binding. Under Article 4 of the Kyoto Protocol, the EU created an Effort Sharing Regulation that requires the setting of individual binding GHG emission reduction targets for each of its Member States. The

current Effort Sharing Decision (ESD) commits Ireland to a 39% reduction in GHG emissions for the period 2021 to 2030 (Department of Communications, Climate Action & Environment, 2019);

- **Paris Agreement** (Conference of the Parties No.21, 2016): A legally-binding agreement within the UN framework convention on climate change which requires all signatories to strengthen their climate change mitigation efforts to keep global warming to below 2°C this century (UNFCCC, 2016);
- **EU Emissions Trading System** (Directive 2003/87/EC (as amended)). The EU's current binding target for 2030 is to cut greenhouse gas (GHG) emissions by at least 40% below 1990 levels. This target is split across the EU Emissions Trading System (ETS) and non-ETS sectors with consideration also for the Land Use, Land Use Change and Forestry (LULUCF) sector. Emissions from electricity generation and large industry are in the ETS. These are dealt with at EU level. The EU ETS includes more than 11,000 power stations and industrial plants (stationary installations) in 31 countries, as well as airlines that operate within the EU. It covers about 45% of EU emissions, but only about 29% of total emissions in Ireland[1]. The ETS is a 'cap and trade' system where an EU-wide limit, or cap, is set for participating installations. The cap is reduced over time so that total emissions fall. Within that limit 'allowances' for emissions are auctioned or allocated for free (outside the power-generation sector). Individual installations must report their CO2eq. emissions each year and surrender sufficient allowances to cover their emissions. If their available allowances are exceeded, an installation must purchase allowances. On the other hand, if an installation has succeeded in reducing its emissions, it can sell any surplus allowances remaining. The EU ETS is designed to bring about reductions in emissions at least cost. To date, it has played an increasingly important role in assisting European industry to implement the type of reductions envisaged within the EU's agreed limit of at least 20% reduction of overall greenhouse gas emissions across the EU by 2020 and 43% by 2030, both relative to 2005 levels. Industrial installations with a thermal capacity of 20 Megawatts are part of the ETS. Electricity generators no longer receive a free allowance but must purchase at auction sufficient allowances to cover their annual emissions. From 2021, the overall European emissions cap will reduce by an annual rate of at least 2.2%;
- **European Green Deal:** Policy initiatives by the European Commission aiming to make Europe GHG neutral by 2050 (European Commission, 2019). A key pillar of the Green Deal requires decarbonising energy systems; and
- **EU Effort Sharing Legislation:** Establishes binding annual greenhouse gas emission targets for Member States for the periods 2013–2020 and 2021–2030. These targets concern emissions from most sectors not included in the EU Emissions Trading System, such as transport, buildings, agriculture and waste.

15.4.2 International Guidance and Information

- The **Greenhouse Gas Protocol** (World Resource Institute & World Business Council for Sustainable Development (WRI & WBCSD, 2004): The GHG Protocol provides standards and guidance for companies and other types of organisations in preparing a GHG inventory;
- The **International Organization for Standardization** (ISO) 14064-1:2019 and 14064-2:2019 (ISO, 2018a and b, respectively) provides specifications for organisational-level and project-level guidance for the quantification and reporting of GHG emissions and removals;
- **Institute of Environmental Management and Assessment** (IEMA) Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance Assessment Methodology and Significance Criteria (IEMA, 2017): This provides a framework for the consideration of greenhouse gas emissions in the EIA process, in line with the EIA Directive. The guidance sets out how to:
  - Identify the GHG emissions baseline in terms of GHG current and future emissions
  - Identify key contributing GHG sources and establish the scope and methodology of the assessment
  - Assess the impact of potential GHG emissions and evaluate their significance

[1] Climate Action Plan 2019

  - Consider mitigation in accordance with the hierarchy for managing project related GHG emissions (avoid, reduce, substitute, and compensate)

- **IEMA** Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation (IEMA, 2020): provides a framework for effective consideration of climate change resilience and adaptation in the EIA process;
- **The Inventory of Carbon and Energy** (ICE) Database (Version 3) and the Cement, Mortar and Concrete Model (Version 1), Bath University, UK (2019): The ICE Database is the world's leading source of embodied energy and carbon data. This database has been used to source appropriate carbon factors to estimate the embodied carbon of materials used for demolition and remediation works of the Proposed Development;
- **GHG Emission Factors** (**Department for Business, Energy and Industrial Strategy** (BEIS) 2021, provide GHG emission factors (BEIS, 2021), which have been used within the GHG emissions calculation methodology, as described in the 'Methodology for Determining Construction Effects' section of this EIAR chapter. These will be used as a proxy for absent Irish emission factors to quantify GHG emissions to convert the activity data into emissions; and
- **Guidance for the Calculation of Land Carbon Stocks** (European Commission, 2010): These Guidelines provide a calculation methodology for calculating carbon stocks from land use.

15.4.3 National Legislation and Policy

- **S.I. No. 93/ 1999**- European Communities (Environmental Impact Assessment) (Amended) Regulation, 1999. Article 25 (2) (b) of this Regulation specifically requires an environmental impact statement to contain (Irish Statute Books, 1999):

  '*a description of the aspects of the environment likely to be significantly affected by the proposed development, including in particular…climatic factors*';

- **Climate Action and Low Carbon Development (Amendment) Bill 2021** (Government of Ireland, 2021). This Bill commits Ireland to move to a climate resilient and climate neutral economy by 2050. The Bill brings in a requirement for 5-year carbon budgets to commence in 2021;
- **Climate Action Plan 2019** (Government of Ireland, 2019). This Plan sets out Ireland's intention to reduce its carbon emissions by 30% between 2021 and 2030 and work towards net zero emissions by 2050. The Plan further describes its intention to establish 5-yearly carbon budgets, with the first to commence in 2021 and penalties to be applied if targets are not met;
- **National Energy and Climate Plan 2021-2030** (Department of Communications, Climate Action and Environment, 2020a). The 2020 NECP incorporates all planned energy and climate policies and measures identified up to the end of 2019. The Plan has been created in part to support the EU's 2050 net zero target and strategy to develop an energy union to provide EU consumers secure, sustainable, competitive and affordable energy through the five dimensions. The five dimensions include:
  - Security, solidarity and trust
  - A full integrated internal energy market
  - Energy efficiency
  - Climate action, decarbonising the economy
  - Research, innovation and competitiveness

  The Plan sets out in detail Ireland's strategy to meeting these five dimensions together with planned policies and measures to ensure that these objectives are achieved. This strategy acknowledges the increasing role of natural gas in the energy mix for heat, transport and power generation, including its role as a back up to intermittent power generation from renewable sources;

- **White Paper Ireland's Transition to a Low Carbon Energy Future 2015-2030.** (Department of Communications, Climate Action and Environment, 2020b). This White Paper, considers Ireland's complete energy policy and European and International climate change objectives and agreements, as well as Irish social, economic and employment priorities. The paper confirms the need to enhance energy security and to provide a reliable supply of gas to meet demand as part of a sustainable energy transition to a low carbon future;

- **National Mitigation Plan** (Department of Communications, Climate Action and Environment, 2017). Ireland's first national mitigation plan sets out the Government's shared approach to reducing GHG emissions;
- **National Adaptation Framework** (Government of Ireland, 2018a). Ireland's first national strategy '*to reduce the vulnerability of the country to the negative effects of climate change and to avail of the positive impacts.';*
- **National Planning Framework** (Government of Ireland, 2018b). The National Planning Framework contains strategic level planning policy for guiding development and investment in Ireland over the coming two decades. As such, it sets the strategic planning context for facilitating the proper planning and sustainable development of the country's regions and local communities, containing a set of national objectives and key principles by which more detailed and refined regional and local plans are informed;

15.4.4 Gas and Electricity Transmission Network Rules and Path to Net Zero

- **The Integrated Single Electricity Market Rules.** EirGrid is part of the EirGrid Group who, through the Single Electricity Market Operator (SEMO), is responsible for the operation of the Single Electricity Market (SEM). SEM is the all-island wholesale electricity market. As the TSO, EirGrid plays a vital role in the operation of the SEM. EirGrid's electricity forecasts are used to ensure that there is sufficient generation capacity to meet electricity demand at all times of the day. The dispatch of the Power Plant will be controlled by SEMO.

  Dispatch under the I-SEM is determined by economic merit as well as the requirements of the grid and EirGrid are obliged to dispatch based on economic merit. As all power production requires the producer to purchase the necessary emissions allowances under the ETS, the cost of emissions as per the ETS is reflected in the price of power and therefore in dispatch (i.e. plants which are less carbon efficient will have higher costs and be lower in the economic merit order). Plants are required under the balancing market principles code of practice to reflect the cost of carbon in their bidding prices which ensure the I-SEM arrangements reflect carbon efficiency as a part of the overall dispatch of plants (SEM Committee, 2017).
- **EirGrid. Tomorrow's Energy Scenarios 2019 Ireland - Planning our Energy Future.** Tomorrow's Energy Scenarios (TES) outlines possible future pathways for the electricity system. TES proposes two scenarios reaching the 70% RES-E target by 2030 as set out in the Government's Climate Action Plan, and one scenario reaches carbon neutrality in the electricity system by 2040. In order to achieve a carbon neutral electricity system, the provision of all capacity, energy and system services must be done without the net release of carbon dioxide emissions (net zero). TES requires new investment in natural gas fired generation capacity to replace forecasted closures.
- **GNI Vision 2050.** GNI's Vision 2050 is a roadmap for the gas network to evolve to become net zero carbon by 2050. In doing so it will support emissions reductions across every sector of the Irish economy at the lowest cost possible. GNI note the solution to Ireland's energy and climate challenge will require the successful deployment of many technologies. Electrification, natural gas (with Carbon Capture and Storage (CCS)), renewable gas and renewable electricity sources will all play significant roles in the energy system in 2050. GNI's Vision 2050 document outlines how net zero can be achieved by meeting half the projected 2050 gas demand with net zero carbon and zero carbon gases and by using Carbon Capture and Storage (CCS) to abate the emissions from the remaining natural gas. Gas Networks Ireland has already begun to invest in new technologies to facilitate renewable gas injection into the gas network, and to supply Compressed Natural Gas (CNG) from the gas network as a fuel source for commercial vehicles.

15.4.5 Regional and Local Guidance

- **Southern Region Waste Management Plan** (Southern Waste Region, 2015). The Proposed Development falls under this Plan that includes key targets in waste prevention;
- **Strategic Environmental Assessment (SEA) Statement, Regional Spatial and Economic Strategy for the Southern Region** (Southern Regional Assembly, 2020). The Regional Spatial and Economic Strategy for the Southern Region contains the statutory, regional-level strategic planning policy for the counties of Kerry, Limerick, Clare, Cork, Tipperary, Waterford, Kilkenny, Carlow, and Wexford, and

aligns with and is informed by the National Planning Framework. One of the Strategic Environmental Objectives guiding the strategy's SEA statement relates to climate and is as follows

Achieving transition to a competitive, low carbon, climate-resilient economy that is cognisant of environmental impacts.

Reducing GHG emissions and integrating sustainable design solutions into the region's infrastructure are some of the climate-related Strategic Environmental Objectives for the region.

- **County Kerry Climate Change Adaptation Strategy** (Kerry Co. Council (KCC), 2019). Formed under the National Adaptation Framework, this strategy details actions for the Council across themes of Local Adaptation Governance and Business Operations, Infrastructure and Built Environment, Land use and Development, Drainage and Flood Management, Natural Resources and Cultural Infrastructure, and Community Health and Wellbeing. Actions include promotion of measures to reduce GHG emissions through sustainable planning strategies, promoting sustainable modes of transport, renewable energy, climate-smart and near zero energy buildings, stipulating climate change requirements for urban storm water drainage systems; and
- **Kerry County Development Plan- Strategic Environmental Assessment** (KCC, 2018). Of the environmental performance objectives, in relation to climate change and this application, it states:
  - '*Encourage the sustainable re-use of brownfield sites*';
  - '*Minimise greenhouse gas emissions to meet national and international standards*';
  - '*Promote the use of the full suite of Sustainable Urban Drainage Systems (SUDS)*';
  - '*Maintain and improve the quality of wastewater discharges*'; and
  - '*Sustainably manage the abstraction of water*'.

15.5 Methodology

The methodologies presented in the following section have been developed in line with the relevant planning policy requirements and appropriate industry guidance for assessing GHGs and climate change resilience and adaptation.

15.5.1 Lifecycle GHG assessment

15.5.1.1 Study Area (Lifecycle GHG Assessment)

The GHG study area considers all direct GHG emissions that arise during the life of the Proposed Development including those from construction and operation activities within the red line boundary area. It also considers indirect emissions from activities onsite as well as upstream and downstream emissions, such as transport, waste disposal and embedded carbon in construction materials and products.

The scope and boundary for the assessment has been determined in line with the GHG Protocol Corporate Standard (WRI & WBCSD, 2015). Scope 1 emissions include direct GHG emissions from sources owned or operated by the company. Scope 2 emissions include indirect emissions generated offsite from purchased electricity and other imported services. Scope 3 emissions include any other indirect GHG emissions occurring from sources not owned or controlled by the company. The reasons for incorporating scope 3 emissions in GHG reporting include (WRI & WBCSD, 2015):

- They are large (or believed to be large) relative to the company's scope 1 and scope 2 emissions
- They contribute to the company's GHG risk exposure
- They are deemed critical by key stakeholders (e.g., feedback from customers, suppliers, investors, or civil society)
- There are potential emissions reductions that could be undertaken or influenced by the company.

15.5.1.2 Determining the Baseline (Lifecycle GHG Assessment)

The baseline for the GHG assessment considers a scenario where the Proposed Development does not proceed.

The baseline for construction emissions considers the current land use at the site of the Proposed Development and the GHGs locked in carbon stocks above and below ground. It also considers any construction that may occur if the Proposed Development does not proceed.

The baseline for operational emissions considers forecast GHG emissions and GHG reduction targets for both Ireland as a whole and the electricity generation sector in Ireland.

15.5.1.3 Sensitive Receptors (Lifecycle GHG Assessment)

There is currently no published standard definition for receptor sensitivity of GHG emissions. All GHG emissions are classed as being capable of being significant on the basis that all emissions contribute to climate change (IEMA, 2017). The global climate has been identified as the receptor for the purposes of the GHG assessment. The sensitivity of the climate to GHG emissions is considered to be ‘high’. The rationale supporting this includes:

- GHG emission impacts could compromise Ireland’s ability to reduce its GHG emissions, in line with international and national future carbon targets;
- The need to reduce GHG emissions to reduce the risks and impacts of climate change, as broadly identified by the climate science community and by the Paris Agreement which aims to keep global temperature rise this century below two degrees above pre-industrial levels, (UNFCCC, 2016). Additionally, a recent report by the IPCC highlighted the importance of limiting global warming below 1.5°C (IPCC, 2018); and
- A disruption to global climate is already having diverse and wide-ranging impacts on the environment, society, economic and natural resources. Known effects of climate change include increased frequency and duration of extreme weather events, temperature changes, rainfall and flooding, and sea level rise and ocean acidification. These effects are largely accepted to be negative, profound, global, likely, long-term to permanent, and are transboundary and cumulative from many global actions.

The effect of the Proposed Development on Ireland’s national GHG inventory and carbon reduction targets will be used as a proxy to the global climate.

15.5.1.4 Approach (Lifecycle GHG Assessment)

In line with ISO14064 (2018a and b) and principles of the GHG Protocol (WRI & WBCSD, 2004), the GHG emissions have been calculated by multiplying activity data by its relevant emission factor:

Activity data x GHG emissions factor = GHG emissions in mass of CO_2e

Activity data is a quantifiable measure of activity, such as operating hours or volumes of fuels used. Emission factors convert the activity data into GHG emissions. Activity data has been sourced from the Applicant. Where specific data is not available, a mix of assumptions and industry benchmarks have been used to fill data gaps. Where this is not possible, then a qualitative approach to assessing the GHG impacts has been followed, in line with the IEMA guidance (2017).

Emission factors have been sourced from publicly available sources, including Sustainable Energy Authority of Ireland (SEAI) (2019), BEIS (2021), and the Bath University ICE (2019). Carbon emissions and sinks through land use change have been calculated by using the European Commission’s Guidelines for Land Carbon Stocks (2010).

In line with the ISO standard 14064 and the principles of the GHG Protocol (WRI & WBCSD, 2004) when calculating GHG emissions, the seven Kyoto Protocol GHGs have been considered, specifically:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous oxide (N_2O);
- Sulphur hexafluoride (SF_6);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Nitrogen trifluoride (NF_3).

These gases are broadly referred to in this report under an encompassing definition of 'GHGs', with the unit of tCO_2e (tonnes CO_2 equivalent) or $MtCO_2e$ (mega tonnes of CO_2 equivalent).

15.5.1.5 Well-to-tank (Indirect) Emissions

Well-to-tank emissions include those upstream emissions associated with the extraction, refining, liquefaction and transportation of the raw fuel source (LNG) to the point of use. These are in addition to the direct emissions from the combustion of the fuel by the end user, and are reported in Scope 3. For this study, well-to-tank emissions have been included only for that proportion of the imported LNG that will be consumed within the Proposed Development. For the LNG that is supplied into the Irish gas network and consumed by a third party, indirect well-to-tank emissions, as well as direct emissions from the final consumption of the gas by a third party, have been excluded from the scope of the Proposed Development. This approach is deemed reasonable as under the EU Emissions Trading System and the EU Effort Sharing Legislation (discussed in Section 15.3) it is the end user of the gas who is responsible for the direct and indirect emissions from the use of this fuel.

Table 15-1 Scope of GHG Emissions Assessment

Scope	Activity	Construction	Operations
Scope 1 (Direct GHG Emissions)	Fuel Usage Onsite	**Included in all phases. Fuel use by plant and machinery onsite (including combustion of gas for electricity generation by Power Plant and energy use in buildings)**	
	Company Vehicle Usage	Not included	
	Fugitive Emissions	N/A- none expected	**Included** within Scope 3- Fuel and Energy-Related Activities
Scope 2 (Electricity Indirect GHG Emissions)	Electricity Purchased	**Included**	N/A- none expected (electricity loads are taken from that generated, not grid sourced with the exception of the BESS)
Scope 3 (Other Indirect Emissions- Upstream)	Purchased Goods and Services	**Included in all phases. Emissions associated with embodied carbon in materials**	
	Capital Goods	Not included- emissions are expected but not possible to calculate	
	Fuel and Energy-Related Activities (not included in Scope 1 or 2)	N/A- none expected	**Included. Emissions from extraction, production and transportation of LNG (WTT)**
	Upstream Transportation and Distribution	**Included. Emissions associated with material and waste transport**	**Included. Emissions associated with material and waste transport, and tugs**
	Waste Generated in Operations	**Included in all phases. Emissions associated with treatment and disposal of wastes**	
	Business Travel	Not included	
	Employee Commuting	**Included in all phases**	
	Upstream Leased Assets	N/A- none expected	
Scope 3 (Other Indirect Emissions- Downstream)	Transportation and Distribution of Sold Products	N/A- none expected	N/A- none expected (grid operator activity)
	Processing of Sold Products	N/A- none expected	
	Use of Sold Products	N/A- none expected	Not included
	End-of-life Treatment of Sold Products	N/A- none expected	
	Downstream Leased Assets	N/A- none expected	
	Franchises	N/A- none expected	

Scope	Activity	Construction	Operations
	Investments	N/A- none expected	
Other	Carbon Displacements and Offsets	**Included in all phases**	
	Land Use Change	**Included in all phases**	

IEMA (2017) guidance states that there are currently no agreed methods to evaluate levels of GHG significance and that professional judgement is required to contextualise the project's emission impacts. In GHG accounting, it is considered good practice to contextualise emissions against pre-determined carbon budgets (IEMA, 2017). In the absence of relevant Irish carbon budgets, the national GHG Inventory and carbon reduction targets can be used to contextualise the level of significance.

PAS 2050 Specification (2011) allows emissions sources of <1% contribution to be excluded from emission inventories, and these inventories to still be considered complete for verification purposes. This exclusion of emission sources that are <1% of a given emissions inventory is on the basis of a '*de minimis*' (relatively minimal) contribution.

On this basis, where GHG emissions from the construction of the Proposed Development are equal to or more than 1% of the most recent Irish GHG inventory, the impact of the Proposed Development on the climate is considered to be of major adverse significance. Only the construction emissions will be compared to the Irish inventory due to proximity in time. The projected operational GHG emissions in 2030 will then be contextualised against the 2030 carbon target. This is summarised in Table 15-2. As published by the EPA (2021), the total Irish emissions in 2019 have been estimated to be 59,777.6 kt CO_2e (59.8 Mt CO_2e). The Climate Action and Low Carbon Development (Amendment) Bill 2021 requires Ireland to achieve a reduction of 51% against a 2018 baseline by 2030. This equates to total allowable emissions in 2030 of 29.86Mt CO2e if the target is met.

Table 15-2 Magnitude Criteria for GHG Emissions

Magnitude of the Effects	Magnitude Criteria Description
High	Estimated GHG emissions equate to equal to or more than 1% of the estimated Irish GHG Inventory in the year which they arise
Low	Estimated GHG emissions equates to less than 1% of the estimated Irish GHG Inventory, or less than the Irish 2030 emissions budget.

This method to determine the significance of GHG emissions are summarised in Table 15-3.

Table 15-3 Significance of GHG Emissions

		Sensitivity of Receptor
Magnitude of GHG emissions (Table 15-2)	**High**	Major adverse significance
	Low	Minor adverse significance

15.5.2 In-Combination Climate Change Impacts

15.5.2.1 Study Area (ICCI assessment)

The study area for the ICCI assessment is the study areas determined in each of the Environmental Discipline assessments presented in this EIAR.

15.5.2.2 Determining the Baseline (ICCI Assessment)

For the purposes of the ICCI assessment, the baseline conditions are based upon historic climate change data obtained from Met Éireann recorded by the closest meteorological station to the Proposed Development (Shannon Airport, approximately 20 km north-east of the site).

15.5.2.3 Sensitive Receptor (ICCI Assessment)

The sensitive receptors for the ICCI assessment are those determined in of each of the Environmental Discipline assessments presented in this EIAR.

15.5.2.4 Approach (ICCI Assessment)

The ICCI assessment considers the ways in which projected climate change will influence the likelihood and severity of the impact of the Proposed Development on receptors in the surrounding environment. The scope of the ICCI assessment is detailed in Table 15-4.

The ICCI assessment considers the existing and projected future climate conditions for the geographical location and assessment timeframe. It identifies the extent to which identified sensitive receptors in the surrounding environment are potentially vulnerable to and affected by these factors. The receptors for the ICCI assessment are those that will be impacted by the Proposed Development as identified within the wider EIAR. These impacts are assessed in liaison with the technical specialists responsible for preparing other technical chapters of this EIAR.

Table 15-4 Scope of ICCI Assessment

Climate Parameter	Scoped In or Out	Decision Rationale
Extreme weather event	In	An increase in the likelihood and severity of extreme weather events could lead to damage to ecosystem stability. In combination with sea level rise, the likelihood and severity of acute coastal impacts such as erosion, loss of habitats, destabilisation and damage to infrastructure. These impacts may be exacerbated by the Proposed Development.
Precipitation change (flooding and droughts)	In	Climate change may lead to both an increase in substantial precipitation and drought events. The combination of the Proposed Development and its water requirements and climate change may cause increased risk of impacts.
Temperature and Humidity	In	Fluctuating levels of temperature may lead to: Increase in likelihood and severity of heat waves which might have a negative impact on biodiversity and health; and Increase in likelihood and severity of freezes which might have a negative impact on biodiversity and health.
Sea level rise	In	The Site is located in an area that is susceptible to sea level rise. The impacts of sea level rise on receptors may be exacerbated by the Proposed Development.
Sea temperature	In	The Proposed Development will produce thermal discharges which may be directed to sea via the outfall. The combination of this with increasing sea temperatures may cause increased risks to marine ecology and the physico-chemical environment.
Wind	Out	The Proposed Development is not expected to alter the wind environment and therefore to not have any additional impact upon receptors identified by other environmental disciplines.

An assessment of ICCI has been conducted for the Proposed Development to identify potential climate change impacts and considers their potential consequence and likelihood of occurrence.

The likelihood of an in-combination impact occurring (a change in the impact significance level to surrounding receptors when the impacts from the Proposed Development have been considered in-combination with climate change) has been determined based on the assessed likelihood of a climate hazard occurring, combined with the sensitivity of the receptor as defined by the relevant environmental disciplines, using professional judgement.

Information on historic observations on climate change, such as carried out by Met Éireann, along with climate change projection data from the Environmental Protection Agency (EPA, 2015), have been used to identify potential chronic and acute climate hazards that may affect the geographical location of the Proposed Development.

The likelihood of each potential climate change hazard occurring has then been assessed. Likelihood is categorised into four levels depending on the probability of the hazard occurring. Table 15-5 presents the likelihood levels and definitions used. This is in line with the definitions presented in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (IPCC, 2014). There is some amount of overlap in the criteria provided to allow for uncertainty and the qualitative approach of the assessment.

Table 15-5 ICCI Assessment - Level of Likelihood of the Climate Hazard Occurring

Level of Likelihood	Definition of Likelihood
Very likely	90-100% probability that the hazard will occur
Likely	66-90% probability that the hazard will occur
Possible, about as likely as not	33-66% probability that the hazard will occur
Unlikely	0-33% probability that the hazard will occur

The likelihood of an impact occurring is then determined. Using their understanding of the receptor sensitivity to the climate hazard, relevant socio-environmental disciplines assigned a likelihood of impact category. In defining the likelihood of an in-combination climate impact occurring, embedded and good practice mitigation measures (primary and tertiary mitigation) are taken into consideration. Definitions of likelihood are set out in Table 15-6.

Table 15-6 ICCI Assessment – Level of Likelihood of the Climate Impact Occurring

Level of likelihood of climate impact occurring	Definition of likelihood
Likely	66-100% probability that the impact will occur during the life of the project
Possible, about as likely as not	33-66% probability that the impact will occur during the life of the project
Unlikely	0-33% probability that the impact will occur during the life of the project

Table 15-7 is then used to determine the overall likelihood of the ICCI. Once the likelihood of an in-combination climate impact occurring on a receptor has been identified, the discrete environmental assessment should consider how this will affect the significance of the identified effects.

Table 15-7 Level of Likelihood of the ICCI

		Likelihood of climate change hazard occurring (Table 15-6)				
		Very unlikely	**Unlikel y**	**Possible**	**Likely**	**Very likely**
Likelihood of impact occurring (given embedded mitigation measures, Table 15-5)	**Unlikely**	Low	Low	Low	Medium	Medium
	Possible	Low	Low	Medium	Medium	Medium
	Likely	Low	Medium	Medium	High	High

The ICCI consequence criteria are defined in Table 15-8 and are based on the change to the significance of the effect already identified by the environmental discipline. To assess the consequence of an ICCI impact, each discipline has assigned a level of consequence to an impact based on the criteria description in Table 15-8 and their discipline assessment methodology.

Table 15-8 ICCI assessment – Consequence Criteria

Consequence	Consequence criteria
High	The climate change parameter in-combination with the effect of the proposed development causes the significance of the effect of the proposed scheme on the resource/ receptor, as defined by the topic, to increase from negligible, minor or moderate to major.
Medium	The climate change parameter in-combination with the effect of the proposed development causes the effect defined by the topic, to increase from negligible or minor to moderate.
Low	The climate change parameter in-combination with the effect of the proposed development, causes the significance of effect defined by the topic, to increase from negligible to minor.
Very low	The climate change parameter in-combination with the effect of the proposed development does not alter the significance of the effect defined by the topic.

The significance of potential effects is determined by the environmental disciplines using the matrix in Table 15-9. As a general rule, where an effect has been identified as moderate or major, this has been deemed significant. However, professional judgement is also applied where appropriate.

Table 15-9 ICCI Assessment – Significance Criteria

		Likelihood of the ICCI Occurring (Table 15-7)		
		Low	**Medium**	**High**
Consequence of ICCI Occurring (Table 15-8)	**Very Low**	Negligible	Negligible	Minor
	Low	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	High	Moderate	Major	Major

Where an ICCI is determined to be significant then appropriate additional mitigation measures (secondary mitigation) are identified. Professional judgement is used to describe whether, with additional mitigation in place, the ICCI remains significant or the residual effect has been reduced to not significant. Where relevant, mitigation measures or mechanisms to reduce the potential significant effects arising from ICCI have been developed in discussion with environmental specialists.

15.5.3 Climate Change Resilience

15.5.3.1 Study Area (CCR Assessment)

The study area for the CCR assessment is the Site of the Proposed Development i.e. it covers all assets and infrastructure which constitute the Proposed Development, during construction, operation (including maintenance) and decommissioning.

15.5.3.2 Determining the Baseline (CCR Assessment)

For the purposes of the CCR assessment, the baseline conditions are based upon historic climate change data obtained from Met Éireann recorded by the closest meteorological station to the Proposed Development (Shannon Airport approximately 20 km north-east of the site).

15.5.3.3 Sensitive Receptor (CCR Assessment)

The sensitive receptors for the CCR assessment include the Proposed Development during its lifetime. Receptors include both the building and operation of the assets as well as construction works and staff.

15.5.3.4 Approach (CCR Assessment)

The CCR assessment has considered the strategic aims and objectives encompassed within the Government's local planning strategy and policy, which has the overarching aim of minimising the adverse impacts of climate change, whilst requiring new developments to take climate change considerations into account within design. This assessment of CCR is undertaken for the Proposed Development to identify potential climate change impacts, and to consider their potential consequence and likelihood of occurrence, taking account of the measures incorporated into the design of the Proposed Development.

For the operational phase of the Proposed Development, potential climate change impacts have been identified using relevant projections and conclusions from the EPA (2015) and considers their potential consequence to receptors and likelihood of occurrence, taking account of the measures incorporated into the design of the Proposed Development. Operational phase receptors may include the Proposed Development assets and their operation, maintenance and refurbishment (i.e. pavements, structures, earthworks and drainage, technology assets, etc.); and end-users (i.e. staff and commercial operators etc.).

The potential climate change impacts identified in the CCR assessment are determined based on the EPA projections. Climatic parameters that will be included in the CCR assessment are detailed in Section 15.6.2. The scope of the CCR assessment is set out in Table 15-10.

Table 15-10 Scope of the CCR Assessment

Climate Parameter	Scoped In or Out	Decision Rationale
Extreme weather event	In	The Proposed Development may be vulnerable to extreme weather events such as storm damage, coastal erosion and storm surge to structures and assets.
Precipitation	In	The Proposed Development may be vulnerable to changes in precipitation, for example, pressure on water supply during periods of reduced rainfall, and damage to structures and drainage systems during periods of heavy precipitation.
Temperature	In	Increased temperatures may increase cooling requirements of the proposed scheme and could impact on structural integrity of buildings and materials.
Sea level rise	In	The site is located in an area that is susceptible to sea level rise.
Sea temperature	Out	The Proposed Development is not likely to be affected by the small increase in sea temperature during its operational life.
Wind	In	The Proposed Development may be affected my increases in wind

Consideration of climate change impacts within EIARs is an area of emerging practice. The approach outlined below is aligned with existing guidance such as that of IEMA (IEMA, 2020). The CCR assessment identifies potential climate change impacts and considers their potential consequence to receptors and likelihood of occurrence.

The following key terms and definitions relating to the CCR assessment have been used:

- Climate hazard – a weather or climate related event, which has potential to do harm to environmental or community receptors or assets, for example, increased winter precipitation;
- Climate change impact – an impact from a climate hazard which affects the ability of the receptor or asset to maintain its function or purpose; and
- Consequence – any effect on the receptor or asset resulting from the climate hazard having an impact.

The types of receptors considered vulnerable to climate change, are:

- Construction phase receptors (i.e. workforce, plant and machinery);
- The Proposed Development assets and their operation, maintenance and refurbishment (i.e. pavements, structures, earthworks and drainage, technology assets, etc.); and

- End-users (i.e. staff and commercial operators etc.).

The assessment includes all infrastructure and assets associated with the Proposed Development. It assesses the resilience against both gradual climate change and the risks associated with an increased frequency of severe weather events as per the EPA climate change projections.

For the operational phase of the Proposed Development, once potential impacts have been identified, the likelihood and consequence of each impact occurring to each receptor (where relevant) are assessed for the selected future time frame for operation. Criteria used to determine the likelihood of an event occurring, based on its probability and frequency of occurrence, are detailed in Table 15-11.

Table 15-11 Description of Likelihood for Climate Change Hazard

Likelihood Category	Description (probability and frequency of occurrence)
Very likely	90-100% probability that the hazard will occur
Likely	66-90% probability that the hazard will occur
Possible, about as likely as not	33-66% probability that the hazard will occur
Unlikely	0-33% probability that the hazard will occur
Very unlikely	0-10% probability that the hazard will occur

The event is defined as the climate event (such as heatwave) and the hazard (such as overheated electrical equipment) occurring in combination

The consequence of an impact has been measured using the criteria detailed in Table 15-12.

Table 15-12 Measure of Consequence for CCR

Consequence of Impact	Description
Very high	Permanent damage to structures/ assets; Complete loss of operation/ service; Complete/ partial renewal of infrastructure; Serious health effects, possible loss of life; Extreme financial impact; and Exceptional environmental damage.
High	Extensive infrastructure damage and complete loss of service; Some infrastructure renewal; Major health impacts; Major financial loss; and Considerable environmental impacts.
Medium	Partial infrastructure damage and some loss of service; Moderate financial impact; Adverse effects on health; and Adverse impact on the environment.
Low	Localised infrastructure disruption and minor loss of service; No permanent damage, minor restoration work required; and Small financial losses and/ or slight adverse health or environmental effects.
Very low	No damage to infrastructure; No impacts on health or the environment; and No adverse financial impact.

Engagement is undertaken with relevant environmental disciplines and the engineering design team to discuss the CCR assessment and identify mitigation measures for incorporation into the design of the

Proposed Development. Measures to adapt the Proposed Development are identified where potential climate change consequences are identified as being significant and would be reported in the EIAR.

The significance is determined by:

Likelihood of climate hazard occurring × consequence to receptor if climate hazard occurs

The identification of likely significant effects on receptors has been undertaken using professional judgement by combining the measure of likelihood with the predicted consequence of impact, as shown in Table 15-13.

Table 15-13 Significance Criteria for CCR Resilience Assessment

		Likelihood of the climate change hazard occurring (Table 15-11)				
		Very unlikely	Unlikely	Possible	Likely	Very likely
Consequence of Climate Change Hazard Occurring (Table 15-12)	**Very Low**	Negligible	Negligible	Negligible	Negligible	Negligible
	Low	Negligible	Minor	Minor	Minor	Minor
	Medium	Negligible	Minor	Moderate	Moderate	Moderate
	High	Negligible	Minor	Moderate	Major	Major
	Very High	Negligible	Minor	Moderate	Major	Major

The assessment of potential impacts and the Proposed Development's vulnerability takes into account the mitigation measures that have been designed into the Proposed Development, as discussed in Section 15.9.

The assessment also identifies and accounts for existing CCR measures either already in place or in development for infrastructure and assets, for example, mitigation measures for potential flooding impacts on the Proposed Development

15.5.4 Limitations and Assumptions

As detailed design has not been completed, some data are not available to allow for a fully quantified assessment of the GHG emissions from the construction and operation of the Proposed Development. Accordingly, appropriate industry estimates and averages have been used. These, and all other assumptions are detailed in Sections 15.8.1.1 and 15.8.1.2.

Due the nature of GHG emissions and the receptor being the global climate, a quantitative assessment of cumulative GHG effects is not possible. Consequently, consideration of the effects of the Proposed Development together with other developments on GHG emissions is not considered to be applicable.

Limitations associated with the approach taken for the CCR review relate to uncertainties inherent within Irish climate projections (EPA, 2015). By its very nature, climate change is associated with a range of assumptions and limitations. To overcome these, current climate change data and science have been incorporated into the assessment and proven effective approaches undertaken to assess similar project types have been replicated.

15.6 Baseline Environment

15.6.1 Greenhouse Gas Emissions

As discussed in Section 15.5.1, the baseline environment assesses the 'Do Nothing' scenario where the Proposed Development does not go ahead.

15.6.1.1 Construction Emissions Baseline

The baseline for construction emissions considers the current land use at the site of the Proposed Development and the GHGs locked in carbon stocks above and below ground. The site is approximately

52 ha of which 41.4 ha is agricultural land (the remainder is the marine footprint). Current vegetation consists of undeveloped grassland, currently in use predominantly as grazing land. GHG stored in terrestrial carbon stocks at the Proposed Development site is estimated to be 4,018 tCO_2e.

No other construction activities are planned at the site therefore baseline emissions from construction are nil.

15.6.1.2 Operational Emissions Baseline

The baseline for operational emissions considers forecast GHG emissions associated with Ireland meeting future energy demands. Natural gas currently meets over 30% of Ireland's energy needs including heat and power for homes and businesses as well as for the generation of electricity. Supply of natural gas is currently met through a combination of domestic production and imports via a pipeline from Scotland. In 2019, 53% of Ireland's natural gas was imported from the UK. This is forecast to rise to around 90% by 2030, which has implications for the security of Ireland's gas supply.

The Climate Action Plan (2019) sets out GHG emissions targets to 2030 for the five sectors that contribute most to Ireland's emissions: Agriculture, Transport, Electricity, Built environment and Industry. Electricity Sector targets presented in the plan include:

- To meet the required level of emissions reduction by 2030 Ireland will reduce CO_2e emissions from the electricity generation sector by 50-55% relative to 2030 Pre-NDP projections;
- Deliver early and complete phase-out of coal- and peat-fired electricity; and
- Increase electricity generated from renewable sources to 70% (largely through onshore wind supported by offshore wind and solar PV).

If these electricity sector targets are met, emissions from the electricity sector in 2030 will be 4-5 Mt CO_2e compared to 12Mt CO_2e in 2019. The plan also highlights that the electricity sector meeting this target will be critical if the other sectors are to also meet their reduction targets.

It is further noted in the NECP (page 48) that '*The generation of electricity using peat and coal is being phased out. This generation will be replaced by a combination of renewable energy, interconnection imports and in the short to medium term by generation from natural gas*.'

In its approach to tackling climate change, the EU has split GHG emissions into two categories: those captured by the EU ETS (the traded sector) and the remainder that are not subject to the EU ETS (the non-traded sector). Emissions from electricity generation and large industry are in the traded sector and are dealt with at EU level. The EU ETS includes more than 11,000 power stations and industrial plants (stationary installations) in 31 countries. It covers about 45% of EU emissions, but only about 29% of total emissions in Ireland. The majority of the direct (Scope 1) emissions resulting from the Proposed Development would likely be captured by the EU ETS, but upstream emissions resulting from the production, liquefaction and transport of LNG would be in the non-traded sector and not subject to the ETS.

To provide additional context, it is assumed that operational emissions from the Proposed Development can be compared to emissions from an open cycle gas turbine (OCGT) generating an equivalent amount of energy. Within this counterfactual scenario, the OCGT is assumed to be fired by natural gas supplied from the Irish gas grid which is in turn connected to the UK gas grid via an interconnector from Scotland. The lower operating efficiency of an OCGT means that it would have significantly higher direct operational emissions than the CCGT that forms part of the Proposed Development. When additional indirect emissions resulting from the supply of fuel (LNG for the Proposed Development; natural gas for the counterfactual OCGT) are taken into account, the overall emissions from the Proposed Development's CCGT are still lower than those of the OCGT.

As discussed in Section 15.4, there are a number of European and Irish policies and initiatives designed to reduce emissions over time, with the European Green Deal aiming to make Europe GHG neutral by 2050. A key pillar of the Green Deal requires the decarbonising of energy systems. Within Ireland, the Climate Action Plan 2019 also seeks to achieve net-zero emissions by 2050. Finally, the Climate Action and Low Carbon Development (Amendment) Bill 2021 commits Ireland to move to a climate resilient and climate neutral economy by 2050. Achieving net-zero emissions or carbon neutrality requires that residual emissions remaining by the target date must be removed from the atmosphere or otherwise offset using a scheme recognised and verified to an approved standard.

In light of the above legislative framework, the path to decarbonise Ireland's gas and electricity systems is described by the Transmission System Operators for electricity and gas in the following two documents:

- EirGrid's *Tomorrow's Energy Scenarios* (TES) 2019 Ireland - Planning our Energy Future (EirGrid Group, 2019); and
- GNI's *Vision 2050*. (GNI, 2019).

EirGrid's TES sets out three credible scenarios for how the power system may be transformed over the period to 2040, with each scenario discussing the contributions of initiatives including the phase out of coal- and peat-fired generation, the role of carbon capture and storage, buildings energy efficiency, decentralisation and microgeneration, the role of smart meters and demand-side management among others.

GNI's Vision 2050 document describes how the Irish gas network will evolve to become net-zero carbon by 2050. This ambition is set to be achieved by two core methods:

- The injection of 50% zero and net-zero carbon gas (such as biomethane and green hydrogen) into the network to displace half the natural gas required to meet customer demand;
- The use of carbon capture and storage technology to abate the remaining emissions from the consumption of gas in the power generation sector and by large industry.

Each of these methods is anticipated to contribute approximately half the emissions reductions required to decarbonise the gas network.

Should the transformations of the electricity and gas networks as described in the EirGrid and GNI scenarios proceed as planned over the coming decades, this is likely to have a material impact on the emissions of the counterfactual OCGT that is assumed to be the direct competitor to the CCGT included in the Proposed Development. If the OCGT can be fitted with carbon capture and storage (included in two of EirGrid's three scenarios as well as in GNI's Vision 2050), this would result in a dramatic reduction in its emissions. Conversely, if the Power Plant in the Proposed Development converts to hydrogen before the counterfactual OCGT implements carbon capture and storage, the Power Plant would have a dramatic emissions benefit over its OCGT competitor.

Likewise, if half of the natural gas supplied by the Irish gas grid is replaced by low-carbon alternatives such as biomethane or hydrogen, as described in GNI's Vision 2050, this would also have a significant impact on the OCGT's emissions. In the event of either the EirGrid TES or the GNI Vision 2050 being implemented, before the Power Plant converts to hydrogen the Proposed Development would no longer enjoy an emissions benefit over its OCGT competitor. It is not currently possible to model with any certainty the planned decarbonisation of the Irish gas grid, so the date at which the counterfactual OCGT will have lower emissions than the proposed CCGT cannot be estimated.
However, if the Power Plant in the Proposed Development converts to hydrogen before the counterfactual OCGT receives biomethane or hydrogen, the Power Plant would have a dramatic emissions benefit over its OCGT competitor.

15.6.2 ICCI and Climate Change Resilience

The current baseline for the CCR review is based on historic climate data obtained from Met Éireann (2020) recorded by the closest meteorological station to the Proposed Development (Shannon Airport, approximately 20 km north-east of the site) for the period 1981-2010. These data are listed in Table 15-14.

Table 15-14 Historic Climate Data

Climatic Variable	Month	Value
Average annual maximum daily temperature (°C)	-	14.0
Warmest month on average (°C)	July	19.6
Coldest month on average (°C)	January	3.2
Mean annual rainfall levels (mm)	-	977.6

Climatic Variable	Month	Value
Wettest month on average (mm)	October	104.9
Driest month on average (mm)	April	59.2
Months with lowest average number of days with less than 0.2 mm of rainfall (days)	June	15
Month with greatest number of days with gales (days)	January	1.7

The future baseline will be used to determine the likely future climate change impacts on the Proposed Development. and where potential climate adaption measures are required. The EPA (EPA, 2015) in the regional climate model projections for Ireland presents the following climate change projections for mid-century (2041-2060), against a baseline period of 1981-2000:

- Temperature projections suggest an increase in mean annual temperatures of 1.2-1.6°C;
- Mean winter temperature projections indicate an increase of 1.2°C in the southwest of Ireland;
- Mean summer temperature projections indicate an increase of 1.1°C in the southwest of Ireland;
- Average annual rainfall is projected to decrease;
- Rainfall projections indicate a significant decrease in average precipitation levels for summer. 'Likely' reductions in summer rainfall of 3% to 20% are anticipated;
- Projections for average winter precipitation are less certain;
- 'Likely' increases in the number of 'wet days' and 'very wet days' for winter of 24% and 30%, respectively;
- The number of extended dry periods (defined as at least 5 consecutive days for which the daily precipitation is less than 1 mm) is also expected to increase over the year, particularly in summer and autumn, with 'likely' values ranging from a 12% to 40% increase;
- Storms affecting Ireland are anticipated to decrease in frequency, but increase in severity, increasing the risk of damage to infrastructure;
- Wind energy is projected to decrease in spring, summer and autumn, while projected increases in wind energy in the winter were found to be statistically insignificant;
- The sea level in Dublin is rising at 0.23 mm every year; and
- A rise in global sea surface temperature of 1.5°C by 2050.

Co. Kerry's Climate Change Adaptation Strategy (KCC, 2019) states that it is located within the 'Atlantic Seaboard South Climate Action Region' and that this region is one of the most climate-susceptible regions in Ireland in due to its exposure to wind and storms. Recent climate hazards experienced by the County include extreme rainfall and strong winds, heatwaves and droughts. Climate change-induced changes to these variables and their assumed likelihood of occurrence are summarised in Table 15-15.

Table 15-15 Summary of Future Climatic Projections

Climate Variable	Projected Change in Likelihood	2041-2060 Likelihood
Temperature		
Average annual temperature	↑	Likely
Average summer temperature	↑	Likely
Average winter temperature	↑	Likely
Rainfall		
Annual rainfall	↓	Likely
Average summer rainfall	↓	Likely
Average winter rainfall	↔	Possible

Climate Variable	Projected Change in Likelihood	2041-2060 Likelihood
Extreme Events		
Heat waves	↑	Possible
Droughts	↑	Likely
Storms- frequency	↓	Likely
Storms- intensity	↑	Likely
Sea Level		
Sea level rise	↑	Very likely

15.7 Embedded Mitigation

15.7.1 Lifecycle GHG Impact Mitigation

To reduce carbon emissions during the construction and operation phase, embedded controls and mitigation measures as outlined in Chapter 02 – Project Description include:

- Existing tree protection measures during construction shall be carried out in accordance with BS 5837:2012, with a 5-10 m buffer of retained vegetation along the stream.
- The Power Plant offers very low minimum stable generation compared to other generators. This will allow the system operator to turn other less efficient generators off while keeping the Power Plant running at minimum generation to ensure grid stability during periods of high wind generation;
- The Power Plant shall not operate in less efficient Open Cycle mode;
- A closed loop air cooled steam condenser shall be used for the Power Plant. This will result in significantly less water being consumed for operation when compared to other possible cooling options;
- The heat for LNG regasification onboard the FSRU shall be principally via heat from seawater rather than gas-fired boilers. Gas-fired boilers shall only be used when there is insufficient heat from the sea in the winter time;
- The site layout is compact and efficient resulting in a smaller area being developed and therefore reduced release of carbon from terrestrial stocks such as soil and vegetation.
- The main site platform is at +18 m OD resulting in minimised cut and fill and therefore minimised terrestrial carbon stocks being released;
- The LNG Terminal would be powered from either the Power Plant or medium voltage (10/ 20 kV) connection. The generators (CTG1, CTG2, & CTG3) would be in operation only as back-up when the Power Plant or medium voltage (10/ 20 kV) connection are either shutdown or lost;
- Diesel Firewater Pump is operated in emergency conditions only, and apart from periodic testing is not run during normal operations;
- Black-start Diesel Generator used for initial start-up only and apart from testing would not be running during normal operations;
- Auxiliary Boiler is only operated when all CTG/ HRSG Trains are not in operation to facilitate a unit start; and
- Other design alternatives were considered (refer to Chapter 03 – Need and Alternatives) which would have had higher CO_2 footprint. Specifically, onshore 200,000 m^3 concrete LNG storage tanks were not proposed and a materials jetty and a hydrotesting pond were eliminated.

15.7.2 In-Combination Climate Change Impacts Mitigation

Full details of the embedded design measures that reduce likelihood or severity of climate change hazards exacerbating operational impacts are detailed within other discipline assessments.

15.7.3 Climate Change Resilience Mitigation

Full details of embedded design measures that reduce the vulnerability of the Proposed Development are detailed within other technical disciplines. A summary of these measures includes:

- Electrical connections would be buried underground, insulating against overheating in times of heatwaves;
- The Proposed Development would be designed with any specific drainage terms and conditions of the IE Licence, as determined by the EPA, and associated planning conditions, to protect against high rainfall events or sea level rise; and
- Drainage will be designed in line with the principles of SUDS for a 1 in 100-year flood event plus an uplift of 20% contingency to account for any influence of climate change.

15.8 Assessment of Impact and Effect

15.8.1 Lifecycle GHG Assessment

This section presents the impacts and effects associated with the construction and operation of the Proposed Development. The assessments have been undertaken with consideration of the mitigation measures outlined in Section 15.5. While the operation of the Proposed Development results in direct GHG emissions it is necessary to consider these impacts in the context of Ireland’s objectives to decarbonise energy and the security of energy supply. As stated in Section 15.4.3, The National Energy and Climate Plan 2021-2030 recognises that that if Ireland is to meet its ambitious renewable energy target of 70% by 2030, then natural gas has a key role to play in providing a contribution to the energy mix for heat and transportation and as a back up to variable renewable power generation.

Furthermore, the use of a CCGT as planned for the Proposed Development provides an efficient source of gas-powered energy generations. For further context emissions from the Proposed Development have been compared against the impact of generating an equivalent amount of energy from a typical Open Cycle Gas Turbine (OCGT) such as those currently supplying electricity to the electricity grid.

15.8.1.1 Construction Phase Emissions

As detailed design has not been completed, the assessment of GHG emissions has been undertaken based on the following conditions using a mixture of existing project data and information, industry benchmarks and professional judgement. The following assumptions, inclusions and exclusions, made on a precautionary basis, have been used in this calculation.

- Construction activities would take 18 months for the LNG facilities and 32 months for the Power Plant, with activities undertaken Monday to Saturday.
- The peak number of workers on-site has been estimated as 975 per day (as described in Chapter 11 – Traffic and Transport). To increase conservatism, it is assumed that there will be 975 workers on-site each of day construction.
- Fuel usage onsite has been based on the list of construction equipment provided by the Applicant, which has been assumed to be in operation 70% of the time. Additionally, the jetty construction is expected to be undertaken 24 hours per day, 6 days per week for 10 months, involving tugs, floating barges and self-elevating platforms (jack-ups), compressors, generators, and land-based machines will also be used. Fuel usage estimates to construct the jetty have been included.
- Electricity usage likely needed for onsite welfare and offices has been included but is based upon industry benchmarks described in CIBSE (2008). As the size of these facilities is not available an estimation of 2.3 m^2 per person has been applied to a ‘general office’ benchmark, for the peak amount of workers onsite being 975 from the construction manpower projection in the Project Description.
- Purchased goods and services include potable water and some building materials. As a bill of quantities for construction materials is not yet available, estimated embodied carbon has been calculated using the Proposed Development buildings floor area (13.2 ha) against the single point benchmark under other industrial/ utilities/ specialist users developed by RICS (2014). Volumes of concrete, aggregates and steel piles to construct the jetty have been included. This is a partial estimate based on assumptions of building dimensions, and excludes fit-out materials, and any explosives required. The embodied carbon of the BESS (27 4.5 MW lithium ion batteries) has been included.

- At this stage in the design and contracting process, it is not confirmed whether a new FSRU vessel will be commissioned or an existing vessel chartered from the market for the operations stage of the Proposed Development. Due to the unavailability of data to estimate the embodied carbon of manufacturing an FSRU, it is assumed that the FSRU will instead be chartered from the market and emissions associated with the initial transport of the FSRU to site are included. These emissions are included under Upstream Transportation and Distribution.
- Water requirements for the construction phase (e.g. wheel washing and dust suppression) have been included as up to 55 m^3 per day, as per Chapter 06:
- Construction transport emissions are based on construction vehicle movement projections in the Project Description, assumed to be travelling 25 km each way based on the distance from the Port of Foynes:
  - 37 HGVs per day; and
  - 73 LGVs per day.
- Transportation of the lithium ion batteries has also been included, based on a worst-case sea transportation from Asia and HGV transport at the source location and within Ireland. Transportation of the tugs to site has not been included as it is assumed they are available locally. Emissions associated with the initial transportation of the FSRU has been assumed on the basis that it requires 30 days sailing and the vessel consumes 100 tonnes of marine fuel oil per day. The main engines of LNG carriers are able to consume boil-off gas (BOG) from the cargo as well as conventional bunker fuel. Emissions from natural gas are almost 30% lower than from bunker fuel for the same energy content, but as it is not possible to estimate the fraction of BOG in an LNG carrier's fuel supply, a conservative worst case scenario of 100% bunker fuel has been assumed.
- Construction waste quantities have been taken from the waste chapter. They have been determined from an average based on the floor area of the site being 13.2 ha (Post-development surfacing quantities) and 480,000m³ excavated and placed overburden soil and rock. Waste quantities are based on percentages for 'good practice recovery' from the waste management practices outlined by the Applicant.
- Municipal waste volumes have been calculated using Ireland's total waste data for 2018 per person, with 81% being recycled or incinerated and 19% going to landfill (EPA, 2018). This has been applied to the total 360,960 worker days for the entire construction period.
- Employee transport emissions have been based on the peak construction staff vehicle movement described in Chapter 11 – Traffic and Transport. It is assumed travel is 40 km each way, which is the average distance between the site and Foynes, Ennis or Tralee.
- Emissions associated with the land use change are based upon a conversion of 17 ha of arable grassland to hardstanding.

As detailed in Table 15-16, the estimated GHG emissions from the construction phase of the Proposed Development have been calculated to be 185,502tCO_2e over the course of the 32 month construction period. The majority of emissions (84%) are associated with purchased goods and services (construction materials). Average annual emissions are therefore expected to be approximately 69,738tCO_2e.

Table 15-16 Estimated Construction GHG Emissions

Scope	Project Activity/ Emission Source	Emissions (tCO_2e)	Percentage of Stage Emissions
1- Direct GHG Emissions	Fuel Usage Onsite	11,814	6%
2- Indirect GHG Emissions	Electricity Purchase	339	<1%
3- Indirect Other GHG Emissions (Upstream)	Purchase Goods and Services	150,834	814%
	Upstream Transportation and Distribution	12,341	7%
	Waste Generated in Operations	1,312	1%
	Employee Commuting	7,212	4%

Other	Land Use Change	1,650	1%
	Stage Total	**185,502**	
	Annual	**69,738**	

To contextualise the magnitude of impact, these emissions have been compared to the current Irish national GHG inventory (EPA, 2019b) (Table 15-2). Emissions from the construction phase of the Proposed Development would not contribute to more than 0.11% of the latest Irish GHG inventory.

The magnitude of effect during construction would therefore be considered **low**. As per Table 15-3, the significance of effects would be **minor adverse**.

15.8.1.2 Operational Phase GHG Emissions

GHG emissions due to activities undertaken during the operation of the Proposed Development are presented below.

The Power Plant will not operate at 100% capacity all year round. The actual operation of the plant will be determined by many factors such as power demand itself, the amount of renewable generation on the system, its bid price into the market compared to other generators, and the rules of the grid to ensure priority is given to renewable generation. The grid also needs to remain stable and secure with increased high levels of renewable generation.

EirGrid has advised the Applicant in pre-application consultations that to ensure grid stability in the context of increased contribution to the grid from renewable sources, the future grid requires flexible gas-fired power plants with high inertia[2], low minimum stable generation and fast response capability. Ireland's National Energy and Climate Plan 2021-2030 supports this advice noting in section 2.4.2 that:

> *In addition, as Ireland transitions itself to a low carbon economy, the gas and electricity networks must be planned and developed to make the transition as smooth as possible. As we make the transition the energy networks in Ireland will face many challenges. For example, as the penetration of electricity generated from wind increases the electricity network must be flexible to handle the unpredictability of wind while still operating in a secure manner. The increased penetration of wind energy also places an increased reliance on Ireland's gas network*

Finally, the Commission for Regulation of Utilities in their Draft Opening Statement for the Joint Oireachtas Committee on Climate - Sector by sector analysis towards a 51% reduction in emissions by 2030 over 2018 levels, 6th July, 2021 noted;

> *The twin challenges of replacing a large part of our existing generation fleet, while meeting rapidly growing demand, means that a minimum of 2GW of new gas-fired plant will be needed in the next few years. This **flexible** capacity is required to support increased renewables, enable us to retire older carbon intensive plant (coal, peat and oil) and ensure security of supply.* **[emphasis added]**

Given the above, the Applicant commissioned a detailed market analysis (*the Baringa Shannon Wholesale & Ancillary Revenue Report*) report to consider these issues and model the future operation of the Power Plant from 2023 to 2050. Other power plant configurations were also modelled. The model assumes the government's 70% renewable by 2030 target is met. It also considers the detailed requirements of the system operator (EirGrid) to keep the grid stable and secure.

In conclusion, analysis confirmed that the flexibility of the Power Plant, including the BESS, is ideally aligned with a high-renewable market from now to 2050. In particular, the Power Plant offers the market high inertia, very low minimum stable generation and fast response capability. The detailed results from the modelling of the Power Plant future operations are confidential, but the CO_2 emissions presented in this chapter are taken from this model.

The 120 megawatt hour BESS will comprise of 27 battery containers that house lithium ion batteries. Due to its fast response, the BESS allows the Power Plant to provide electricity during 'ramp up' and can provide quick power to the grid in times of fluctuating renewable energy generation. Once the Power Plant is

[2] One of the challenges with increased renewable (wind) generation on the system is a potential for an increased rate at which the grid frequency falls. This is known as the rate of change of frequency (RoCoF). Events that result in high RoCoF levels can potentially lead to instability in the power system. All power systems, including the Irish power system, have inertia. Inertia is a resistance to change in motion. The inertia on the power system resists the RoCoF and helps maintain system stability.

operating at the necessary capacity and the electrical demand is met, the BESS will be shut down and recharged directly from the Power Plant. It is estimated that the BESS will be used 187 times each year.

In order to estimate additional emissions resulting from the use of the BESS, the following assumptions have been made:

- The BESS will be charged directly by the power generated by the CCGT, i.e. it will be a parasitic load on the plant;
- Each of the 187 times that the BESS is used each year will involve a full discharge-charge cycle, with all the 120 MWh of energy stored being used; and
- The round-trip efficiency of the charge-discharge cycle is 80%.

Applying these assumptions, together with the emissions factor for natural gas and the stated operational efficiency of the CCGT, it is estimated that the use of the BESS will result in additional emissions of 1,577 tonnes CO_2e in 2026, the first full year of operation. Over the lifetime of the Proposed Development, use of the BESS contributes additional emissions of 39,910 tonnes CO_2e, which is 0.2% of direct operational emissions from the CCGT without use of the BESS.

Calculations of GHG emissions are based on the following conditions using a mixture of existing Proposed Development information, industry benchmarks and professional judgement. The following assumptions, inclusions and exclusions, made on a precautionary basis, have been used in this calculation:

- An operational life of 25.5 years (to 2050), active every day, all day. After this time, the Proposed Development may be transitioned from a natural gas to a hydrogen-powered facility subject to technology availability and feasibility and approval from planning authorities. There is currently not enough information to include this consideration into the assessment;
- No planned downtime for maintenance;
- The LNG Terminal will import approximately 4 million tonnes of LNG annually. Some of this will be combusted in the CCGT power station onsite to generate electricity, but the majority will be fed into the Irish natural gas grid for consumption elsewhere in Ireland. Emissions associated with onsite combustion are included in Scope 1 emissions. Emissions associated with the gas supplied into the gas network as a result of the Proposed Development are not included in the scope of this assessment. GHG emissions from the use of this gas include both direct emissions from combustion of the fuel at third party sites or assets (i.e. for domestic or industrial use) and the associated indirect well-to-tank emissions. These emissions are the responsibility of the end user;
- Other Scope 1 emissions included are those from emergency/ backup/ auxiliary plant. As described in Chapter 08 – Air Quality, this comprises seven units, each operating for 52 hours per year. It has been assumed that each item has a power rating of 1000 kW;
- Carbon emissions associated with annual electricity generation have been calculated from the Baringa Shannon Wholesale & Ancillary Revenue Report with 184g per kWh emissions factor applied for natural gas. It is assumed all electricity to the LNG Terminal would be provided by the Power Plant. The LNG Terminal load is estimated at 10 MW with the Power Plant parasitic load being an additional 10 MW;
- Energy usage used to recharge the BESS has been included using the methodology stated above;
- Materials and products used include 35 m^3 per hour potable/ fresh water for welfare and fire protection systems only, as per Chapter 06. A maintenance schedule is not available and therefore maintenance materials have not been included;
- Indirect upstream emissions associated with emissions from purchased fuels (extraction, production, and transportation) used or processed within the Proposed Development. These are known as Well-to-Tank (WTT) emissions and are subject to a degree of uncertainty as we project into the future. How future WTT emissions have been calculated is detailed below. WTT emissions are assumed to cover emissions associated with the main engines of the FSRU, the re-gasification boilers on the FSRU, the main engine on the LNGC delivering to the operational facility, the water bath heaters, and the boilers at the AGI;
- Wastes have been calculated in line with the estimates detailed in Chapter 16 – Waste, assuming 81% is recycled and 19% disposed of at landfill (EPA, 2018);

- A total workforce of 141 land-based and 51 marine-based operational workers. Land-based workers are onsite everyday whilst marine-based workers are generally leaving site by road every three months. Commuters are assumed to be travelling 40 km each way, based on the average distance from significant urban areas; and
- Four tugs, assumed to be using 187 litres of marine fuel oil per hour, two of which are active for 4,620 hours per year and the remaining two active for 2,310 hours per year, as per the worst case scenario described in Chapter 08 – Air Quality. These emissions are included under 'Upstream Transportation and Distribution'.

As detailed in Table 15-17, the total GHGs estimated to be emitted from the operational phase of the Proposed Development have been calculated to be 20,056,725 tCO_2e over the course of the 25.5-year period. The large majority of emissions (84%) would be associated with the combustion of gas at the Power Plant, with a further 15% from the upstream extraction, processing, liquefaction and transport of the LNG (WTT emissions). The remaining 1% comes from minor sources such as the embodied carbon in purchased goods and services, upstream transportation and distribution, waste disposal and employee commuting.

Table 15-17 Operational GHG Emissions (tCO_2e)

Scope	Project Activity/ Emission Source	2026: Annual Emissions (tCO_2e)	2030: Annual Emissions (tCO_2e)	2050: Annual Emissions (tCO_2e)	Total Emissions (tCO_2e)
1- Direct GHG Emissions	Fuel Usage Onsite (all CCGT)	712,812	655,974	605,741	16,791,260
3- Indirect Other GHG Emissions (Upstream)	Purchased Goods and Services	44	44	44	1,132
	Fuel and Energy-Related Activities (not included in Scope 1 or 2) (WTT)	126,369	116,269	107,342	2,976,223
	Upstream Transportation and Distribution	9,842	9,842	9,842	250,958
	Waste Generated in Operations	563	563	563	14,366
	Employee Commuting	894	894	894	22,786
Other	Land Use Change	0	0	0	0
	Total	**850,524**	**783,586**	**724,426**	**20,056,725**
				Annual average	**786,538**

If passed, the Climate Action and Low Carbon Development (Amendment) Bill 2021 will set a binding target of cutting GHG emissions in Ireland by 51% by 2030 based on a 2018 baseline, with the aim of reaching carbon neutrality by 2050. Ireland's GHG emissions in 2018 were 60,935 $ktCO_2e$ consisting 19,953 $ktCO_2e$ from agriculture, 23,146 $ktCO_2e$ from non- ETS energy related, 2,304 $ktCO_2e$ other non-ETS and 15,532 $ktCO_2e$ ETS (SEAI).

To provide context, direct emissions from the Proposed Development in 2030 would equate to approximately 2.2% of Ireland's estimated emissions allowance. This excludes indirect well-to-tank emissions as these are not included in Ireland's emissions inventory. The magnitude of effect during operation would therefore be considered **High**. As per Table 15-3, the significance of effects would be **major adverse**. It is acknowledged however that without a supply of gas-powered electricity generation, Ireland would not meet its 70% by 2030 renewable energy electricity target, in turn allowing Ireland to meet is national carbon reduction target. Furthermore, direct operational emissions from the Proposed Development will be covered by the EU ETS. The EU ETS operates in trading phases, with the current Phase 4 running from 2021-2030. The EU-wide emissions cap will reduce by an annual rate of 2.2% for the period 2021-25 (European Commission, 2021). This annual reduction rate is set to increase from 2026 onwards as the European Union acts to meet more ambitious emissions reductions targets. It must be noted that the annual reduction in the EU ETS emissions cap (the 'linear reduction factor') is binding on the EU traded sector as a whole, and not on any one individual installation.

Ireland currently imports circa 57% of its natural gas via a pipeline under the Irish Sea from the UK. Around half of the UK's gas supplies come from the North Sea gas fields on the UK Continental Shelf (UKCS) while the remainder is imported from a number of sources including from Norway and other countries in mainland Europe by pipeline, and from other sources around the world in the form of LNG transported by ship.

The upstream WTT emissions of LNG, resulting from the extraction, processing, liquefaction and transport of the gas, are significantly higher than those of the natural gas within the UK gas network. Over time, the WTT emissions of the gas in the UK grid are set to increase, largely as the share of LNG in the UK grid increases. Based on information from the UK Government Oil and Gas Authority, WTT emissions of LNG are currently around 2.5 times higher than those of the UK gas network, but while this ratio is set to fall over the lifetime of the Proposed Development, by 2050 LNG is still projected (see WTT Calculation Methodology below) to have WTT emissions around 1.7 times higher than those of the gas in the UK grid.

The higher WTT emissions from the 4 million tonnes of LNG imported annually compared with the same amount of gas from an alternative gas supply is likely to result in additional annual average Scope 3 emissions of around 940 ktCO_2e/yr per operational year, or 23,971 ktCO2e over the full operational lifetime of the Proposed Development.

WTT calculation methodology

The WTT emissions from gas supplied via the national grid will change as the mix of gas supplies changes over time, e.g. as the UK Continental Shelf (UKCS) declines as a source of gas, alternative sources will increase in the UK gas mix. Alternative sources are primarily LNG imported by ship, and gas supplied via pipelines from Norway, Belgium, and the Netherlands. The Oil and Gas Authority (2019) provides WTT emissions for LNG, gas from the UKCS, and gas supplied from Norway and continental Europe (Table 15-18). We can assume that the WTT emissions of LNG will remain broadly constant over time, while the overall WTT emissions of gas in the UK grid will change over time as the proportion of the supply from UKCS, pipeline and LNG changes.

Table 15-18 WTT Carbon Intensity from Varying UK LNG Sources

Source of gas	Carbon intensity (kg CO_2e/BoE)[3]
UK Continental Shelf	22
Pipeline (Norway or continental Europe)	18
LNG	59

The National Grid (2020) publishes a set of Future Energy Scenarios annually, under which the energy mix of the UK varies according to factors including consumer choice, market forces and government policy. For each of these scenarios, the National Grid projects not only the overall volume of gas consumed, but how the mix of sources may vary. The WTT emissions associated with gas sources are detailed in Table 15-19.

Table 15-19 WTT Carbon Intensity from Varying UK Gas Sources

Source of gas	Carbon intensity (kg CO_2e/boe)	Notes
UKCS	22	From UK Oil and Gas Authority (UK OGA)
Shale	22	Assumed to be same as UKCS[4]

[3] BoE – Barrel of Oil Equivalent; a standard unit of energy content used in the oil and gas sector
[4] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/237330/MacKay_Stone_shale_study_report_09092013.pdf

Source of gas	Carbon intensity (kg CO_2e/boe)	Notes
Green gas	0	Very low volumes; WTT assumed to be zero
Norway	18	From UK OGA
Continent	18	From UK OGA; assumed to be same as Norway
LNG	59	From UK OGA
Generic imports	38.5	'This is gas that can be any mixture of LNG and continental gas'[5]; assumed to be 50:50 with WTT emissions average of the two

The 2020 National Grid data for the volumes of gas supplied from different sources is all provided in billions of cubic metres per year, and this was converted to BoE/yr using the appropriate conversion factor (1bcm = 6,088,793 BoE). The WTT emissions intensity for each source were applied to derive an average WTT figure for the UK gas grid in each year to 2050. Although the overall volume of gas supplied under each of the four scenarios varied significantly, it was notable that average WTT emissions did not, although they all increased over time as the proportion of LNG in the UK gas mix increased. This is illustrated in Figure 15-1.

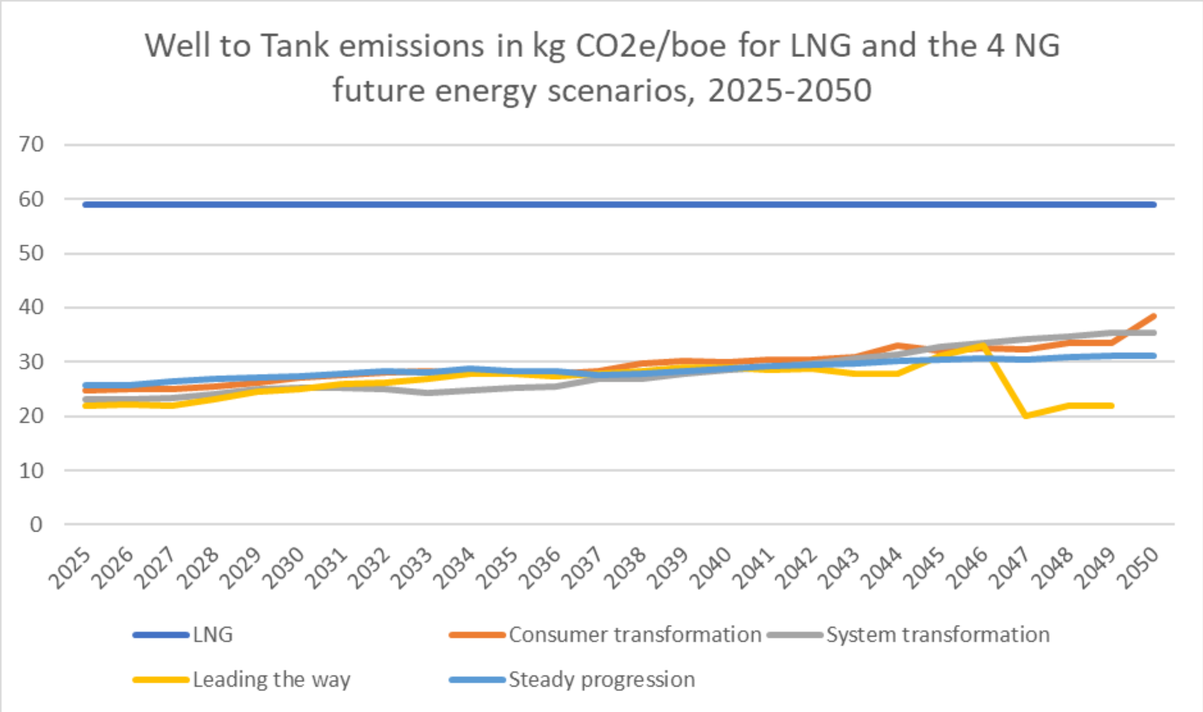

Figure 15-1 WTT Emissions intensity for National Grid Future Energy Scenarios

As each of the four National Grid scenarios had very similar WTT intensities, it was decided to use a composite scenario with the average WTT emissions factors for each year. The WTT emissions were also converted from kg CO_2e/BoE to kg CO_2e/tonne using the appropriate factor (1 tonne of LNG or NG = 7.65 BoE).These WTT data were applied to the gas consumed in the proposed CCGT, the counterfactual OCGT and the residual gas supplied to the Irish gas grid.

Assuming that the Proposed Development's first year of operation is 2026 and it runs for 25 years to 2050, we can estimate the overall direct and indirect (including upstream Well To Tank) emissions for the Proposed Development and counterfactual scenario shown in Table 15-20 below:

[5] https://www.nationalgrideso.com/document/173796/download

Table 15-20 Combustion and WTT Emissions of the Proposed Development vs. the Counterfactual Scenario

	Proposed Development emissions ($ktCO_2e$)	Counterfactual scenario emissions($ktCO_2e$)
Direct combustion emissions from power station (Scope 1)	16,786	22,364
Indirect WTT emissions from power station (Scope 3)	2,976	1,901
Sub-total for power station	**19,762**	**24,604**
Indirect WTT emissions from residual gas (Scope 3)	43,040	20,622
Total	**62,802**	**44,887**

Alternative gas fired electricity energy generation

As discussed, for Ireland to meet its 2030 target for 70% of electricity generation from renewable energy the remaining 30% will predominantly have to be met from natural gas-powered generation. From 2025 onwards, natural gas fired electricity generation comes from a mixture of open-cycle gas turbine (OGCT) plant and combined cycle gas turbine plant (CCGT). Any OCGT plant on the Irish network is less efficient than a CCGT and therefore likely to be dispatched after the Proposed Development.

Figure 15-2 shows annual emissions from the Proposed Development running on imported LNG together with an alternative counterfactual scenario i.e. an OGCT running on natural gas from Ireland's gas grid producing the equivalent amount of power. OCGT efficiency has been based on published data for efficiency and intensity of different plant types from the UK in the absence of Irish-specific data (UK Parliament).

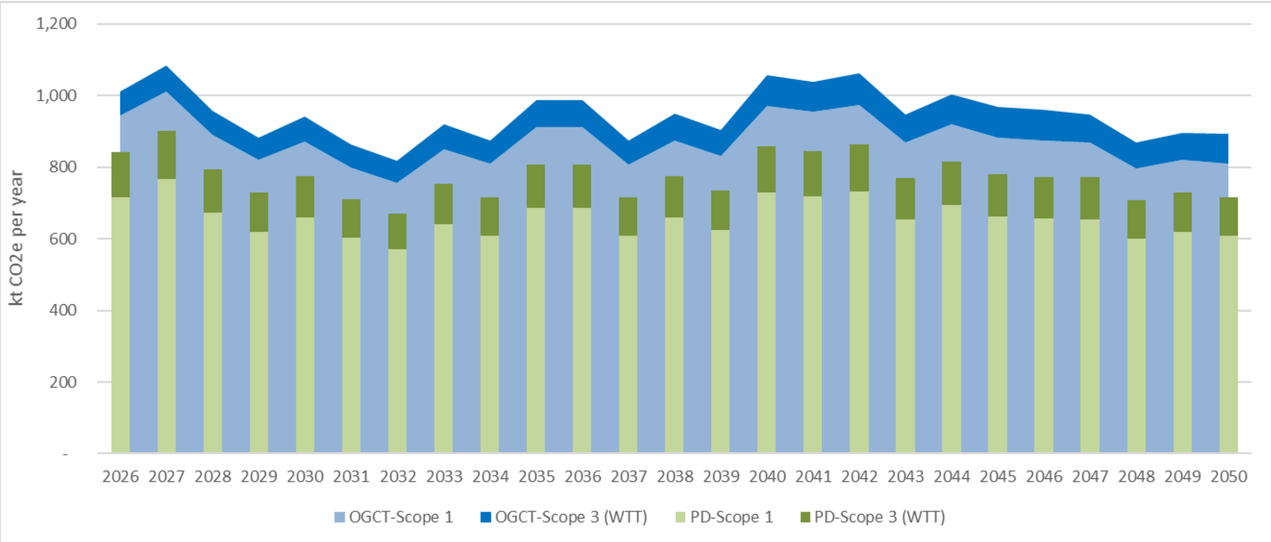

Figure 15-2 Direct + Indirect (WTT) Operational Emissions from the Proposed Development with Imported LNG and Equivalent Emissions from an OCGT Powered by Gas from the Irish Grid (kt CO_2e/yr)

The carbon impact of the proposed CCGT Power Plant is significantly lower than an equivalent OCGT, when we consider the gas combustion within the Power Plant, and the upstream 'Well to Tank' (WTT) emissions from the production and delivery of this gas. The CCGT is more efficient than the equivalent OCGT, but the WTT emissions from LNG are greater than those for natural gas supplied via the gas grid.

It is not possible to state exactly which power generation unit will be displaced by the Proposed Development as this will depend on a number factors including the volume of energy generated by renewables and the availability via grid interconnectors. In summary however, where the proposed CCGT plant displaces less efficient OGCT power generators on the grid, this will result in lower direct GHG emissions to generate the equivalent amount of energy.

15.8.2 In-Combination Climate Change Impacts

15.8.2.1 Construction Phase ICCI impacts

During construction, environmental and social receptors may experience exacerbated project impacts through changing climates hazards. These could include:

- Increased risks to soil quality and air quality (dust production) through construction activities combined with reduced rainfall, increased temperatures, increased droughts and heatwaves;
- Increased risks of invasive species translocation through construction vessels and warming sea temperatures;
- Increased risks of noise disturbance to residents through construction noise combined with increased summer temperatures (open windows); and
- Increased risks to soils, marine and aquatic river quality through construction ground disturbance and sea level rise, increased storm intensity and rainfall.

15.8.2.2 Operational Phase ICCI impacts

Technical specialists have undertaken a review of climate change hazards to understand if climate change would exacerbate any project risks to their receptors. No potential ICCIs have been identified by technical specialists and therefore no further mitigation or monitoring has been recommended.

15.8.3 Climate Change Resilience

15.8.3.1 CCR Construction Impacts

During construction, receptors such as the construction work force, construction plant, vehicles, and materials may be vulnerable to a range of climate risks. These could include:

- Inaccessible construction site due to severe weather event (flooding, snow and ice, storms) restricting working hours and delaying construction;
- Health and safety risks to the workforce during severe weather events;
- Unsuitable conditions (due to very hot weather or very wet weather, for example) for certain construction activities; and
- Damage to construction materials, plant and equipment, including damage to temporary buildings/ facilities within the site boundary, such as offices, compounds, material storage areas and worksites, for example as a result of stormy weather.

15.8.3.2 CCR Operational Phase Impacts

The potential impacts and effects of projections for climate change to the Proposed Development are detailed in Table 15-21 and are based upon that scoped in to the assessment (see Table 15-10).

Table 15-21 Potential CCR Impacts and Relevant Embedded Adaptation/ Resilience Measures

Climate Hazard Type	Climate Hazard Projection	Sensitive Receptor	Description of Potential Impact	Embedded Design Measure	Likelihood of Impact Occurring	Consequence of Impact Occurring	Resilience Risk Level	Significant?	Additional Mitigation or Monitoring Measures
Increase in annual temperature	Likely	Built terrestrial assets, staff facilities and access routes to sites	See- Increase in summer temperature	See- Increase in summer temperature	Possible	Low	Minor	No	None Required
Increase in summer temperature	Likely	Assets, facilities, roads	Overheating of electrical equipment Heat damage, deformation, cracking and thermal expansion of building surfaces and pavements	Electrical connections would be buried underground, insulating against overheating in times of heatwaves All buildings would be designed to Irish standards and specifications	Very Unlikely	Medium	Negligible	No	None Required
		Staff, visitors onsite	Impacts on the thermal comfort of building users Increase in ambient temperature of buildings, leading to higher air conditioning requirements and impacts on the thermal comfort of building users	Detailed design of air conditioning units for offices would include an allowance for future rise in ambient temperature. All buildings would be designed to Irish standards and specifications	Very Unlikely	Low	Negligible	No	None Required
		Function of facility	Reduced efficiency of CCGT operations- An increase in summer temperature could impact the base load plant efficiency	The Power Plant is designed to operate over a large range of ambient conditions and the plant efficiency difference is less than 1% from high to low. Temperature changes would not have a noticeable impact. The efficiency impact would also be less when the plant is operating at lower loads.	Likely	Low	Minor	No	None Required

Climate Hazard Type	Climate Hazard Projection	Sensitive Receptor	Description of Potential Impact	Embedded Design Measure	Likelihood of Impact Occurring	Consequence of Impact Occurring	Resilience Risk Level	Significant?	Additional Mitigation or Monitoring Measures
Increase in winter temperature	Likely	Built terrestrial assets, staff facilities and access routes to sites	None considered	None considered	Very Unlikely	Very Low	Negligible	No	None Required
Decrease in annual rainfall	Likely	Assets, facilities, roads	See- Decrease in summer rainfall	See- Decrease in summer rainfall	Very Unlikely	Medium	Negligible	No	None Required
Decrease in summer rainfall	Likely	Assets, facilities, roads	Water shortages Drying out of pavement structures Deterioration of structures or foundations due to decrease in soil moisture levels Insufficient water for plant cooling	The Power Plant utilises air cooled heat exchangers rather than use of cooling water. Buildings would utilise water efficient fixtures All buildings would be designed to Irish standards and specifications	Very Unlikely	Low	Negligible	No	None Required
Increase to winter rainfall	Possible	Built terrestrial assets, staff facilities and access routes to sites Staff, contractors and visitors	Surface water flooding and standing waters Deterioration of structures or foundations due to increase in soil moisture levels Damage to building surfaces/ exposed utilities from increased drying/ wetting and increase frost penetration Loss or damage to materials	The FRA considers climate change considerations of the 'mid-range' and 'high end' future scenarios including increases in extreme rainfall, flood flow and flash flood times Development footprint avoidance of Flood Zones A and B. Finished floor level of the Substation to be constructed at the 0.1% AEP level plus a freeboard allowance of 600 mm. Finished floor level of the remainder of the facility to be constructed at the 1% AEP level plus a freeboard allowances of 600 mm. Use of attenuation ponds to hold peak discharges from storm events to reduce flash flooding onsite. These would be	Unlikely	Medium	Minor	No	None Required

Climate Hazard Type	Climate Hazard Projection	Sensitive Receptor	Description of Potential Impact	Embedded Design Measure	Likelihood of Impact Occurring	Consequence of Impact Occurring	Resilience Risk Level	Significant?	Additional Mitigation or Monitoring Measures
				built in accordance with the SuDS manual and designed for a 1 in 100-year event plus a 20% allowance for climate change.					
Increase to heat waves	Possible	Staff, visitors onsite	See- Increase in summer temperature	See- Increase in summer temperature	Very Unlikely	Low	Negligible	No	None Required
		Function of facility	See- Increase in summer temperature	See- Increase in summer temperature	Likely	Low	Minor	No	None Required
Increase droughts	Likely	Assets, facilities, roads	See- Decrease in summer rainfall	See- Decrease in summer rainfall	Very Unlikely	Low	Negligible	No	None Required
Increase in storm frequency	Very Unlikely	Flooding onsite	Increase to rainfall leading to increases in fluvial flows Greater storm surge generation Surface water flooding and standing waters Deterioration of structures or foundations due to increase in soil moisture levels Damage to building surfaces/ exposed utilities from increased drying/ wetting and increase frost penetration Damage to infrastructure through coastal erosion, storm surge and coastal destabilisation.	The FRA considers climate change considerations of the 'mid-range' and 'high end' future scenarios including increases in extreme rainfall, flood flow and flash flood times Development footprint avoidance of Flood Zones A and B. Finished floor level of the Substation to be constructed at the 0.1% AEP level plus a freeboard allowance of 600 mm. Finished floor level of the remainder of the facility to be constructed at the 1% AEP level plus a freeboard allowances of 600 mm. Use of attenuation ponds to hold peak discharges from storm events to reduce flash flooding onsite. These would be built in accordance with the SuDS manual and designed for a 1 in 100 year event plus a 20% allowance for climate change. All buildings would be designed to Irish standards and specifications	Very Unlikely	Medium	Negligible	No	None Required

Climate Hazard Type	Climate Hazard Projection	Sensitive Receptor	Description of Potential Impact	Embedded Design Measure	Likelihood of Impact Occurring	Consequence of Impact Occurring	Resilience Risk Level	Significant?	Additional Mitigation or Monitoring Measures
Increase in storm intensity	Likely	Built terrestrial assets, staff facilities and access routes to sites Staff, contractors and visitors	Increase to rainfall leading to increases in fluvial flows Greater storm surge generation Surface water flooding and standing waters Deterioration of structures or foundations due to increase in soil moisture levels Damage to building surfaces/ exposed utilities from increased drying/ wetting and increase frost penetration Damage to infrastructure through coastal erosion, storm surge and coastal destabilisation.	Onshore facilities (bar AGI) set at +18 m OD. The FRA considers climate change considerations of the 'mid-range' and 'high end' future scenarios including increases in extreme rainfall, flood flow and flash flood times All buildings would be designed to Irish standards and specifications	Possible	Medium	Moderate	No	None Required
		Marine assets	Physical damage to marine assets	Jetty platform level to be designed to +9 m OD Malin Head to be clear of extreme water levels and waves Mooring equipment has been designed to hold the FSRU in position in wind speeds of up to 60 knots. Mooring lines designed in accordance with Oil Companies International Marine Forum (OCIMF) design specifications Tugs used to help position vessel Metocean conditions have been considered as part of the mooring analysis A conservative storm surge allowance of 1.0 m by 2050 has been used in marine modelling for jetty height design	Very Unlikely	Very High	Negligible	No	None Required

Climate Hazard Type	Climate Hazard Projection	Sensitive Receptor	Description of Potential Impact	Embedded Design Measure	Likelihood of Impact Occurring	Consequence of Impact Occurring	Resilience Risk Level	Significant?	Additional Mitigation or Monitoring Measures
Sea level rise	Very Likely	Built terrestrial assets, staff facilities and access routes to sites Staff, contractors and visitors	Surface water flooding and standing waters Deterioration of structures or foundations due to increase in soil moisture levels Damage to building surfaces/ exposed utilities from increased drying/ wetting and increase frost penetration	The FRA considers climate change considerations of the 'mid-range' and 'high end' future scenarios that include sea level rise Finished floor level of the Substation to be constructed at the 0.1% AEP level plus a freeboard allowance of 600 mm. Finished floor level of the remainder of the facility to be constructed at the 1% AEP level plus a freeboard allowances of 600 mm. Use of attenuation ponds to hold peak discharges from storm events to reduce flash flooding onsite. These would be built in accordance with the SuDS manual and designed for a 1 in 100-year event plus a 20% allowance for climate change. All buildings would be designed to Irish standards and specifications	Very Unlikely	High	Negligible	No	None Required
		Marine assets	Physical damage to marine assets	A conservative sea level allowance of 0.6 m by 2050 has been used in marine modelling Jetty platform level to be designed to +9 m OD Malin Head to be clear of extreme water levels and waves	Very Unlikely	High	Negligible	No	None Required
Sea temperature rise	Very Likely	Marine assets	Physical damage to marine assets (through water chemistry change, marine pests)	Adherence to ballast water, sediments and biofouling regulations to prevent the spread of invasive species by vessels which may cause smothering or damage to marine infrastructure, and maybe more prevalent in warmer sea temperatures.	Very Unlikely	Medium	Negligible	No	None Required

15.9 Mitigation and Monitoring

A number of embedded mitigation measures have been realised through the iterative design process and have been incorporated into the design of the Proposed Development. The following embedded controls and mitigation measures to reduce GHG emissions, the likelihood of an ICCI and to reduce vulnerability have been proposed.

15.9.1 Construction Phase

15.9.1.1 GHG Emissions Impact Assessment

To reduce carbon emissions during the construction phase, embedded controls and mitigation measures as outlined in the Outline Construction Environmental Management Plan (OCEMP) include:

Energy Consumption:

- To reduce fuel deliveries, sizeable sized diesel tanks would be held onsite;
- Site personnel would be encouraged to use green transport options, including car-pooling, public transport, walking and cycling;
- Material transport associated with the project would be assessed in order to reduce associated carbon expenditure. The Contractor would engage the supply chain to reduce the number of vehicle movements relating to site material;
- Vehicles and plant with low exhaust emissions would be used and would be serviced regularly. Engines would not be left running unnecessarily. In addition, vehicles would be monitored entering the site for noticeable exhaust emissions and site security personnel would have the power to ban offending vehicles from the site; and
- Energy efficiency measures would be installed in all offices and drying rooms; sprung door closers in external doors, awareness notices to save energy, timers on heaters and boilers, passive infrared (or similar) sensors for lighting where possible and supervision to switch off other lights, computers, etc. at the end of the day. Energy consumption would be logged and monitored through an electrical meter.

Materials:

- Waste generated during the construction phase would be carefully managed according to the accepted waste hierarchy which gives precedence to prevention, minimisation, reuse and recycling over disposal with energy recovery and finally disposal to landfill;
- Reuse of excavated soil where possible, any that is unsuitable for engineering would be used for landscaping;
- Locally sourced materials, purchasing recycled materials, sustainably sourced certified timber;
- Purchasing of materials for just-in-time delivery; and
- Designation of separate storage areas for different types of waste, in order to maximise the reuse and recycling potential of the waste.

Other statutory requirements:

- Development of the Construction Environmental Management Plan (CEMP) prior to construction;
- Waste Management Plan; and
- Undertaking construction works in accordance with all legal, regulatory and licence conditions, including the Safety, Health and Welfare at Work (Construction) Regulations, NSAI Construction Standards and the Construction Industry Federations Construction Standard Operating Procedures.

15.9.1.2 In-Combination Climate Change Impacts

Full details of the embedded design measures that reduce likelihood or severity of climate change hazards exacerbating construction impacts are detailed within the OCEMP and other discipline assessments.

Other statutory requirements:

- Development of the CEMP; and
- Undertaking construction works with all legal, regulatory and licence conditions.

15.9.1.3 Climate Change Resilience

Full details of the embedded design measures that reduce the vulnerability of the Proposed Development are detailed within the OCEMP and other discipline assessments. A summary of these measures includes:

- An outline emergency response plan and procedure for environmental incidents such as flooding or storms;
- Storage of topsoil and other construction materials to protect against high rainfall and flooding events, or sea level rise;
- Suitable storage and bunding of pollutants to protect from high rainfall events or sea level rise; and
- Laydown and welfare areas would be laid with permeable membranes to protect the Proposed Development site from high rainfall and flooding events or sea level rise.

Other statutory requirements:

- Development of the CEMP; and
- Undertaking construction works in accordance with all legal, regulatory and licence conditions.

15.9.2 Operational Phase

15.9.2.1 GHG Emissions Impact Assessment

Undertaking operations in accordance with all legal, regulatory and licence conditions.

15.9.2.2 In-Combination Climate Change Impacts

Undertaking operations in accordance with all legal, regulatory and licence conditions.

15.9.2.3 Climate Change Resilience

Undertaking operations in accordance with all legal, regulatory and licence conditions.

15.10 Cumulative Impact

Climate change is the result of cumulative impacts. As it is the result of innumerable minor activities, a single activity may itself result in a minor or insignificant impact, but when combined with many other activities, the cumulative effect could be significant. The GHG emissions assessment by its nature is a cumulative assessment and considers whether the Proposed Development would contribute significantly to emissions on a national level. By comparing the Proposed Development against the national inventory, as being representative of the global climate, the cumulative impact of the scheme is being considered on a national scale.

The global atmosphere is the receptor for climate change impacts and has the ability for holding GHG emissions. Nevertheless, as stated by IEMA (2017), all GHG emissions are considered significant and therefore would contribute to climate change. While the impact of any individual proposed development may be limited, it is the cumulative impact of many proposed developments over time that could have a significant effect on climate change.

When addressing the cumulative impact of the Proposed Development it should also be considered on a sectoral scale. As previously noted, while the Proposed Development will result in direct emissions from the combustion of fossil fuel, this is seen as necessary if the overall impact of electricity generation on the climate is to be reduced through the introduction of higher renewable generation capacity.

As described previously, separate to this planning application, the wider site is also intended to be further developed with 220 kV and medium voltage (10/ 20 kV) power lines, as well as data centres. The cumulative impact of wider site activities has not been assessed, but it should be noted that the emissions calculated within this assessment are part of a wider masterplan.

15.11 Residual Impacts

This section identifies the residual effects, following the implementation of mitigation and monitoring measures outlined.

15.11.1 Construction Phase

There would be unavoidable GHG emissions resulting from the construction phase of the Proposed Development as materials, energy and fuel use, and transport would be required. However, with embedded mitigation measures their effects have been assessed as **minor adverse**. No further mitigation and monitoring measures (other than that detailed in Section 15.9) have been recommended therefore the residual effect of **minor adverse** remains unchanged.

ICCI and CCR were assessed qualitatively in this assessment as their implementation would be short, in the near future and therefore not significant. Embedded mitigation measures were deemed sufficient for construction phase impacts, therefore the residual effect of no significance remains unchanged.

15.11.2 Operational Phase

There would be unavoidable GHG emissions resulting from the operational phase of the Proposed Development as materials, energy and fuel use, and transport would be required. The fuel consumption associated with the operating of the Power Plant would contribute the majority of the operational phase emissions. Operational emissions have been assessed as **major adverse**. However, the Proposed Development would contribute towards achieving energy security for the country by reducing reliance on the UK for gas supply, as well as providing an alternative electricity supply to the typically intermittent electricity supply from wind power. It is important to note that the emissions associated with the Power Plant could reduce over time based upon projected running hours. For example, emissions for the opening year for the plant running at maximum capacity are estimated at 712,596 tCO_2e and by 2050 these emissions are estimated to be 655,758 tCO_2e.

Further, the specifications of the Proposed Development are such that it would be required to have a GHG Permit, to submit annual emissions reports and to surrender sufficient EU Allowances to cover its annual emissions under the terms of the EU Trading System. These requirements do not affect the significance of these emissions. ICCI and CCR were assessed semi-quantitatively in this assessment. No ICCI impacts were identified, and embedded mitigation measures were deemed sufficient for operational phase impacts, therefore the residual effect of no significance remains unchanged.

15.12 Summary

The requirement for the Proposed Development supports the implementation of the National Energy and Climate and Climate Plan 2021-2030. Ireland has set an ambitious target for 70% of electricity generation capacity to be from renewable sources by 2030. It is acknowledged that gas has an increasing part to play in Ireland's energy mix if this renewable energy target is to be met by providing back up to the intermittent power supply.

Emissions from the Proposed Development will equate to around 2.2% of Ireland's carbon allowance in 2030, a major adverse impact, however without the supply of energy from gas fired power stations to support the wider decarbonisation of the economy, these reduction targets may not be met.

A number of embedded mitigation measures have been developed through the design process to reduce GHG emissions throughout its design life including measures to reduce energy and material consumption. Further, in the future it is likely that the Power Plant may be transitioned from a natural gas to a hydrogen-powered facility which would substantially reduce GHG emissions and aid the further decarbonisation of the national grid.

The Proposed Development site and surrounding environment is likely to experience a range of climate change impacts including increasing temperatures, reductions in annual and summer rainfall but possible wetter winters, more periods of drought, increased severity of storms, and sea level rise.

This assessment also looked at the influence of climate change to the Project-related impacts to neighbouring sensitive receptors. Technical specialists used the climate change projections to examine if there were any changes to either the likelihood or severity of impact to their receptors, however no combined impacts were identified.

This assessment also looked at the influence of climate change on the Proposed Development itself, particularly its physical and functional aspects. Any identified vulnerabilities were found to be sufficiently mitigated against by aspects of the design, particularly aspects of flood design such as drainage systems and building/ infrastructure heights that take sea level rise into account.

Table 15-22 Summary

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Effect Significance
Construction	GHG Emissions	High		Minor adverse	• Development and implementation of the OCEMP, where measures to reduce GHG emissions are detailed; • Encouragement of green transport options for commuting, installation of energy efficient measures and engage the supply chain to reduce the number of vehicle movements relating to site material Waste management plan: • Maximising reuse and recycling of waste, i.e. Reuse of excavated soil where possible, • Using locally sourced materials , using Ground Granulated Blast Furnace Slag (GGBS) concrete, purchasing recycled materials, sustainably sourced certified timber. See Section 2.4.1 of Chapter 02 – Project Description.	Minor adverse
Construction	In-combination Climate Change Impacts	Not assessed/ Not applicable		Not assessed- No Significance	• Development and implementation of the OCEMP, where measures to reduce impacts to sensitive receptors are detailed; • Undertaking construction works with all legal, regulatory and licence conditions. See Section 2.4.1 of Chapter 02 – Project Description.	Not assessed- No Significance
Construction	Climate Change Resilience	Not assessed/ Not applicable		Not assessed- No Significance	• Development and implementation of the OCEMP, where measures to protect construction assets and materials are detailed; • An outline emergency response plan and procedure for environmental incidents such as flooding or storms;	Not assessed- No Significance

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Effect Significance
					• Storage of topsoil and other construction materials to protect against high rainfall and flooding events, or sea level rise; • Suitable storage and bunding of pollutants to protect from high rainfall events or sea level rise; • Laydown and welfare areas would be laid would permeable membranes to protect the Site from high rainfall and flooding events or sea level rise; and • Undertaking construction works with all legal, regulatory and licence conditions.	
Operational	GHG Emissions	High	•The Proposed Development will diversify the supply of natural gas and electricity to the Irish market. It does not in itself increase demand for natural gas or electricity. •As the use of coal and peat for electricity generation will cease by 2025 under the 2019 Climate Action Plan, natural gas has been identified in the Climate Action Plan, and the National Energy and Climate Plan, as the only remaining dispatchable power source capable of providing significant security of electricity supply when wind sources are insufficient.	Major adverse	• Expected reduced operating hours over the life of the Power Plant; • Only 2 of 3 generators (CTG1, CTG2, & CTG3) would be in operation at any point in time; • Diesel Firewater Pump is operated in emergency only and would not be running during normal operations; • Black Start Diesel Generator used for initial start-up only and would not be running during normal operations; • Auxiliary Boiler is only operated when all CTG/ HRSG Trains are not in operation to facilitate a unit start; • The Proposed Development will operate in the EU ETS scheme, with an EU-wide cap currently reducing by 2.2% annually. Sufficient allowances to cover an installation's annual emissions must be surrendered each year. Power generators are not eligible for any free allocation of allowances, so all allowances to cover the direct emissions from	Major adverse

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Effect Significance
					the Proposed Development must be purchased at auction; • In a 'business as usual' scenario, where the Proposed Development is not progressed, this demand would be met by alternative, and potentially more carbon intensive power suppliers; • The efficiency of the Power Plant combined with its ability to operate at a low minimum generation capacity means that the Power Plant will be dispatched ahead of a less efficient OCGT power plant as it will provide lower direct emissions; • The proposed Power Plant will not operate at 100% capacity all year round; • As the level of renewable generation on the system at any one time increases, thermal power plant has their dispatch quantities decreased by EirGrid to facilitate the output of the renewable power plants. However, a certain number of dispatchable plants must remain on the system to provide the services mentioned above. 'Positioning' is when the grid operator keeps a power plant running so as to be on standby to provide these services to the grid operators in real time. This is a vital process for grid stability; however, with inflexible power plants it can lead to larger than necessary power plants being positioned. This causes increased emissions, increased curtailment of renewables (to make room for the positioned power plant) and increased costs; • The ability of the Power Plant to operate at a 50% blend of hydrogen by design, offers the potential for the Power Plant to become even	

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Effect Significance
					more efficient in emission terms over the period to 2050 as and when the required policies and supply chains for hydrogen are implemented; and • The Proposed Development has a unique location and flexible design that can easily transition to alternative low carbon fuels, subject to future planning applications, once the technology and public policies are established. See Section 2.4.1 of Chapter 02 – Project Description.	
Operational	In-combination Climate Change Impacts	Assessed by other disciplines		No significance	• Detailed within other discipline assessments. • Undertaking operations with all legal, regulatory and licence conditions. See Section 2.4.2 of Chapter 02 – Project Description.	No significance
Operational	Climate Change Resilience	Not assessed/ Not applicable		No significance	• Electrical connections would be buried underground, insulating against overheating in times of heatwaves; • The Proposed Development would be designed with any specific drainage terms and conditions of the IE licensed, as determined by the EPA and associated planning conditions, to protect again high rainfall events or sea level rise; and • Undertaking operations with all legal, regulatory and licence conditions. See Section 2.4.2 of Chapter 02 – Project Description.	No significance

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CHAPTER 16
Waste

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park
Environmental Impact Assessment Report

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16. Material Assets - Waste

16.1 Introduction

This chapter presents an assessment of the impacts of the Proposed Development with respect to waste management.

The effects associated with waste generated from the Proposed Development on physical environmental aspects are assessed separately in the relevant chapters e.g. air and water.

This chapter defines the study area; the methodology used for developing the baseline and impact assessment; provides a description of the baseline environment in relation to waste arisings and infrastructure; and presents the findings of the impact assessment.

For the purpose of this EIAR, waste is defined as per the Waste Framework Directive (WaFD) (EC, 2008), as amended, as '*any substance or object which the holder discards or intends or is required to discard*.' The generic term used for waste generated from any civil engineering activities and in the WaFD is construction and demolition waste (CDW). CDW '*arises from activities such as the construction of buildings and civil infrastructure, total or partial demolition of buildings and civil infrastructure, road planning and maintenance*' (EC, 2008).

The scope of this waste management assessment includes:

- Waste generated by the construction and operation of Shannon Technology and Energy Park which includes the LNG Terminal (including FRSU and AGI) and CCGT Power Plant; and
- Any potential cumulative impacts arising from wastes generated by Shannon Technology and Energy Park in combination with other projects.

The assessment considers the following types of impact:

- Impact from construction activities on national waste plans and policies and the national infrastructure capacity; and
- Impact from operational activities on national waste plans and policies and the national infrastructure capacity.

16.2 Competent Expert

This assessment has been undertaken by Mike Bains, Technical Director, BSc (Hons), CChem MRSC. Mike has 24 years' experience in environmental consultancy, predominantly in the field of waste management in Ireland, the UK and internationally. He has been subject-matter expert for waste management in a large number of major projects, including nationally significant infrastructure projects in the UK. Mike is also experienced in waste management in the pharmaceutical sector.

16.3 Sources of Information and Methodology

In the absence of specific guidance on assigning significance for waste management impacts, professional judgement, national and local policy, and recognised best practice have been used to objectively assess the impact and associated effect of the Proposed Development against the baseline.

16.3.1 Legislation and Guidance

The assessment of the impacts of waste and the design of appropriate mitigation is informed by the legislation, regulations, policies and guidance in the key documents as outlined below and in Table 16-1.

National waste management regulations in Ireland include the following:

- Waste Management (Collection Permit) Regulations 2007 (as amended) (Government of Ireland, 2007a);
- Waste Management (Facility Permit and Registration) Regulations 2007 (Government of Ireland, 2007b);
- Waste Management (Licensing) Regulations 2004 (Government of Ireland, 2004);

- Waste Management (Packaging) Regulations 2014 (Government of Ireland, 2014);
- Waste Management (Planning) Regulations 1997 (Government of Ireland, 1997a);
- Waste Management (Landfill Levy) Regulations 2015 (Government of Ireland, 2015);
- Waste Management (Food Waste) Regulations 2009 (as amended) (Government of Ireland, 2009);
- Waste Management (Hazardous Waste) Regulations 2007 (as amended) (Government of Ireland, 2007c);
- Waste Management (Shipments of Waste) Regulations 2007 (as amended) (Government of Ireland, 2007d);
- Waste Management (Movement of Hazardous Waste) Regulations 1998 (Government of Ireland, 1998);
- The Waste Management Act 1996 (as amended 2001) (Government of Ireland, 1996);
- Environmental Protection Agency Act 1992 (Government of Ireland, 1992);
- The Protection of the Environment Act 2003 (Government of Ireland, 2003);
- Litter Pollution Act 1997 (Government of Ireland, 1997b); and
- Planning and Development Act (as amended 2020) (Government of Ireland, 2000).

Table 16-1 Policy and Legislation

Legislation	Year	Key Points
Waste Framework Directive 201/851 (EC, 2008	2018	Directive (EU) 2018/ 851 amends Directive 2008/ 98/ EC including: • Increase targets for preparing for re-use and recycling of waste; • Remove substances intended for animal feed from the scope of directive 2008/ 98/ ec; • Add several new definitions; • Change end-of-waste conditions and requirements; • Set out exemptions for separation of waste collection; • Establish bio-waste separation; • Establish household hazardous waste collection; and • Update record keeping requirements. This Directive includes the following target: • By 2020, a minimum of 70% (by weight) of non-hazardous construction and demolition waste excluding naturally occurring material defined in category 17 05 04 in the List of Wastes (LoW) shall be prepared for re-use, recycled or undergo other material recovery.
Southern Region Waste Management Plan (SRWMP, 2015)	2015-2021	For the purposes of waste management planning, Ireland is divided into three regions: Southern, Eastern-Midlands and Connacht-Ulster. Waste Management Plans (WMP) for the three regions were published in May 2015. The Proposed Development is location within the Southern region. The WMP for the Southern Region is the framework for the prevention and management of wastes in a safe and sustainable manner.
A Waste Action Plan for a Circular Economy – Irelands National Waste Policy (Government of Ireland, 2020))	2020-2025	The new national waste policy will inform and direct waste planning and management in Ireland and embeds climate action in all aspects of public policy, aligning with the goals of the European Green Deal. The policy shifts focus away from waste disposal, moving it back up the production chain. The document contains over 200 measures across various waste areas including Circular Economy, Municipal Waste, Consumer Protection and Citizen Engagement, Plastics and Packaging, Construction and Demolition, Textiles, Green Public Procurement and Waste Enforcement.
National Hazardous Waste Management Plan, 2014-2020 (EPA 2014)	2014	The overarching objectives for the National Hazardous Waste Management Plan for the revised Plan period are: • To prevent and reduce the generation of hazardous waste by industry and society generally; • To maximise the collection of hazardous waste with a view to reducing the environmental and health impacts of any unregulated waste;

Legislation	Year	Key Points
		• To strive for increased self-sufficiency in the management of hazardous waste and to minimise hazardous waste export; and • To minimise the environmental, health, social and economic impacts of hazardous waste generation and management.
European Communities (Waste Directive) Regulations, 2011, S.I. No 126 of 2011 (EC, 2011)	2011	This regulation transposes the EU Waste Framework Directive into Irish legislation, and (amongst other provisions) allows an operator to decide that a material is a by-product and not a waste material if approved by the EPA.
Waste Management Act 1996 and Amendment Act 2001 (Government of Ireland, 1996)	2001	The Waste Management Acts provide for a general duty on everyone not to hold, transport, recover or dispose of waste in a manner that causes or is likely to cause environmental pollution.
Basel Convention (Basel Convention, 1992)	1992	The Basel Convention regulates transboundary movements of hazardous wastes and provides obligations upon its Parties to ensure that such wastes are managed and disposed of in an environmentally sound manner. The main principles of the convention are as follows: • Transboundary movements of hazardous wastes should be reduced to a minimum, which is consistent with their environmentally sound management; • Hazardous wastes should be treated and disposed of as close as possible to their source of origin; and • Hazardous waste generation should be reduced and minimised at source. Annexes I–VIII of the Basel Convention provide lists of waste categories requiring special consideration or controls, including disposal operations. Annex I outlines a list of waste categories to be controlled, Annex II details waste categories requiring special consideration and Annex III provides a list of important hazardous characteristics.
The International Convention for the Prevention of Pollution from Ships (MARPOL) (IMO, 1973)	1973/ 78	MARPOL is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. The Convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations - and currently includes six technical Annexes. Special Areas with strict controls on operational discharges are included in most Annexes. The relevant Annexes for waste management for the Proposed Development are: • Annex I - Regulations for the Prevention of Pollution by Oil: covers prevention of pollution by oil from operational measures as well as from accidental discharges; the 1992 amendments to Annex I made it mandatory for new oil tankers to have double hulls and brought in a phase-in schedule for existing tankers to fit double hulls, which was subsequently revised in 2001 and 2003. • Annex IV - Prevention of Pollution by Sewage from Ships: contains requirements to control pollution of the sea by sewage; the discharge of sewage into the sea is prohibited, except when the ship has in operation an approved sewage treatment plant or when the ship is discharging comminuted and disinfected sewage using an approved system at a distance of more than three nautical miles from the nearest land; sewage which is not comminuted or disinfected has to be discharged at a distance of more than 12 nautical miles from the nearest land. • Annex V - Prevention of Pollution by Garbage from Ships: deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of; the most important feature of the Annex is the complete ban imposed on the disposal into the sea of all forms of plastics. The Sea Pollution Act, 1991 enabled Ireland to ratify MARPOL 73/ 78: regulations to give effect to MARPOL were introduced in 1994 and updated in 1997, 2002 and 2003.
Kerry County Development Plan 2015-2021 (KCC, 2015)	2015-2021	The County Development Plan 2015-2021 incorporates the aims, objectives, policies and guidelines to provide for the proper planning and sustainable development of Co. Kerry. The County Development Plan is a spatial planning framework that gives

Legislation	Year	Key Points
		effect to the delivery of sustainable and planned economic and social development in a manner consistent with higher level plans and strategies. In Chapter 7, the plan sets out the Council's overall aims for waste management, which are to: • Seek to ensure the provision of the highest standards of waste management and to prevent and control water, air and noise pollution. With respect to waste policy, the Council's objectives are to: • Ensure the implementation of the Regional Waste Management Plan with emphasis on waste reduction, reuse and recycling and the sustainable disposal of residual waste in the most appropriate manner. • Facilitate the implementation of the current Regional Waste Management Plan, and any replacement or amending plan, to include implementation of the waste hierarchy and maximising the diversion of waste from landfill in accordance with current national and European policy.

16.3.2 Study Area

The extent of the study area for the assessment of waste management infrastructure capacity for the Proposed Development includes the footprint of the Proposed Development site (within which waste will be generated from the construction and operational activities). This also extends to the whole of Ireland due to the need to consider all available waste management infrastructure capacity in Ireland.

16.3.3 Determination of the Baseline Environment

The baseline environment for waste focuses on national waste arisings and the availability and capacity of waste management infrastructure within the study area.

The baseline information on waste arisings and waste management facilities capacity in Ireland has been sourced from the most recent available data published by the Environmental Protection Agency (EPA).

16.3.4 Determination of Sensitive Receptors

Assessment of waste impacts does not follow the approach of identifying receptors and determining their sensitivity that is typically used for other environmental aspects. Attempting to identify receptors is problematic since:

- Waste producers have a legal duty of care to manage their waste in accordance with regulations and to ensure that any waste leaving the site of generation is transferred to a suitably licensed facility for further treatment or disposal;
- Facilities transferring, treating or disposing of waste must be either licensed or apply for an exemption from a license. Impacts arising from the operation of waste management facilities are considered as part of the planning and permitting process for such facilities; and
- Waste collectors are required by the Waste Management (Waste Collection Permit) Regulations 2007 as amended, to have and comply with conditions of a permit to collect waste. Offaly Co. Council was appointed the National Waste Collection Permit Office (NWCPO) in 2012 and is responsible for administering waste collection permits in the Republic of Ireland.

The receptor for this assessment is therefore the waste management infrastructure capacity in the study area.

16.3.5 Describing Potential Effects

The waste assessment focuses on the effects the waste arisings generated onsite would have on the capacity of waste management infrastructure in the study area.

In the absence of specific guidance or requirements, professional judgement is used to determine the significance of effect by the following approach:

- Establishing the baseline waste infrastructure capacity and arisings for the study area;

- Estimating the likely types and quantities of waste that would be generated by the Proposed Development;
- For each category of waste, comparing the likely waste arisings from the Proposed Development to the baseline waste arisings and confirming whether sufficient capacity is available; and
- Assessing whether the Proposed Development conforms to relevant Irish and European waste policies and strategies.

The criteria used for assessing the significance of effect are shown in Table 16-2.

Table 16-2 Significance of Effect Criteria

Significance of Effect	Criteria
Imperceptible	• No waste generated
Not Significant	• Project achieves >99% overall material recovery/ recycling (by weight) of non-hazardous CDW excluding naturally occurring material defined in category 17 05 04 in the List of Wastes. • Project waste for disposal is ≤1% of national waste arisings (for the relevant categories of waste).
Slight	• Project achieves 70-99% overall material recovery/ recycling (by weight) of non-hazardous CDW excluding naturally occurring material defined in category 17 05 04 in the List of Wastes. • Project waste for disposal is ≤5% of national waste arisings (for the relevant categories of waste).
Moderate	• Project achieves less than 70% overall material recovery/ recycling (by weight) of non-hazardous CDW excluding naturally occurring material defined in category 17 05 04 in the List of Wastes. • Project waste for disposal is >5% and < 10% of national waste arisings (for the relevant categories of waste).
Significant	• Project recovers or recycles a negligible proportion of non-hazardous CDW excluding naturally occurring material defined in category 17 05 04 in the List of Wastes. • Project waste for disposal is >10% of national waste arisings (for the relevant categories of waste).
Very Significant	• Project waste for disposal is >25% of national waste arisings (for the relevant categories of waste).

16.3.6 Limitations and Assumptions

The assessment presented herein has been developed based on the following limitations and assumptions:

- The assessment has been undertaken on the basis of information available at the time of writing.
- Waste arising from the offsite extraction, processing and manufacture of demolition and remediation plant and materials has been scoped out of this assessment. This is based on the assumption that these products and materials are being developed in a manufacturing environment with their own waste management plans, facilities, and supply chain, which are potentially in different regions of Ireland or the world, and therefore outside of the geographical scope of this assessment.
- Environmental impacts associated with the management of waste for the Proposed Development are addressed in the following:
  - Land and soils, e.g. impacts from hazardous waste to ground – Chapter 05
  - Water, e.g. from uncontrolled wastewater discharge or runoff – Chapter 06
  - Air quality, e.g. emissions to atmosphere from the site – Chapter 08;
  - Noise and vibration, e.g. from waste generating activities and processing – Chapter 09;
  - Climate, e.g. greenhouse gas emissions – Chapter 15; and

– Roads and traffic, (e.g. removal of waste by road) – Chapter 11.

16.4 Baseline Environment

16.4.1 Background Information

The Proposed Development is located within the Southern Region. The region has appointed Limerick City and Co. Councils and Tipperary Co. Council as regional leads acting on behalf of the other authorities (including Kerry Co. Council (KCC)) with responsibility for the implementation of the Southern Region Waste Management Plan 2015-2021. The Waste Enforcement Regional Lead Authority (WERLA) for the Southern Region is Cork Co. Council. In terms of waste management, the WERLA are responsible for setting priorities and common objectives for waste enforcement within the region.

16.4.2 Construction and Demolition Waste Arisings

In 2018, an estimated 6,251,396 tonnes of CDW was collected by authorised waste collectors in the whole of Ireland (Table 16-3). Recent data for the Southern Waste Region is not available. Waste soil and stones made up 76.7% of the total quantity. Mixed CDW accounted for 7% of the total, and concrete, bricks, tiles and similar for 12%.

Table 16-3 National Construction and Demolition Waste Material Streams Collected In 2018 (EPA, 2020a)

Waste Materials from CDW Sources	Quantity (tonnes)
Soil and stone	4,794,821
Mixed CDW	437,598
Concrete, bricks, tiles and similar	750,168
Metals	187,542
Bituminous mixtures (asphalt/ tarmacadam)	62,514
Segregated wood, glass and plastic	25,006
Total	6,251,396

The EPA's 'Progress to EU Targets' published on 12th December 2020 shows that Ireland achieved 77% recovery of CDW in 2018.

16.4.3 Hazardous Waste Arisings

The EPA reported that 580,977 tonnes of hazardous waste were managed in Ireland in 2019 by the methods shown in Table 16-4 below.

Table 16-4 National Hazardous Waste Management, 2019 (EPA, 2020b)

Year	2019
Irish hazardous waste treatment facilities - hazardous waste excl. soils	117,246
Irish hazardous waste treatment facilities - contaminated soils	55,282
Onsite treatment at licensed industrial facilities - hazardous waste excl. soils	29,063
Exports - hazardous waste excl. soils	333,195
Exports - contaminated soils	46,191

16.4.4 Municipal Waste Arisings

The EPA reports that in 2018, Ireland generated 2,912,353 tonnes of municipal waste (EPA, 2020c), which includes both waste from households, and similar types of waste from commercial activities. The EPA does not publish statistics for overall generation of non-hazardous industrial waste, although it reports that in 2017 113,825 tonnes of industrial waste were disposed of and landfilled and 46,020 tonnes were recovered.

16.4.5 Landfill Inputs and Capacity

Table 16-5 shows that there has been a significant decrease (86%) in the availability of landfills accepting municipal waste over the last 12 years. There are three landfills currently receiving municipal waste (Table 16-6) with a total capacity of 570,000 tonnes per annum.

Table 16-5 Number of Operational Landfills, 2013-2020 (EPA, 2020d)

Year	2013	2014	2015	2016	2017	2018	2019	2020
Number of landfills accepting municipal waste for disposal	11	9	6	7	5	5	4	3

Table 16-6 Landfills Accepting Municipal Waste for Disposal, 2020

Authorisation Number	Facility Name and Location	Waste for Disposal (maximum tonnes per annum)	Waste Types for Disposal (maximum tonnes per annum)		Waste Types for Recovery (maximum tonnes per annum)	
W0146	Knockharley Landfill Co. Meath	175,000	household	100,000	25,000	construction & demolition
			commercial	45,000	70,000	inert waste
			industrial	30,000		
W0165	Ballynagran Residual Landfill Co. Wicklow	175,000	household	62,500	28,000	construction & demolition
			commercial	67,500		
			industrial	45,000		
W0201	Drehid Waste Management Facility Co. Kildare	120,000	non-hazardous municipal, commercial and industrial wastes	120,000	No limit for inert waste where used in landfill engineering	
	Total	470,000				

There is no commercial hazardous waste landfill in Ireland, and there are limited hazardous waste treatment operations (these are mainly used for oil recovery, healthcare waste treatment and solvent reclamation), meaning that Ireland is dependent on export for treatment of many hazardous waste streams.

16.4.6 Other waste management infrastructure

Table 16-7 shows that there has been an increase in the availability of incinerators. There are two incinerators currently operating (Table 16-8) with a total capacity of 835,000 tonnes per annum. An additional 342,875 tonnes of capacity is available for co-incineration in cement kilns.

Table 16-7 Number of Operational Incinerators, 2013-2020 (EPA, 2020d)

Year	2013	2014	2015	2016	2017	2018	2019	2020
Number of municipal waste incinerators	1	1	1	1	2	2	2	2

Table 16-8 Authorised Waste to Energy Capacity

Authorised Waste to Energy Capacity in Ireland		Authorisation Number	Maximum Waste Acceptance Limit Per Year (tonnes)
Incineration	Indaver Ireland Ltd.	W0167	235,000
	Dublin Waste to Energy Ltd.	W0232	600,000
Co-Incineration	Lagan Cement	P0487	95,000
	Irish Cement Ltd.	P0030	120,000
	Quinn Cement Ltd.	P0378	127,875
	Total		1,177,875

The authorised capacity for composting, anaerobic digestion and biostabilisation or organic fines is 687,660 per year as shown in Table 16-9

Table 16-9 Authorised Capacity for Composting, Anaerobic Digestion and Biostablisation of Organic Fines (EPA, 2020d)

Maximum Annual Intake Authorised for:	Tonnes per annum
Composting, anaerobic digestion and biostabilisation of organic fines[1]	687,660
Composting[2]	Approximately 459,000
Anaerobic digestion[2]	Approximately 110,000
Biostabilisation of organic fines[2]	Approximately 143,700

Notes

1: Does not include facilities where only waste generated onsite is treated onsite such as at industrial installations.

2: Approximate as some facilities carry out more than one activity e.g. composting and biostabilisation.

Authorised capacity for other types of waste management infrastructure including material recovery facilities and CDW treatment facilities are not summarised in the EPA waste data release.

16.5 Assessment of Impact and Effect

16.5.1 Effects from Construction and Demolition Waste on National Waste Plans and Policies and National Capacity

The following wastes will be generated from the construction and demolition works:

- Workforce waste from construction workers and site offices;
- Surplus or damaged construction materials including steel, concrete and aggregates;
- Small quantities of hazardous wastes (e.g. paints, chemicals, lubricants, oily rags etc.); and
- Site clearance wastes (e.g. vegetation).

The estimated main types and quantities of non-hazardous waste generated during construction and demolition and potential recovery rates are shown in Table 16-10. Estimates of quantities of waste from vegetation clearance and jetty piling are not available at this stage but are expected to be of similar or smaller quantities to those main waste types identified below.

At this stage it is anticipated that excavated material will be reused onsite to form the development platform, giving an overall cut-fill balance, and hence no requirement to transport any surplus excavated material offsite as waste.

It is planned to reuse all material excavated during the construction period onsite (including pile arisings from jetty construction works). Typically, excavated material that is unsuitable for use as engineering fill will be used where possible for landscaping and other uses throughout the site thus eliminating the need for offsite disposal (see Chapter 10 – Landscape and Visual).

Any waste material that is required to be moved offsite for treatment/ disposal will be done so by licensed waste haulers transporting to licensed waste management facilities, using local facilities where practicable.

The estimated recovery rates in Table 16-10 are based on the 'good practice quick win' recovery rates set out in the 'Achieving Good Practice Waste Minimisation and Management' report published by WRAP (WRAP, ND). The overall recovery rate is calculated by tonnage.

Table 16-10 Estimated Main Types and Quantities of Non-hazardous Waste Generated During Construction and Demolition

Waste Type	Waste Classification	Total Amount (tonnes)	Potential Waste Management Route	Potential Standard Practice Recovery Rate (%)	Recovery (tonnes)	Potential Good Practice Recovery rate (%)	Recovery (tonnes)	Potential Best Practice Recovery rate (%)	Recovery (tonnes)
Bricks	Non-hazardous	269	Recycling offsite at licenced facility	75	202	85	229	100	269
Tiles & Ceramics	Non-hazardous	2	Recycling offsite at licenced facility	75	1.5	85	1.7	100	2
Concrete	Non-hazardous	1,245	Concrete crushed onsite and recycled as fill or recycling offsite at licenced facility	75	934	95	1.13	100	1,245
Inert	Inert	735	Recovery/ recycling offsite at licenced facility	75	55	95	698	100	735
Insulation	Non-hazardous	11	Recycling or energy recovery offsite at licenced facility	12	2.4	50	10	75	15
Metals	Non-hazardous	72	Recycling offsite at licenced facility	95	68	100	72	100	72
Packaging	Non-hazardous	51	Recycling offsite at licenced facility	60	30	85	43	95	49
Gypsum	Non-hazardous	28	Recovery/ recycling offsite at licenced facility	12	3.4	50	14	75	21
Plastics	Non-hazardous	9	Recycling offsite at licenced facility	60	5.4	80	7.2	95	8.6
Timber	Non-hazardous	59	Recycling or energy recovery offsite at licenced facility	57	34	90	53	95	56
Canteen/ Office/ Adhoc	Non-hazardous	16	Recycling offsite at licenced facility	12	1.9	50	8	75	12

Applying good industry practice to the management of non-hazardous waste generated by the Proposed Development's construction activities, it is anticipated that an overall recovery rate of 78% can be achieved. This exceeds the Government's 70% target for recovery of construction waste and the effects are therefore assessed as being **slight adverse.**

The estimated CDW waste arisings have been compared to the quantity of CDW collected in Ireland in 2018. Assuming all waste is removed from the Proposed Development site, the overall estimated CDW waste arisings would be **0.058%** of total national CDW arisings. Since this is <1% of total CDW arisings, the effect is considered to be **not significant**.

There is significant scope for re-use and recycling of surplus construction materials and waste onsite which will help achieve the aim of the site being a net zero import site for soil.

It is intended that all suitable stone recovered on the site will be reused as hardcore in the building construction

It is planned to reuse all spoil and excavated material onsite. Typically, excavated material that is unsuitable for use as engineering fill will be used where possible for landscaping and other uses throughout the site thus eliminating the need for offsite disposal.

The site has historically been used for agriculture and consequently it is anticipated that no soil contamination will be encountered. In the unlikely event of any evidence of soil contamination being found during work onsite, the appropriate remediation measures will be employed (See Chapter 05 – Land and Soils). Any work of this nature will be carried out in consultation with, and with the approval of the Environmental Department of KCC.

Other types of waste will be generated during construction including. canteen, office and staff welfare wastes and very small quantities of hazardous waste (e.g. oily waste and batteries from construction plant maintenance, waste paints and chemicals etc.). These have not been quantified however the quantities are anticipated to small in the context of national waste arisings. The capacity for waste to energy, composting, anaerobic digestion and landfill that is available nationally for these municipal-type wastes is likely to be sufficient to cover the estimated wasted generated by the Proposed Development. Waste generated by workers will be segregated at source into recyclable and residual streams, collected by a registered commercial waste management company, and transferred to a suitable licensed facility for recycling, recovery or disposal. There is a wastewater treatment plant (WWTP) onsite to treat operational wastewater.

16.5.2 Effects from Operational Waste on National Waste Plans and Policies and National Capacity

The estimated main types and quantities of waste generated during operation are shown in Table 16-11. This includes waste from the onshore elements of the Proposed Development, as well as MARPOL waste from the, FSRU, tugs and potentially from visiting LNG carriers.

Table 16-11 Estimated Waste Quantities from Operation

Waste Type	Waste Classification	Quantity per Year (m^3)	Potential Waste Management Route
Galley waste (garbage from FSRU, tugs and LNG carriers)	Non-hazardous	240	In accordance with MARPOL Annex V requirements, when in port waste all waste will be stored in suitable containers onboard. Periodically this will be transferred to shore and taken to a licensed waste management site by a licensed waste contractor. Waste from visiting LNG carriers will be managed as International Catering Waste and securely

Waste Type	Waste Classification	Quantity per Year (m^3)	Potential Waste Management Route
			transferred to a designated and licensed disposal site. Source segregation of recyclables (e.g. paper/ card, plastics, metal & glass) for non-ICW
General office waste from onshore activities	Non-hazardous	50	Source segregation of recyclables (e.g. paper/ card, plastics, metal & glass) Residual waste transported to licensed waste treatment facility (landfill or energy-from-waste)
Oily waste (waste from FSRU, tugs and LNG carriers, e.g. sludges from oily water separators)	Hazardous	900	In accordance with MARPOL Annex I the material will be will be transferred to shore to a licensed waste contractor for management or disposal at a licensed site.
Hazardous materials, e.g. chemicals from FSRU, LNG Terminal and CCGT	Hazardous	10	Export to hazardous waste management facility for recycling/ recovery or high-temperature incineration – delivery to an approved reception facility offshore
Sanitary waste from site washrooms	Not applicable (not subject to Waste Framework Directive)	Faecal wastewater ('black water'): 270 m^3 Other sanitary wastewater ('grey water'): 2430 m^3	Treated by onsite wastewater treatment plant (WWTP) and discharged, see Chapter 02 – Project Description.

Onshore, sanitary effluent (foul water) will be generated in:

- The workshop/ warehouse building,
- The nitrogen package control room; and
- The main control room.

Sanitary effluent (foul water) will be generated at the following locations on the site:

- The administration building;
- Central control/ operations building;
- Storage/ workshop/ canteen building; and
- Each turbine building.

All sanitary effluent will be pumped or fall by gravity to a wastewater treatment plant (WWTP) , see Chapter 02 – Project Description.

The effluent waste stream will be monitored for compliance with the IE licence emission limit values including pH, BOD and TSS and discharged, via the storm water outfall pipe, to the estuary. Details of the WWTP are provided in Chapter 06 – Water. A biological Wastewater Treatment System is proposed.

The automatic control system associated with the WWTP will sound an alarm if pH falls outside of expected range. This will alert the operator to take corrective action to remedy the problem. If the problem continues to go outside the pre-set range, this will automatically close the discharge valve and effluent will be diverted to a holding tank.

Table 16-12 Characteristics of Waste Water Treatment Plant Discharge

Parameter	Emission Limit Value
Volume	35 m^3/day
pH	6 – 10
BOD	25 mg/l
Suspended Solids	35 mg/l
Ammonia	5 mg/l as N
Total Phosphorous	2 mg/l as N

The estimated operational waste arisings have been compared to the quantity of hazardous and non-hazardous waste collected in Ireland in 2018. Operational waste arisings would be 0.04% of total national waste arisings. Since this is <5% of total waste arisings, the effect is considered to be **not significant.**

16.6 Cumulative Impact Assessment

Cumulative impacts could arise when considering the 220 kV and medium voltage (10/ 20 kV) substation cables anticipated to be connected under the L1010 road in addition to the construction of the gas pipeline.

Detailed estimates of waste generation for these projects are not available, and are subject to a separate application.

Considering that other projects will compliance with relevant Irish policy and legislation, it is considered that cumulative impacts on waste management infrastructure capacity are unlikely to be significant during construction.

During operations, none of the projects are expected to generate large quantities of waste when considered in the context of the regional waste arisings, and cumulative impacts on waste management infrastructure capacity are unlikely to be significant during operation.

16.7 Mitigation Measures

Notwithstanding the impact from demolition and remediation waste on national waste plans and policies and national capacity being assessed as not significant, the following best practice measures will be implemented to manage the CDW produced by the Proposed Development:

- All wastes will be managed in accordance with Irish waste legislation, and in particular waste will only be transported by hauliers holding a valid collection permit, and will be transported to waste management sites which hold the necessary license, permit, certification or exemption.
- MARPOL Annex V waste (garbage) from LNG carriers or other vessels arriving from outside Ireland will be managed as International Catering Waste (ICW) and managed in accordance with the ICW license held by Shannon Foynes Port Company (current authorised disposal route is to Drehid Landfill, Co. Kildare).
- In accordance with EU and national policy and legislation the waste hierarchy (Figure 16-1) will be applied to all waste arisings. A Site Waste Management Plan (SWMP) will be developed and implemented for the Proposed Development and will, as a minimum include the following:
  - Statutory requirements, the Applicant's corporate requirements, site-wide waste policy and mitigation and monitoring measures defined within this EIAR where applicable to waste management;
  - Waste types and procedures for classification, segregation, containment, storage, transportation and disposal. The Contractor will apply the principles of the 'Waste Hierarchy' (Prevention, Preparing for Re-use, Recycling, Other Recovery, Disposal) to minimise waste generation, maximise re-use of site-won materials onsite and minimise the need for disposal of waste. Where re-use is not possible onsite, alternative re-use and recycling options will be sought offsite with the final disposal option;

  - Roles and responsibilities;
  - Training requirements;
  - Waste handling procedures;
  - Waste compound maintenance measures;
  - Emergency planning and response;
  - Monitoring, reporting and document control procedures; and
  - Corrective action process.
- As part of the document control procedures, a comprehensive docketing system (including waste transfer notes) will be detailed in the SWMP. The documentation to be maintained in relation to waste material removed from the site will include the following:
  - The names of the agent(s) and the transporter(s) of the wastes;
  - The name(s) of the person(s) responsible for the ultimate treatment of the wastes;
  - The ultimate destination(s) of the wastes;
  - Written confirmation of the acceptance and treatment of the hazardous waste consignments;
  - The tonnages and List of Wastes (LoW) code for the waste materials;
  - Details of each individual consignment dispatched from the Proposed Development site;
    - Description of waste (cell number/ AEC number, stockpile number or origin of waste)
    - Date and time of dispatch from the Proposed Development site
    - Name of haulage company
    - Details of contractor and haulier docket numbers
    - Vehicle registration number and driver name
    - Volume/ weight of waste removed
    - Name of waste receiving facility
    - Date and time of arrival at waste receiving facility
  - Details of any rejected consignments;
  - Waste transfer forms for hazardous wastes transferred from the site (stamped at receiving facility); and
  - The transfrontier shipment of waste forms (where exported).
- The SWMP will include procedures for monitoring the overall CDW recovery rate.

Figure 16-1 Waste Hierarchy

16.8 Do Nothing Scenario

In the Do Nothing scenario, no project waste will be generated and hence there will be no impacts.

16.9 Residual Impacts and Effects

Following implementation of mitigation and monitoring measures, the residual effect significance on national waste plans and policies, and national capacity as a result of the waste generated from the Proposed Development is considered to remain **not significant**.

16.10 Transboundary Impacts

If necessary, transboundary shipments of waste will be carried out in accordance with the Basel Convention and will require approvals from the competent authorities in Ireland (Dublin City Council) and the receiving country. This may be required in the case of small quantities of hazardous waste for which there is no suitable management route in Ireland (e.g. waste chemicals). Any impacts associated with the management of waste at waste management facilities in countries outside of Ireland are not included in the scope of this assessment, since it is assumed that they will have been assessed and (where necessary) mitigated as part of the planning and permitting of these facilities.

16.11 Decommissioning Phase

As outlined in Chapter 02 – Project Description, in the event of decommissioning, measures will be undertaken by the Applicant to ensure that there would be no significant, negative environmental effects from the closed LNG Terminal and Power Plant. Examples of the measures that would be implemented are outlined in Section 2.11, Chapter 02 – Project Description. As a result, additional potential impacts and associated effects arising during the decommissioning phase are not anticipated above and beyond those already assessed during the construction phase. The majority of the physical assets onsite will comprise of steel, concrete or asphalt, all of which are capable of being recycled.

16.12 Summary

Assuming all waste is removed from the Proposed Development site, the overall estimated CDW waste arisings would be 0.058% of total national CDW arisings. The effect is to be considered **not significant**.

By applying good industry practice to the management of non-hazardous waste generated by the Proposed Developments construction activities, it is anticipated that an overall recovery rate of 78% could be achieved onsite which exceeds the Government's 70% target for recovery of construction waste.

The estimated operational waste arisings have been compared to the quantity of hazardous and non-hazardous waste collected in Ireland in 2018. Operational waste arisings would be 0.04% of total national waste arisings. The effect is also considered **not significant**.

Following implementation of mitigation and monitoring measures, the residual effect significance on national waste plans and policies, and national capacity as a result of the waste generated from the Proposed Development is considered to remain **not significant**.

Table 16-13 Summary

<table>
<tr><th>Proposed Development Stage</th><th>Aspect/ Impact Assessed</th><th>Existing Environment/ Receptor Sensitivity</th><th>Effect/ Magnitude</th><th>Significance (Prior to Mitigation)</th><th>Mitigation and Monitoring Measures
(the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)</th><th>Residual Effect Significance</th></tr>
<tr><td>Construction</td><td>Non-hazardous waste</td><td>Waste facility</td><td>N/A</td><td>Slight</td><td rowspan="4">The following best practice measures will be implemented to manage the CDW produced by the Proposed Development:

EU, National and Irish policy and legislation require the waste hierarchy (Figure 16-1) to be applied to all waste arisings. Widely implemented best practice is to adopt a Site Waste Management Plan (SWMP) to reduce the amount of waste generated and follow the waste hierarchy in for far as practicable. A SWMP will be developed and implemented for the Proposed Development and include the following details:

Statutory requirements, the Applicants corporate requirements and mitigation and monitoring measures defined within this EIAR where applicable to waste management;
Waste types and procedures for classification, segregation, containment, storage, transportation and disposal. This will include details on the measures to prevent impacts to the receiving environment. The Contractor will apply the principles of the ‘Waste Hierarchy’ (Prevention, Preparing for Re-use, Recycling, Other Recovery, Disposal) to minimise waste generation, maximise re-use of site-won materials onsite and minimise the need for disposal of waste. Where re-use is not possible onsite, alternative re-use and recycling options will be sought offsite with the final disposal option;.

Roles and responsibilities;
Training requirements;
Waste handling procedures;
Waste compound maintenance measures;
Emergency planning and response;
Monitoring, reporting and document control procedures; and
Corrective action process.

As part of the document control procedures, a comprehensive docketing system (including waste transfer notes) will be detailed in the SWMP. The documentation to be maintained in relation to waste material removed from the site will include the following:

The names of the agent(s) and the transporter(s) of the wastes;
The name(s) of the person(s) responsible for the ultimate treatment of the wastes;

</td><td>Slight</td></tr>
<tr><td>Construction</td><td>CDW waste arisings</td><td>Waste facility</td><td>N/A</td><td>Not Significant</td><td>Not Significant</td></tr>
<tr><td><s>Operation</s></td><td>Ballast Water</td><td>Shannon Estuary and waste facilities</td><td>N/A</td><td>Not Significant</td><td></td></tr>
<tr><td>Operation</td><td>Non-hazardous and hazardous waste</td><td>Waste facility</td><td>N/A</td><td>Not Significant</td><td>Not Significant</td></tr>
</table>

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Effect Significance
					– The ultimate destination(s) of the wastes; – Written confirmation of the acceptance and treatment of the hazardous waste consignments; – The tonnages and List of Wastes (LoW) code for the waste materials; – Details of each individual consignment dispatched from the Proposed Development site; ▪ Description of waste (cell number/ AEC number, stockpile number or origin of waste) ▪ Date and time of dispatch from the Proposed Development site ▪ Name of haulage company ▪ Details of contractor and haulier docket numbers ▪ Vehicle registration number and driver name ▪ Volume/ weight of waste removed ▪ Name of waste receiving facility ▪ Date and time of arrival at waste receiving facility – Details of any rejected consignments; – Waste transfer forms for hazardous wastes transferred from the Proposed Development site (stamped at receiving facility); and – The transfrontier shipment of waste forms (where exported). • The SWMP will include procedures for monitoring the overall CDW recovery rate. • Ballast water will be dealt with in line with the IMO ballast water management convention (see also Chapter 07 – Biodiversity)	

16.13 References

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CHAPTER 17
Material Assets

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park
Environmental Impact Assessment Report

Table of Contents

Figures

No table of figures entries found.

Tables

17. Material Assets

17.1 Introduction

This chapter presents an assessment of the potential impacts of the Proposed Development on Material Assets. This chapter defines the study area; the methodology used for developing the baseline and impact assessment; provides a description of the baseline environment; and presents the findings of the impact assessment.

The Environmental Protection Agency's draft '*Guidelines on the information to be contained in an Environmental Impact Assessment Reports*' (2017) describes Material Assets to be taken to mean 'built services' (i.e. Utilities networks including electricity, telecommunications, gas, water supply infrastructure and sewerage), 'waste management' and 'infrastructure' (roads and traffic).

This chapter presents an assessment of the potential impacts of the Proposed Development on built services, as well as infrastructure: land use and buildings (on the Proposed Development site). Chapter 11 discusses the assessment of roads and traffic and Chapter 16 discusses waste and as such these topics are not considered in this chapter.

17.2 Competent Expert

This assessment has been undertaken by Niamh O'Connell, Associate Director Environment and Sustainability, BA (Mod) Eng, H dip Env Eng, MSc, PM, MIEnvSc CSci. Niamh is a Chartered Scientist and Associate Director in the AECOM Environment and Sustainability Team and has more than 16 years' post-graduate experience. She has extensive experience of managing environmental issues on major projects for both public and private sector clients taking projects from feasibility through EIAR, the planning process and later through detailed design and construction phases.

17.3 Methodology

The methodology used to assess impact on built services is in accordance with the draft '*Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*' (EPA, 2017) and as summarised in Chapter 01 – Introduction.

17.3.1 Legislation and Guidance

The legislation and guidance applicable to the material assets assessment include:

- Directive 2011/ 92/ EU of the European Parliament and the Council on the assessment of the effects of certain public and private projects on the environment, as amended by Directive 2014/ 52/ EU (the 'EIA Directive');
- *European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018)*;
- EPA Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (2003); and
- EPA's draft guidance document '*Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*' (2017).

17.3.2 Study Area

The study area is the Proposed Development site (Chapter 02 – Project Description), as well as the surrounding area in relation to utilities networks and land use that could be impacted by the Proposed Development. This study area has been used for the assessments associated with the utilities, land use and property impact assessment and is referred to herein as the material assets study area.

17.3.3 Desktop Study

A desktop assessment of client provided and publicly available information was undertaken to determine the baseline utility arrangements and existing land uses within the study area which could be impacted by the Proposed Development.

Data gathered included:

1. Location and description of existing utilities network;
2. Location and number of properties at risk of demolition, or from which land will be required/ access affected by the Proposed Development;
3. Existing land uses in the study area; and
4. Land registry maps;

For the utilities assessment, the information reviewed included site utility plans and preliminary design information. The Applicant/ AECOM consulted with EirGrid, the Commission for Regulations of Utilities (CRU), Irish Water, Gas Networks Ireland (GNI) and Electricity Supply Board Networks (ESBN) during the design of the Proposed Development.

The Applicant has made the following utility connection requests:

1. A connection request to export up to 600 MW of power to the electricity transmission system. The application was made to EirGrid under the Enduring Connection Process (ECP) 2.1 process;
2. A connection request to import up 10 MW of power from the electricity transmission network. The application was made to ESBN; and
3. A connection request to the municipal water supply system. The application was made to Irish Water.

Offers have not been received yet for these connection applications.

17.3.4 Determination of Sensitive Receptors

The sensitivity of the existing environment can be determined by describing changes to the environment that could limit the access to, or use of, the material asset (EPA, 2003). For the purpose of this assessment, the sensitive receptors are regarded as the existing utilities networks infrastructure in the study area. Terminology used to describe the sensitivity of the receptor is as per the draft '*Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*' (EPA, 2017).

17.3.4.1 Utilities

Examples of the sensitivities used for existing utilities infrastructure within this chapter are outlined in Table 17-1.

Table 17-1 Sensitivity Criteria

Sensitivity	Description
High	• Electricity network 220 kV and above. • Transmission gas pipeline (high pressure).
Medium	• Distribution gas network (medium pressure). • Electricity network 38 kV and 110 kV.
Low	• Low pressure gas pipeline. • Low/ medium voltage electricity network 230 v and 400 v. • Telecommunications network. • Water supply network. • Drainage network including foul sewerage.
Negligible	N/A

17.3.4.2 Land Use and Properties

Criteria used when applying a sensitivity for land use and properties within this chapter are outlined in Table 17-2.

Table 17-2 Examples of Sensitivities Assigned to Different Land Uses and Property Types

Sensitivity	Description
High	• Private residential buildings, or land allocated for development of housing. • Buildings used for employment use, and land allocated for development of employment uses. • Regularly used community buildings which have only limited alternatives available nearby. • Designated public open spaces, or open spaces which attract users nationally e.g. national parks
Medium	• Land associated with private residential buildings e.g. gardens. • Community buildings which are regularly used or where there are only limited alternatives available in the local area. • Open spaces which span over a regional area and attract visitors from a regional catchment e.g. country parks, forests. • Public rights of way and other routes close to communities which are used for recreational or utility purposes, but for which alternative routes can be taken.
Low	• Community buildings which are infrequently used or where there are many alternatives available in the local area. • Open spaces which are used for informal recreation (e.g. dog walking), and where there are alternative open spaces available. • Locally used community land e.g. local parks and playing fields. • Property consisting of public road/ private road and small plots of land.
Negligible	• Derelict or unoccupied buildings.

17.3.5 Describing Potential Effects

A development could impact existing utilities networks if it involves any of the following:

- Demolition of a utility;
- Diversion of a utility;
- Modification of a utility;
- Connections to existing infrastructure; and
- Additional demand on existing supply.

Impacts from a development on existing land use and buildings can include:

- Acquisition of land;
- Changes to accessibility and severance;
- Demolition of buildings; and/ or
- Revaluation of or change in the development potential of adjoining lands/ buildings.

The methodology used for evaluating impact levels and the terminology for describing the quality, significance, extent, probability and duration of effects is as per the draft '*Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*' (EPA, 2017) and as summarised in Chapter 01 – Introduction. In summary, it involves combining a sensitivity of a receptor with a description of an impact on that receptor (its quality, type, frequency, duration, probability and magnitude) to determine a significance of an effect.

17.4 Baseline Environment

17.4.1 Utilities

Please see Figure F17-1, Vol. 3 for an overview of the proposed 220 kV and medium voltage (10/ 20 kV) cable routes and substations.

17.4.1.1 Electricity Network

There is no electricity network infrastructure within the boundary of the Proposed Development site. The following infrastructure is located nearby, principally under the L1010, close to the entrance of the Proposed Development site.

- High voltage (HV) 220 kV, 110 kV cable route; and
- Medium voltage (MV) 38 kV and 20 kV cable route.

There is HV electricity grid in close proximity to the Proposed Development site. A 220 kV and 110kV electrical transmission is available from the nearby Kilpaddoge 220 kV substation approximately 3 km east of the study area. Additional electrical substations in the vicinity of the Proposed Development include the 590 MW Tarbert Power Station approximately 6 km from Proposed Development site and the 855 MW coal-fired station at Moneypoint 3.5 km north east of the Proposed Development. Tarbert Power Station is scheduled to close by the end of 2023 and Moneypoint is scheduled to close in 2025 (EirGrid and Soni, 2020).

The Kilpaddoge-Knockanure Project is a new EirGird project which looks to install an underground electricity cable linking Kilpaddoge and Knockanure substations. This project aims to strengthen the transmission network in the south west of Ireland. The project is currently ongoing, and expected to be completed and the cables put into service in 2021 (Gas Networks Ireland, 2021).

17.4.1.2 Telecommunications (including Phone and Broadband)

An existing overhead telecom line (Eir phone line) runs along the L1010 road. There are no broadband connections within the footprint of the Proposed Development site. The closest fibre broadband infrastructure is located in Ballylongford, 3.5 km from the Proposed Development site.

17.4.1.3 Gas Network

There is no existing natural gas transmission network within the footprint of the Proposed Development site. A GNI owned gas transmission pipeline is located approximately 26 km from the Proposed Development site at its nearest point. The pipeline has a diameter of 762 mm (30 inches) and runs from its landfall on the south side of the estuary to the west and south of Foynes along its route to Craggs Above Ground Installation (AGI) (Gas Networks Ireland, 2021).

Planning permission exists for the development of a 26 km natural gas pipeline which will facilitate the connection of the Proposed Development site to the GNI transmission system at Foynes in Leahys, Co. Limerick.

17.4.1.4 Water Supply Network

Currently there is a group water scheme, supplied from Ballylongford, that extends to a distance of about 150 m beyond the entrance to the Proposed Development site. The condition of this water main is uncertain.

Ballylongford, which is approximately 3.5 km west of the Proposed Development site, is served by the Listowel Regional Water Supply with adequate water supply. Tarbert, which is approximately 4.5 km east of the Proposed Development site is designated as a District Town of the Listowel Municipal District. It is served by both the Listowel Regional Water Supply with adequate capacity and Tierclea spring, which has no additional capacity (KCC, 2020).

17.4.1.5 Drainage Network (Stormwater and Sewerage)

There are no existing piped stormwater or sewerage drainage systems within the footprint of the Proposed Development site, or along the L1010 adjacent to the Proposed Development site.

A wastewater treatment plant (WWTP) operated by Irish Water is located in Tarbert in proximity to Harold’s Bridge to the south of Tarbert settlement. The treatment plant has a capacity of 1,300 Population Equivalent (P.E) (KCC, 2020).

A survey conducted by Irish Water inspected the existing foul network for the Tarbert area. It concluded that the existing sewerage is a partially combined system consisting of the following (Irish Water, 2014):

- 2,372 m of 100 mm and 150 mm diameter sewers;
- 2,261 m of 225 mm diameter sewers;
- 56 m of 300 mm diameter concrete sewers; and
- 23 m of 450 diameter sewers.

The WWTP serving Ballylongford has a capacity of 1,000 P.E, however, network constraints are known to exist in Ballylongford. According to the Listowel Municipal District Local Area Plan (LAP) 2020-2026, Irish Water intend to prepare a drainage area plan for the Ballylongford settlement (KCC, 2020), which is currently under review by Irish Water.

17.4.1.6 Land Use and Building

As outlined in Chapter 05 – Land and Soils, the Proposed Development site is located on the southern shore of the Shannon Estuary and predominantly comprises grassland, with minimal infrastructure in place.

The Proposed Development is in a predominantly agricultural area, with the following surrounding land uses noted:

- Immediately to the north is the Shannon Estuary;
- To the east is forestry and agricultural land;
- To the south is agricultural land and the L1010, with scattered residential properties; and
- To the west is agricultural land, beyond which is coastline.

The lands within the Proposed Development site are currently leased and in agricultural use, mainly in pasture with some tillage.

A small stream runs in a north-westerly direction through the Proposed Development site and discharges into the Shannon Estuary.

According to the latest Kerry County Development Plan 2015 – 2021 (KCC, 2015), the Proposed Development site is zoned for '*marine-related industry, compatible or complimentary industries and enterprises which require deep water access*' and 'Secondary Special Amenity'. The lands are accessed by the L1010 coast road. Widening works on the L1010 by KCC are ongoing, and it anticipated these will be complete prior to main construction works onsite.

There are a number of disused and unoccupied buildings within the Proposed Development site (see Figures F12-2 to F12-4, Vol. 3), including a derelict set of buildings which now appear used as agricultural outbuildings. It is intended that these will be demolished and removed during the initial stage of construction. Please see Chapter 12 – Cultural Heritage for additional information.

Figure 17-1 Utilities

17.5 Assessment of Impact and Effect

17.5.1 Construction and Operational Phase

Where pipe laying and connection to public utilities are required for the Proposed Development, tie-ins to public utilities for the construction phase will be specifically designed and installed following approved methods, and with the agreement of the relevant utility provider.

Utilities will likely come onsite from cables/ pipes under the L1010 and traverse along the side of the Proposed Development site access road before connecting into the infrastructure onsite.

17.5.1.1 Electricity Network

Construction

The Power Plant will have an installed capacity of up to 600 MW and will be designed in accordance with best available techniques (BAT) for large combustion plants, industrial cooling systems, energy efficiency and emissions from storage.

As there is no existing supply (See Section 17.3.1.1), during the construction phase of the Proposed Development, electricity will be supplied via a series of portable site diesel generators, until the 220 kV and medium voltage (10/ 20 kV) grid connections are installed (subject to a future planning application), as discussed in Chapter 02 – Project Description. Therefore, there will be no impacts on the existing electricity supply network.

Operation

It is anticipated that once operational approximately 10 MW of electricity generated by the Power Plant will be supplied to the LNG Terminal. During periods of high wind (renewable) generation it is expected that the Power Plant will be turned off by the system operator (EirGrid) to give priority to renewable power. In this event, the LNG Terminal will require power. In times when the Power Plant is shut down, power may be imported to the Proposed Development site via the proposed future 220 kV high voltage grid connection.

However, it is currently anticipated that the LNG Terminal will be operational before the Power Plant and the 220 kV grid connection are completed. Therefore, a medium voltage (10/ 20 kV) grid connection will be required to supply power to the LNG Terminal to provide approximately 10 MW of power to the LNG Terminal while awaiting the completion and availability of the Power Plant and/ or 220 kV HV grid connection. The medium voltage (10/ 20 kV) grid connection will be reserved as a backup power supply during periods when the Power Plant is shut down for maintenance.

A connection request for the 220 kV connection was made to EirGrid in September 2020 under the Enduring Connection Process (ECP) 2.1 process. A connection request to import up 10 MW of power from the electricity transmission network was made to ESBN in April 2021.

Therefore, there could be a temporary, negative effect on the existing electricity network as a result of the future medium voltage (10/ 20 kV) and 220 kV grid connections during times where the Power Plant is not operational.

However, although the medium voltage (10/ 20 kV) and 220 kV connection are both subject to separate connection agreements with EirGrid and ESBN respectively, and will be assessed under a separate planning application, overall it is anticipated that if the 220 kV grid connection is approved and consented, the Power Plant will likely have a **long-term**, **positive**, **high** and **very significant** effect on the existing electricity supply network (**high** sensitivity). As outlined in Chapter 02 – Project Description, the 220 kV GIS substation, which forms part of the Proposed Development, will accept the 220 kV output from each CCGT Block and BESS in the Power Plant and connect to the national electricity grid via the future proposed 220 kV grid connection. Electricity generated by the Power Plant (up to 600 MW) will be for sale to the integrated Single Electricity Market (iSEM). These future projects are considered further under cumulative impacts in Section 17.6.

Onsite gas power generators may also be used to power the LNG Terminal until the Power Plant is operational or until the medium voltage (10/ 20 kV) connection is approved and operational. The Applicant has submitted an application to ESBN networks (ref number 50000446571) for the medium voltage (10/ 20 kV) connection. When available, these onsite gas generators will be utilised as backup power supply; for example, if the proposed future medium voltage (10/ 20 kV) and/ or 220 kV grid connections fail or are unavailable due to maintenance works. Potential impacts arising from the operation of these gas generators is outlined in Section 17.4.1.4.2.

Once operational, the Power Plant will generate power for its own needs via gas turbines utilising gas from the nearby LNG Terminal and will not require a supply from the existing electricity network to meet its power demands. The FSRU will also be self-sufficient in terms of producing the necessary electricity, for example, to power pumps and regasification equipment, for auxiliary systems and for staff accommodation. Generators onboard will be powered by dual-fuel engines which will use boil-off natural gas (BOG) from the LNG storage tanks as main fuel. Therefore, there will be no additional demand on the existing electricity supply network.

17.5.1.2 Water Supply Networks

Construction Phase

As detailed within Chapter 02 – Project Description, water supply will be required in the contractor compounds, wheel wash areas, welfare facilities, for general construction works, hydrotesting of tanks and pipework, for the construction of the concrete elements and for dust suppression during construction. The maximum potable water demand for construction personnel will be 98 m^3/day. It is anticipated that water supply for the construction phase will be obtained from a water main along the L1010. The Applicant has submitted a pre-connection agreement application to Irish Water for this supply. If this supply is not available, water will be delivered by road and stored in a temporary tank onsite. The Proposed Development will incorporate water efficiency measures such as collection of grey water to minimise water consumption as far as possible.

It is not anticipated the additional demands on the water supply network during the construction phase will be excessive given the transient nature of the works; therefore, the additional demands will likely result in a **negative, short-term** and **medium** effect on an existing environment of **low** sensitivity; therefore, the significance of the effect on the existing water supply will be **moderate.**

The Applicant has submitted a pre-connection agreement application to Irish Water for this supply and for supply during operational phase. The temporary and/ or permanent connection works associated with connecting the Proposed Development site to the water main may temporarily disrupt services in the local area. However, this will be dependent on requirements from Irish Water, which will be set out in the connection agreement during the connection works. The water supply system will be metered to determine water consumption and facilitate leakage detection and will be in accordance with Irish Water requirements. The impact will likely result in a **negative**, **short-term**, **medium** effect on the existing water supply network of **low** sensitivity; therefore, the significance of the effect on the existing water supply network will likely be **moderate**.

See below section for potential effects from the additional demands on the existing supply network during the operational phase.

Operational Phase

As outlined above, to facilitate the water demand for the Proposed Development during operation, a new permanent water supply via a connection to the existing water supply infrastructure will be required during operations. The anticipated demand is as follows:

- Domestic Site Staff – 3.6 m^3/day;
- Process Water – Ranging between 10 m^3/hr and 33 m^3/hr; and
- Fire water supply – non-continuous - to fill or top up onsite firewater storage tanks periodically.

Irish Water have confirmed that there is sufficient capacity to supply human drinking water and process water to the Proposed Development. It is anticipated that this will be provided along the Coast Road from Ballylongford to the Proposed Development site (see Chapter 02 – Project Description). The Proposed Development has been developed to minimise water consumption. The Proposed Development will adhere to all conditions of the connection offer from Irish Water.

As a result, it is anticipated that the additional demands on the existing water supply network during operation will likely be result in a **long-term**, **negative** and **low** effect on existing supply network (**low** sensitivity). The effect significance is therefore considered **slight**.

17.5.1.3 Telecommunications

Construction
Telecommunications requirements during the construction phase will be covered by mobile phone/ broadband networks. It is not anticipated that the Proposed Development will impact or disrupt the existing telecommunication networks in the study area.

Operation
The Proposed Development supply will require a connection to a broadband network. It is anticipated that it will be serviced by a new fibre cable which will be supplied via a new duct under the widened L1010.

17.5.1.4 Gas Network

Construction
No requirement for natural gas is anticipated during the construction phase; therefore, there will be no impacts on the existing gas transmission network in the study area.

Operation
As outlined in Chapter 02 – Project Description, the Proposed Development will include onsite backup power generation capacity of up to 24 MW to power the LNG Terminal until the Power Plant is operational. The onsite power generation will consist of three 8 MW gas fired electricity generators. The fuel gas for these generators will be supplied primarily from gas from the FSRU. However, if there is no gas from the FSRU, for example if the FSRU is temporarily disconnected due to a storm (this is estimated to be about 1% of the time over the year), the generators may be powered by gas which will be reverse flowed from the already consented 26 km natural gas pipeline (known as the 'Shannon Pipeline') between the AGI and the existing GNI national gas transmission network near Foynes, Co. Limerick. This will supply power for the control room, warehouse and administrative building.

The generators will supply power for the LNG Terminal until grid power is available and in the event that both of the LNG Terminal's grid connections fail, as the LNG Terminal will need to be operational 24/ 7.

Consultation has been undertaken with GNI, who has confirmed that subject to a valid connection agreement being put in place, the consented pipeline connection to the existing gas transmission network near Foynes will be facilitated and potential gas demand from the LNG Terminal will be accommodated with current the network capacity. Therefore, it is anticipated that the Proposed Development will have a temporary, **neutral**, **negligible** and **not significant** effect on the existing gas supply network (**high** sensitivity), during occasions where there are interruptions to LNG deliveries.

Natural gas will be supplied to the Power Plant from the LNG Terminal. The Power Plant will use to up to 2.7 million Sm^3 per day of natural gas when operating at full capacity, and the LNG Terminal will have sufficient capacity to meet this demand. Therefore, there will be no requirement to utilise gas from the existing network and as a result, there will be no impact on the existing gas network. However, if there is no gas from FSRU, for example if the FSRU is temporarily disconnected due to a storm, the Power Plant may be powered by fuel gas which will be reverse flowed from the already consented 26 km natural gas pipeline (known as the 'Shannon Pipeline' between the Proposed Development site and the existing GNI national gas transmission network near Foynes, Co. Limerick.

During the operational phase, it is likely that there will be a **long-term**, **positive** and **high** effect on the existing gas network (**high** sensitivity) as the Proposed Development will facilitate an additional/ alternative supply of natural gas into the national grid, reducing Ireland's reliance on deliveries through the UK gas interconnector. This will result in a **very significant** improvement in terms of security of supply of natural gas into the existing supply network, and overall improve Ireland security of supply of energy. The Proposed Development may supply up to 22.7 million Sm^3/d of natural gas to the Irish gas transmission system via the already consented 26 km Shannon Pipeline.

17.5.1.5 Sewerage Networks

Construction
As outlined in Section 17.3.5, there is no existing piped stormwater drainage system on the Proposed Development site. As a result, during the construction phase sewage effluent arising from facilities within the construction compound, will be collected in tanks and portable self-contained toilet units for removal by tanker to a licensed water treatment plant.

Therefore, there will be no impacts from sewerage drainage arising from the Proposed Development on drainage networks as there is currently no piped network on the Proposed Development site.

Operation

As outlined in Chapter 02 – Project Description, during the operational phase, all foul water will be pumped or fall by gravity to a wastewater treatment plant (WWTP). The treated effluent from the WWTP will be discharged to the Shannon Estuary via the same discharge point as the surface water. All sanitary effluent arising onboard the FSRU will be retained onboard and discharged ashore via vacuum lorry and transferred to a licensed site by licensed waste operator. Estimated operational waste quantities are provided in Table 2-8 of Chapter 02 – Project Description.

Therefore, there will no impacts from sewerage drainage arising from the Proposed Development on drainage networks in the study area as there is no piped network on the Proposed Development site.

17.5.1.6 Process Effluent

There will be several process effluent streams generated in the Power Plant as outlined in Chapter 02 – Project Description. There will be no process wastewater from the onshore LNG Terminal and AGI. All process water discharge will be pumped to the effluent sump, and then discharged, via the storm water outfall pipe, to the Shannon Estuary. Therefore, there will no impacts from process effluent arising from the Proposed Development on drainage networks in the study area.

Please see Chapter 06 – Water for assessment of potential impacts from process effluent on receiving watercourses.

17.5.1.7 Stormwater Drainage Network

Construction

There are no existing piped stormwater drainage systems within the footprint of the Proposed Development site or along the L1010 (Section 17.3.1.5). During the construction phase, stormwater runoff will be diverted from the main construction area by a combination of suitable falls on subgrade surfaces, as well as temporary drainage ditches. All runoff will then be passed through a series of settlement and filtration ponds in order to remove any suspended solids, before being discharged to the Shannon Estuary. Therefore, in addition to the fact there are currently no stormwater drainage networks in the study area, there will no impacts from stormwater runoff arising from the Proposed Development.

Please see Chapter 06 – Water for assessment of potential impacts from stormwater drainage on receiving watercourses.

Operation

During the operational phase, it is proposed that all stormwater from vegetated and impermeable areas and groundwater from the groundwater drainage network of the Proposed Development site will be collected and discharged, where possible, to the existing stream/ drainage ditches, or discharge directly to the Shannon Estuary via the drainage outfall pipe, which will extend across the foreshore to the below the low water mark (see Chapter 02 – Project Description and Chapter 06 – Water for more detail). The drainage features along the access road all ultimately drain to a single surface water course, the Ralappane Stream, which discharges into the Shannon Estuary. Therefore, in addition to the fact there are currently no stormwater drainage networks in the study area, there will no impacts from stormwater runoff arising from the Proposed Development.

Please see Chapter 06 – Water for assessment of potential impacts from stormwater drainage on receiving watercourses.

17.5.1.8 Land Use and Buildings

The Applicant has entered into an agreement with the owner of the Landbank (Shannon Commercial Properties (DAC) for the purchase of the entire Shannon Landbank. The Shannon Landbank has a total area of 243 ha (603 acres). The Proposed Development requires 41 ha of this 243 ha. The total site area including the offshore elements is 52 ha.

An abandoned farmhouse and a ‘pillbox’[1] structure (within the Proposed Development site will need to be demolished to facilitate the construction of the Proposed Development. Refer to Chapter 12 –

[1] It is described as ‘*a detached single-bay single-storey hexagonal pill box, built approximately 1942, now derelict. Flat concrete roof. Concrete walls with rubble limestone camouflage covering. Square-headed chamfered openings. Square-headed door*

Cultural Heritage for more details and the location of identified cultural heritage assets. There will likely be a **permanent**, **neutral** and **negligible** effect due the demolition of the farm buildings as these are currently unoccupied and derelict (**negligible** sensitivity); therefore, the effects on existing buildings will be **imperceptible**. Please see Chapter 12 – Cultural Heritage for additional information on effects from the Proposed Development on existing buildings/ structures within the Proposed Development site.

As outlined in Section 17.3.1.6, the lands are currently zoned for industry, are identified as a strategic development location and are currently owned for the purpose of Proposed Development; however, the lands are currently leased to local farmers and the Proposed Development will impact on the existing agricultural land use. The effects from the removal of land from agricultural use is assessment in Chapter 05 – Land and Soils.

17.6 Cumulative Impacts and Effects

Cumulative effects are defined as the combination of many minor impacts creating one, larger, more significant effect (EPA, 2017). Cumulative effects consider existing stresses on the natural environment as well as developments that are underway and in planning.

This cumulative assessment has been undertaken with reference to Appendix A1-5, Vol. 4, which lists planning applications within 5 km and outside 5 km of the Proposed Development.

There are three future possible developments associated with the Proposed Development, which will form part of the future' Shannon Technology and Energy Park' as described in Chapter 02 – Project Description and shown on the masterplan in Figure F1-1, Vol. 3:

1. Medium voltage (10/ 20 kV) grid connection;
2. 220 kV grid connection; and
3. Data Centre Campus.

These are also considered in the cumulative impact assessment.

17.6.1 Construction Phase

As outlined in Section 17.4, there will be no additional demands on the electricity, gas and telecommunications network during the construction phase of the Proposed Development. The Contractor may require a temporary connection to the existing water supply network; however, anticipated demands from the Proposed Development on existing water supply networks during the construction phase will not be excessive, as discussed above, and will not likely result in significant effects. Irish Water have been consulted in relation to provision of these services for the Proposed Development and have not signalled any difficulty with the proposed resources required.

Based on the review of the tables in Appendix A1-5, Vol. 4, there are no notable planning applications that will significantly increase demand on utilities supply networks utilised during the construction phase. Therefore, the cumulative effects of the Proposed Development on existing utilities networks with other surrounding permitted, planned and existing developments listed in Appendix A1-5, Vol. 4 will likely not be significant during the construction phase.

17.6.1.1 Grid Connections

Provided that the medium voltage (10/ 20 kV) and 220 kV grid connections are consented, the construction phases may coincide with the construction of the Power Plant. During the construction phase of these projects, there may be negative cumulative effects on the existing water supply, telecommunications and gas networks due to additional demands on these networks to facilitate their construction. However, the supply requirements are unknown at this stage. In addition to this, any required temporary connections by the Contractor will be conducted in consultation with the relevant service provider. Therefore, effects on the existing networks will be temporary, and as a result, negative and significant cumulative effects are not anticipated during the construction phase.

During the construction phase, the final connection of the proposed 220 kV grid into Kilapddoge may require an outage of the local 220 kV transmission system. However, it is anticipated that the

opening. Built within a field boundary. A typical WWII era pill box, of functional design. It remains in good condition due to its simple Design' (Laban, 2008).

construction and commissioning programme will be aligned with the standard EirGrid outage season which normally runs between April and September. In addition, works within the L1010 will be scheduled to avoid disruption to the local school between the site and Kilpaddoge. Therefore, this new electrical connection should have no impact or disruptions to the national grid during connection works.

17.6.1.2 Data Centre Campus

The third future project associated with the Shannon Technology and Energy Park is a Data Centre Campus that is proposed to be located in lands southwest of the Proposed Development. However, the Proposed Development and the Data Centre Campus will not be constructed simultaneously and there will likely be no cumulative impacts on existing utilities network during the construction phase associated with these developments.

17.6.2 Operational Phase

17.6.2.1 Grid Connections

The three future developments associated with the Proposed Development could also result in cumulative impacts on the existing electricity network during their operation.

Anticipated demands from the Proposed Development on existing utilities networks during the operational phase will not be excessive, as discussed in Section 17.4.1, and will not likely result in significant effects. The relevant service providers (Irish Water, ESBN, EirGrid, GNI and broadband suppliers along with KCC) have been consulted in relation to provision of these services for the Proposed Development and have not signalled any difficulty with the resources required.

It should also be noted that the 600 MW Power Plant will not be operational all year round and will see frequent periods where it is instructed to shutdown down by the system operator, EirGrid. This is because under current grid rules, renewable generation is given priority to generate ahead of gas fired generation i.e. Shannon Technology and Energy Park's 600 MW Power Plant. However, the LNG Terminal will need to be operational all year round.

As outlined in Chapter 02 – Project Description and Section 17.4.1, a high voltage 220 kV electrical connection to the national electrical transmission system will be required to export power from the Power Plant. An offer has yet to be received so the precise connection details cannot be confirmed at the time of writing. However, it is expected that the connection point will be the ESBN/ EirGrid Killpaddogue 220 kV substation which is approximately 5 km east of the Proposed Development site with the connection method being 220 kV cable(s) under the L1010 road.

It is expected that the 220 kV connection will also require an onsite ESBN/ EirGrid 220 kV substation and this is currently proposed to be located approximately 500 m from the main Proposed Development site entrance. This ESBN/ EirGrid 220 kV site substation will be included with the future 220 kV connection planning application and will be adopted by EirGrid post commissioning and will form part of the overall 220kV transmission system. Electricity generated by the Power Plant (up to 600 MW) will be for sale to the integrated Single Electricity Market (iSEM) via the proposed future 220 kV connection.

The onsite ESBN/ EirGrid 220 kV substation will also connect to the Power Plant 220 kV GIS substation, which forms part of this Proposed Development. As outlined in Section 17.4.1.1, in times when the Power Plant is shut down, power will be imported to the Proposed Development site via the proposed future 220 kV high voltage grid connection. However, this will be subject to a connection agreement with EirGrid. A small amount (approximately 20 MW) of the electricity generated by the Power Plant will be used in the LNG Terminal, and in the operation of the Power Plant itself. The balance of the electricity produced is intended for the market and will be sold into the integrated Single Electricity Market (iSEM).

The LNG Terminal may need to be operational before the Power Plant and/ or 220 kV high voltage grid connection are completed or operational. Therefore, the LNG Terminal will require a separate medium voltage (10/ 20 kV) connection to power the LNG Terminal in the absence of the Power Plant and/ or 220 kV high voltage grid connection. Once the Power Plant and/ or future 220 kV grid connection are completed, this medium voltage (10/ 20 kV) grid connection will be reserved as a backup power supply. However, this is subject to a connection agreement with ESBN and will be assessed under a separate planning application. Please see Chapter 02 – Project Description for further details.

17.6.2.2 Data Centre Campus

The Data Centre Campus will result in additional demands on the existing electricity grid. However, this will be subject to BAT, as well as its own licence and planning application; therefore, the power demands are unknown at this stage.

17.6.2.3 Additional Developments

In addition to the future developments associated with the LNG Terminal and Power Plant, a 1.4GW offshore wind farm using floating technology is proposed off the coast of Clare and Kerry, with Moneypoint power station set to become the base for the renewable energy project. A windfarm in the Townlands of Aghanagran Middle, Aghanagran Lower, Ballyline West, Tullahennell South, Ballylongford, Co. Kerry (planning application: 304807-19), located within 5 km from the Proposed Development site has also be proposed. There are also a number of solar farm developments proposed, which are located further than 5 km from the Proposed Development site.

It is anticipated that effects on the existing grid network in combination with the future Shannon Technology and Energy Park, will result in a **positive** and **very significant** cumulative effect.

During the operational phase of the aforementioned projects, there could also be cumulative effects on the existing water supply, telecommunications and gas networks due to additional demands on these networks. However, the supply requirements are unknown at this stage. In addition to this, any required connections will be conducted in consultation with the relevant service provider. Therefore, long-term, negative, and significant cumulative effects are not anticipated.

Based on the review of Appendix A1-5, Vol. 4, there are no other notable planning application that will significantly increase the pressure on utilities networks utilised during both the construction and operational phase of these developments.

17.6.2.4 Summary

However, despite the limited additional demands on the existing electricity supply network associated with the developments of the future 'Shannon Technology and Energy Park', overall it is anticipated that the effects from these future developments, in combination with effects from the Proposed Development, will likely result in a **positive** and very **significant** cumulative effect on the existing electricity supply network due to the amount of electricity generated that could be generated and sold onto the national grid network (i.e. up to 600 MW).

17.7 Mitigation and Monitoring Measures

17.7.1 Utilities

Although it has been determined that the effects identified during the assessment on the existing utilities network in the study area will likely be not significant or imperceptible during the construction phase, the following best practice measures will be implemented by the Contractor during the construction phase:

- The Contractor will be obliged to put measures in place during the construction phase to ensure that there are no interruptions to existing services and all services and utilities are maintained unless this has been agreed in advance with the relevant service provider and local authority. When service suspensions are required during the construction phase, reasonable prior notice will be given to the residents in the area. The disruption to services or outages will be carefully planned so the duration is minimised. The timing of local domestic connections will be addressed between the Contractor and the local community at the detailed design stage;
- Works during the construction phase, including service diversions and realignment will be carried out in accordance with relevant guidance documents, including Gas Networks Ireland's publication 'Safety advice for working in the vicinity of natural gas pipelines'; the ESB's Code of Practice for Avoiding Danger from Overhead Electricity Lines', 2008 and the Health and Safety Authorities (HSA) 'Code of Practice for Avoiding Danger from Underground Services', 2010;
- All potential temporary connections will be agreed in advance with the relevant service provider; and
- Periodic water quality monitoring at point of supply.

During the operational phase, all conditions specified by Irish Water will be adhered to, therefore no additional mitigation or monitoring measures are required.

There will be no requirement for additional mitigation or monitoring measures during the operational phase.

17.7.2 Land Use and Buildings

No mitigation or monitoring measures have been proposed.

17.8 Do Nothing Scenario

If the Proposed Development did not proceed, there will be no change to the existing material assets.

17.9 Residual Impacts and Effects

With the implementation of best practice measures outlined in Section 17.5, the Proposed Development could still require a temporary suspension of services to facilitate the connection works to the water supply network during the construction phase; however, the residual effect significance on existing utilities network will likely be reduced to **slight** during the construction phase as consultation with service providers will ensure the disruption to services or outages will be carefully planned so the duration is minimised.

The effects from the additional demands on existing water supply will likely remain **negative, short-term medium** and **moderate** during the construction phase.

No utilities mitigation measures have been proposed during the operational phase of the Proposed Development. The effects on the existing gas and electricity supply network will likely remain **long-term**, **positive**, **high** and **very significant.** The effects on existing gas and water supply will likely remain **long-term**, **negative**, **low** and **slight** as a result of the additional demand on the networks.

The effects on the existing buildings which will be demolished within the Proposed Development site boundary will be **permanent**, **neutral** and **imperceptible** as no mitigation is possible to avoid or reduce the effect.

17.10 Decommissioning Phase

As outlined in Chapter 02 – Project Description, in the event of decommissioning, measures will be undertaken by the Applicant to ensure that there will be no significant, negative environmental effects from the closed LNG Terminal and Power Plant. Examples of the measures that will be implemented are outlined in Section 2.9, Chapter 02 – Project Description. As a result, additional potential impacts and associated effects arising during the decommissioning phase are not anticipated above and beyond those already assessed during the construction phase.

17.11 Summary

In summary:

- It has been assessed that the residual effects from connection works during the construction phase on the existing utilities networks will likely reduce to **slight** with the implementation of embedded mitigation measures.
- The effects from additional demands on existing water supply will remain **moderate** during the construction and **slight** during the operational phase.
- No utilities mitigation or monitoring measures have been proposed during the operational phase of the Proposed Development, which will be designed in accordance with best available techniques for energy efficiency. The effects on the existing gas and electricity supply network will remain **long-term**, **positive**, **high** and **very significant,** if the 220 kV grid connection is consented and becomes operational.
- The effects on existing buildings within the Proposed Development site boundary will remain **permanent**, **neutral** and **imperceptible** as no mitigation is possible to avoid or reduce the effect.

- It is anticipated that effects on the existing grid network from a number of future developments in combination with the future Shannon Technology and Energy Park, will result in a **positive** and **significant** cumulative effect.

Table 17-3 Summary of Impacts and Effects

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures	Residual Impact Significance
Construction	Diversion/ connection works on existing utility infrastructure: water supply infrastructure	Low	Negative, temporary, medium	Moderate	• Prior to excavation diversion works, the appointed Contractor will be supplied with accurate service drawings and additional site investigations will be carried out if necessary, to ensure services are not damaged during construction works. The Contractor will be obliged to put measures in place during the construction phase to ensure that there are no interruptions to existing services and all services and utilities are maintained unless this has been agreed in advance with the relevant service provider and local authority. When service suspensions are required during the construction phase, reasonable prior notice will be given to the residents in the area. The disruption to services or outages will be carefully planned so the duration is minimised. The timing of local domestic connections will be addressed between the Contractor and the local community at the detailed design stage; • Works during the construction phase, including service diversions and realignment will be carried out in accordance with relevant guidance documents, including Gas Networks Ireland's publication 'Safety advice for working in the vicinity of natural gas pipelines'; the ESB's Code of Practice for Avoiding Danger from Overhead Electricity Lines', 2008 and the Health and Safety Authorities (HSA) 'Code of Practice for Avoiding Danger from Underground Services', 2010; • All potential temporary connections will be agreed in advance with the relevant service provider; and • Periodic water quality monitoring at point of supply.	Slight
Construction	Demand on existing supply: • Water supply	Low	Negative, temporary and medium	Moderate	N/A	Moderate
Construction	Permanent acquisition of land.	Negligible	Permanent, neutral and negligible	Imperceptible	N/A	Imperceptible

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures	Residual Impact Significance
Operational	Demand on existing supply: • Water supply	Low	Long-term, negative and low.	Slight	N/A	Slight
	• Gas supply	High	Long-term, neutral-negative and low	Slight	N/A	Slight
Operational	Export to existing supply network: • Electricity network	High	Long-term, positive and high	Very significant	N/A	Very significant
	• Gas network	High	Long-term, positive and high	Very significant	N/A	Very significant

17.12 References

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CHAPTER 18
Interactions

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park
Environmental Impact Assessment Report

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18. Interactions

18.1 Introduction

This chapter of the EIAR evaluates the potential interaction of effects described within this EIAR, which the Proposed Development may have on the receiving environment and sensitive receptors.

Article 3 (1) of Directive 2011/ 92/ EU of the European Parliament and the Council on the assessment of the effects of certain public and private projects on the environment, as amended by Directive 2014/ 52/ EU (the 'EIA Directive') as amended by Directive 2014/ 52/ EU requires that:

> '*The environmental impact assessment shall identify, describe and assess in an appropriate manner, in the light of each individual case, the direct and indirect significant effects of a project on the following factors:*
>
> *(a) population and human health;*
>
> *(b) biodiversity, with particular attention to species and habitats protected under Directive 92/ 43/ EEC and Directive 2009/ 147/ EC;*
>
> *(c) land, soil, water, air and climate;*
>
> *(d) material assets, cultural heritage and the landscape; and*
>
> *(e) the interaction between the factors referred to in points (a) to (d).'*

The interaction of effects within the Proposed Development in respect of each of the environmental factors, listed in Article 3(1) of the EIA Directive, have been identified and addressed in detail in the respective chapters in this EIAR. This chapter, however, presents a summary of each assessment of the interaction (interrelationship) of impacts, from the Proposed Development, between the various environmental factors.

A summary of the interactions (or inter-relationship) of effects identified from the Proposed Development between the following environmental aspects are outlined in this chapter:

- Land and Soil;
- Water;
- Biodiversity;
- Air Quality;
- Noise and Vibration;
- Landscape and Visual;
- Traffic and Transport;
- Cultural Heritage;
- Population and Human Health;
- Major Accidents and Disasters;
- Climate;
- Waste; and
- Material Assets.

All potential effects arising from the interactions were identified early in the design process and in preparation of the EIAR and were therefore addressed in the design of the Proposed Development, in addition to the impact assessment studies. As a result, any potential effects were either avoided through design measures or have been addressed through specific mitigation and monitoring measures within respective chapters within this EIAR. No additional mitigation or monitoring measures are proposed in this chapter.

18.2 Competent Expert

This assessment has been undertaken by Adèle Wratten, Senior Environmental Consultant, MEnvSci, PIEMA, REnvP (AECOM). Adèle has five years' experience coordinating multi-disciplinary teams across all stages of the EIA process. She has experience of managing site appraisal and feasibility assessments, EIA screening, scoping and Environmental Impact Assessment reports, and the discharge of consents and permits across a range of sectors including energy, water, commercial and residential developments.

18.3 Land and Soils

Land and soil interactions are summarised under the following sections.

18.3.1 Water

Various construction activities have the potential to release sediment and cause unacceptable sediment levels in receiving watercourses; for example, site stripping and bulk earthworks, which will potentially lead to increases in sediment loading of the drainage network or direct runoff to the estuary or to the Ralappane Stream and its tributaries. Contamination from suspended sediments may also be caused by runoff from material stockpiles.

It was determined that the mitigation measures outlined in Chapter 05 – Land and Soils will minimise the potential for any adverse effects from the Proposed Development to water features in the area. It was therefore determined that residual effect significance from the Proposed Development will be **imperceptible** and **not significant**, provided that appropriate mitigation measures are applied (as specified in Chapter 05 – Land and Soils).

18.3.2 Biodiversity

Land take will result in the loss of a number of habitat types including hedgerows, treelines and sedimentary sea cliffs in order to facilitate the construction of the Proposed Development; a number of species are expected to be affected within the study area, including otter, badger, bats, hare, breeding and estuarine (winter) birds and frogs, due to habitat loss and reduction in foraging resources.

With the implementation of a number of mitigation measures, including landscape planting, this will likely reduce the significance of effects from land take on a number of species within the study area. For example, hedgehogs and woodland edge bird species will likely recolonise the Proposed Development site following the new landscape planting. In addition, replacement woodland planting may provide replacement habitat for bats. Residual impacts on habitats as a result of the land take will remain **negative**, **long term** and **slight-not significant**.

18.3.3 Air Quality

Various construction activities, including earthworks and movement of material on and offsite have the potential to create negative effects on air quality sensitive receptors from dust arising during the construction phase. It was concluded in Chapter 08 – Air Quality that, provided best practice site construction dust mitigation measures and a proportionate level of site boundary dust monitoring are implemented onsite (all of which are common practice on well managed construction sites) potential impacts can be adequately controlled to the extent that any effect is **not significant**. The final list of mitigation measures to be taken forward during the construction works will be defined within the Proposed Development's Outline Construction Environmental Management Plan (OCEMP) (Appendix A2-4, Vol. 4).

18.3.4 Noise and Vibration

Movement of excavated materials onsite can result in noise and vibration impacts to sensitive receptors surrounding the Proposed Development site during the construction phase. However, with the implementation of the identified mitigation measures and long term noise monitoring outlined in Chapter 09 – Airborne Noise and Groundborne Vibration and the OCEMP (Appendix A2-4, Vol. 4), no adverse impacts on sensitive receptors located close to the Proposed Development site are predicted.

18.3.5 Landscape and Visual

It is considered that the emergence of new structures within an extended area of construction activity will be the most visually prominent aspect of the construction works relating to the Proposed Development. Views of the construction area and associated earthworks will be partly restricted due to the undulating nature of the topography within the Co. Kerry part of the study area. Landscape and visual effects will therefore range from **low** to **high** and their significance from **slight neutral** to **significant adverse** but **temporary-short term** depending on the distance to the Proposed Development and the extent of intervening topography and vegetation.

18.3.6 Cultural Heritage

Groundworks associated with the construction of the Proposed Development will likely impact upon a number of known cultural heritage assets and any previously unrecorded archaeological assets, should they exist, and will alter the special interests or qualities of an asset. For example, groundworks associated with the Proposed Development will result in **significant** effects on an unoccupied and derelict farm complex, an abandoned gun emplacement and a well as these will be permanently removed to facilitate the construction of the Proposed Development, altering their special interests and qualities.

Mitigation has been proposed to reduce potential effects which will ensure any archaeological and architectural assets are identified and recorded to best practice, thereby enriching the known heritage of Co. Kerry.

18.3.7 Population and Human Health

During construction, excavations and earthworks, temporary stockpiling of potentially dusty materials, cutting and grinding of materials and cement, use of unsurfaced haul roads and construction traffic haul roads could result in some temporary air quality, noise and neighbourhood amenity impacts.

Appropriate mitigation measures outlined in Chapter 05 – Land and Soils, will likely reduce identified construction phase negative impacts.

18.3.8 Climate

Construction activities such as land clearance and land use change can affect GHG emissions resulting from a loss of a carbon sink. There will be unavoidable GHG emissions resulting from the construction phase of the Proposed Development.

Removal of vegetation during land clearance and ground disturbance could also increase the likelihood or severity of flooding after extreme rainfall. Further, land and soils could be impacted due to sea level rise and changes to storm patterns. This reduction in climate change resilience could negatively affect the development itself by causing additional costs onsite through damage or loss of any materials stockpiles and reducing site access.

However, with embedded mitigation measures and identified mitigation measures, as outlined in Chapter 15 – Climate, none of the potential effects from GHG emissions on land use were identified to be of major or high significance.

18.4 Water

Water interactions are summarised under the following sections.

18.4.1 Land and Soils

The embedded mitigation measures outlined in Chapter 02 – Project Description, including the provision of an attenuation system with a Class 1 interceptor and effluent treatment in a packaged Waste Water Treatment Plant prior to discharge to marine surface water under IE licence conditions and monitoring requirements, will minimise the potential for adverse impacts to soils and groundwater from drainage, process/ sanitary effluent and chemical/ fuel storage from the Proposed Development during the operational phase. As such, likely significant effects on receiving land and soils environment are not anticipated.

18.4.2 Biodiversity

As outlined in Chapter 07B – Terrestrial Ecology, potential impacts on water quality could arise from mobilised suspended solids as well as spillage of fuels and lubricants from construction plant. In the absence of appropriate mitigation measures, site stripping, earthworks and material stockpiles associated with the construction could potentially give rise to a high degree of solids washout which could discharge into the local drainage network and the Ralappane Stream. Silt generated during the construction phase could potentially interfere with spawning of Stone Loach and Stickleback smothering spawning gravels and deposited eggs and newly hatched larvae. If sufficient quantities of silt enter local watercourses it could potentially settle on the bottom, smothering benthic flora, ultimately affecting faunal feeding and breeding sites. However, with the implementation of mitigation measures as outlined in Chapter 06 – Water, the significance of effects will likely reduce and residual impacts are predicted to be **imperceptible** and **not significant**.

In addition to this, the bridge across the Ralappane Stream and drainage ditch will likely reduce the amount of feeding area available and may affect existing fish stocks, either directly via habitat loss or indirectly via effects on water quality. However, it is noted that this stream is small with limited fish stocks and it is unlikely to be a significant source of prey for otter.

Sediment deposition rates from the suspended sediment plume are predicted to be low due to the high flow velocities. As discussed in Chapter 07A – Marine Biodiversity, the cold water, suspended sediment and treated effluent will undergo extremely high levels of dilution and dispersion within a short distance (approximately 1 km) of the Proposed Development site. Also, the predicted current directions on the ebb tide indicate little or no interaction with the oyster production sites in inner Ballylongford Bay.

18.4.3 Cultural Heritage

Chapter 12 – Cultural Heritage notes the presence of areas of archaeological potential which are located outside, but adjacent to, the Proposed Development. These areas of archaeological potentially contain sub-surface features and deposits which could be affected by changes in the local water table arising from construction works. These effects could include desiccation of archaeological features and artefacts by the removal of water. It is considered that adverse effects to soils are not anticipated during the construction and operational phases. As such, likely significant effects upon the adjacent areas of archaeological potential are not anticipated.

18.5 Biodiversity

Biodiversity interactions are summarised below. Additional interactions with air quality, noise and climate are identified in the sections that follow. The Proposed Development will be operated under the conditions of an Industrial Emissions (IE) licence and incorporate ongoing monitoring through construction and operation.

18.5.1 Landscape and Visual

Chapter 10 – Landscape and Visual notes that the Proposed Development will retain existing screening vegetation onsite where possible. A detailed landscape mitigation plan indicates the retention of existing vegetation including hedgerows, and proposes new planting along the entrance road minimising the impact on vegetation cover within the area and supporting the integration of the Proposed Development into its environs. It is considered that the proposed landscape planting will mitigate the majority but not all of the likely adverse visual effects.

18.5.2 Population and Human Health

Biodiversity and the natural environment are considered to be a determinant of health, when health is defined broadly as encompassing general wellbeing, not just the absence of illness. There may be opportunities for the Proposed Development to maintain or enhance biodiversity, or for potential negative impacts to be mitigated. Chapter 13 – Population and Human Health therefore considers biodiversity as part of its assessment of human health impacts. It is however acknowledged that many habitats and species will have limited/ no direct interaction with humans and so potential impacts will be indirect or limited.

18.6 Air Quality

Air quality interactions are summarised under the following sections.

18.6.1 Biodiversity

As outlined in Chapter 07B – Terrestrial Ecology, air quality effects from construction works on sensitive ecological receptors may include the deposition of dust on vegetation, within watercourses or protected habitats i.e. Lower River Shannon Candidate Special Area of Conservation (cSAC)/ River Shannon and River Fergus Estuaries Special Protection Area (SPA). However, the assessment has noted that the majority of the cSAC/ SPA within 50 m of the construction site boundary is tidal estuary and should dust deposit beyond the Proposed Development site boundary, it is likely to be washed away naturally. In addition to this, it was identified that no rare species or habitat which are sensitive to air quality effects are located in the vicinity of the Proposed Development. In the absence of mitigation, the effect on terrestrial, freshwater and estuarine habitat during construction will be **short-term** and **not significant**.

The assessment of operational phase emissions has identified that whilst the Proposed Development will have some impact on local air quality, the extent of that effect is **slight** to **moderate** at limited locations where the effect does not put at risk compliance with an Air Quality Standard or Environmental Assessment Level. The Proposed Development will be operated under the conditions of an IE licence and ongoing monitoring through construction and operation, which will ensure no further impact. Details of the proposed mitigation and monitoring measures are provided in Chapter 08 – Air Quality and the OCEMP (Appendix A2-4, Vol. 4). Therefore, no significant effects on ecological receptors from operational air emissions are predicted to occur.

18.6.2 Cultural Heritage

Dust generated from a number of construction activities may affect the setting of cultural heritage assets identified within close proximity to the Proposed Development site. As discussed in Chapter 12 – Cultural Heritage, Ralappane House (RPS KY 003-001) is located to the south of the Proposed Development, and although this asset will not be physically impacted by the Proposed Development, there is the possibility of a negative effect to the setting of the designated assets by dust from construction related traffic which may diminish the importance of this asset. This effect will be short term and will cease once construction is complete. In addition to this, during the construction phase, procedures will be adopted, as described in the OCEMP (Appendix A2-4, Vol. 4), to ensure that archaeological areas and sites are protected during construction.

18.6.3 Population and Human Health

During the construction phase, construction activities including excavations and earthworks, temporary stockpiling of potentially dusty materials may result in some temporary air quality and neighbourhood amenity effects. For example, there is a risk of potential odour emissions from fugitive sources during the operation of the Proposed Development. Provided that the appropriate air quality mitigation measures are followed, the potential health effect during construction due to dust and odours is assessed to be neutral.

18.6.4 Climate

There will be unavoidable GHG emissions resulting from the construction and operational phases of the Proposed Development as materials, energy and fuel use, and transport will be required. However, with embedded mitigation measures their effects have been assessed as **minor adverse**. The fuel consumption associated with the operating of the Power Plant would contribute the majority of the operational phase emissions. Operational emissions have been assessed as **major adverse**. However, the Proposed Development would contribute towards achieving energy security for the country by reducing reliance on the UK for gas supply, as well as providing an alternative electricity supply to the typically intermittent electricity supply from wind power. It is important to note that the emissions associated with the Power Plant could reduce over time based upon projected running hours.

18.7 Noise and Vibration

Noise and vibrations interactions are summarised under the following sections.

18.7.1 Biodiversity

The Terrestrial Ecology (Chapter 07B) assessment has identified a number of potential negative impacts on sensitive ecological areas from noise and vibration generated during both the construction and operation of the Proposed Development. For example, during the construction phase it is expected that there will be considerable disturbance of the Proposed Development site, particularly during underwater piling for the jetty and controlled rock blasting on land. The noise and vibration levels have been identified as potentially causing disturbance to bats, otters, foraging birds, badger and wintering birds. While this may create a disturbance to birds within the SPA, this will be a temporary and not significant impact on a small number of birds.

However, with the implementation of good construction management practice, as described in Section 9 of the OCEMP (Appendix A2-4, Vol. 4) and in Chapter 09 – Airborne Noise and Groundborne Vibration, the risk of adverse impacts from the noise and vibration during the construction phase will be minimised.

The assessment also identified that noise generated from the operations of the Proposed Development may also disturb or displace badgers from favoured foraging habitats, bats and otters, hedgehogs and birds, resulting in long term, negative effects on these sensitive ecological receptors. However, the noise assessment determined, during operation predicted noise levels from the Proposed Development in the absence of mitigation will be less than 55 dB, which are below the threshold likely to cause disturbance responses. The principal mitigation measures required for the Proposed Development in relation to noise concern selection of equipment, sound containment, and acoustic attenuators, in order to achieve the required limits. The predicted noise levels, as outlined in Chapter 09 – Airborne Noise and Groundborne Vibration are considered to be readily technically achievable using standard methods.

18.7.2 Cultural Heritage

As discussed in Chapter 12 – Cultural Heritage, Ralappane House (RPS KY 003-001) is located to the south of the Proposed Development. There is the possibility of negative effects to the setting of the designated asset by noise and vibration from construction related traffic and onsite construction activities which can diminish the importance of this asset. This effect will be short term and will cease once construction is complete. In addition to this, during the construction phase, procedures will be adopted, as described in the OCEMP, to ensure that archaeological areas and sites are protected during construction.

18.7.3 Population and Human Health

Construction activities can result in noise and vibration impacts to sensitive receptors surrounding the Proposed Development site during the construction phase. However, with the implementation of the identified mitigation measures and long-term noise monitoring outlined in Chapter 09 – Airborne Noise and Groundborne Vibration and the OCEMP (Appendix A2-4, Vol. 4), no adverse impacts on sensitive receptors are predicted from onsite construction activities. A significant impact arising from noise generated by construction traffic on the existing road network is predicted on Link 2 (L1010 – Site entrance to Tarbert). However, this impact is limited to a relatively small number of properties and may be less significant than indicated due to the contextual factors discussed in Section 9.7.4 of Chapter 09.

18.8 Landscape and Visual

Landscape and visual interactions are summarised under the following sections.

18.8.1 Biodiversity

As outlined in previous sections, replacement woodland planting may provide some replacement habitat for bats, and species including hedgehogs will likely recolonise the site following this planting. The residual impact on these species is therefore expected to be **negative**, **slight** and **long-term** following the implementation of the landscape masterplan.

18.8.2 Population and Human Health

Visual effects will mainly relate to the introduction of large turbine halls and ancillary buildings including storage tanks, the LNG Terminal and LNG ships. The main visual receptor groups are residents and vehicle travellers including ferry passengers, workers, visitors/ tourists. Residents will have the highest sensitivity to change than the road users or ferry passengers. Vehicle travellers and workers will focus on traffic or their commercial tasks and not primarily on available views. Ship passengers will see the Proposed Development in conjunction with the prominent existing Tarbert Power Station and Moneypoint Power Station structures. As discussed in Section 18.5.1 and Chapter 11 – Landscape and Visual, it is considered that the proposed landscape planting and retention of existing vegetation to screen the site will mitigate the majority but not all of the likely adverse visual effects.

18.8.3 Climate

Climate change interacts a number of ways with landscape and visual sensitivities. Landscaping will increase terrestrial carbon sinks and reduce the net GHG emissions from the Proposed Development. In addition to this, landscaping will aid mitigation of climate change risks to the Proposed Development by reducing air temperatures and flooding impacts. Lastly, landscaping will help mitigate the effects of combined Development-rated climate change impacts to biodiversity by creating habitats for flora and fauna.

18.9 Traffic and Transport

Traffic and Transport interactions are summarised under the following sections.

18.9.1 Land and Soils

Similar to the above, accidental spillage or leakage of oils and fuels from construction machinery or site vehicles may potentially result in the impact of soils and groundwater underlying the Proposed Development site if inappropriately handled or stored. Potential contaminants could migrate through the subsoils and impact underlying groundwater.

However, with the implementation of mitigation measures outlined in Chapter 05 – Land and Soils it was determined that the likelihood and magnitude of the potential effects on land and soils occurring during the construction phase will significantly reduce. It was therefore determined that residual effects to soil and groundwater from accidental spillage and leaks will be **imperceptible** provided that appropriate mitigation/ control measures as specified is applied.

18.9.2 Water

There is risk of pollution due to accidental spillage and leaks from vehicles using the Proposed Development during its operation, as well as fuel spillages from machinery operating close to watercourses during the construction phase.

However, the mitigation measures outlined in Chapter 06 – Water, in addition to the embedded mitigation measures that have been included in the design, will minimise the potential for any adverse impacts to receiving watercourses both during the construction and operational phases of the Proposed Development. It was therefore determined that residual impact to water from accidental spillage and leaks will be **imperceptible** provided that appropriate mitigation /control measures as specified are applied.

18.9.3 Biodiversity

During construction, potential impacts on water quality include spillage of fuels, lubricants, hydraulic fluids and cement from construction plant, which may result in negative effects on fish and aquatic vertebrates. However, as outlined in Section 18.4.2, with the implementation of mitigation measures outlined in Chapter 06 – Water, the significance of effects will likely reduce and residual impacts are predicted to be **imperceptible** and **not significant**.

18.9.4 Air Quality

During the construction phase, construction traffic will likely generate dust which may result in negative effects on sensitive receptors within 50 m of a public road used by construction traffic (within 500 m of the Proposed Development site entrance), including residential dwellings adjacent to the L1010. With the implementation of appropriate mitigation measures, the residual effects significance from dust impacts was identified as **imperceptible** and **not significant**.

During the operational phase, there will be emissions to air from road traffic entering and existing the Proposed Development site. The assessment identified that cumulatively emissions to air from road traffic with site emissions will likely result in **imperceptible** to **slight adverse** residual effects.

18.9.5 Noise and Vibration

Noise generated by changes to traffic flows on existing road will likely result in negative noise and vibration effects on sensitive receptors located close to the Proposed Development site. During the operational phase, long term impacts associated with noise generated by changes to traffic flows on existing roads will likely occur.

However, with the implementation of identified mitigation measures outlined in Chapter 09 – Airborne Noise and Groundborne Vibration, **no adverse impacts** on sensitive receptors located close to the Proposed Development site are predicted, with the exception of one likely **short-term significant impact** with regard increased traffic flows during the construction phase on the L1010 between the Proposed Development site entrance and Tarbert.

18.9.6 Landscape and Visual

Increased vehicular traffic as a result of the Proposed Development will affect views for receptors such as residents or tourists during both construction and operation, particularly along scenic roads, protected views and prospects as well as the Wild Atlantic Way touring route. As discussed in Chapter 10 – Landscape and Visual, residents will have the highest sensitivity to change than the road users or ferry passengers. Vehicle travellers and workers will focus on traffic or their commercial tasks and not primarily on available views. At some viewpoints, the Proposed Development will be screened from view by intervening vegetation, however a residual **moderate-significant adverse** effect will remain at some locations as the Proposed Development will increase the prevalence of large industrial infrastructure in the landscape.

18.9.7 Cultural Heritage

The change in traffic on the existing road network as a result of the Proposed Development during the construction and operational phase will likely affect the setting of cultural heritage assets identified within/ close to the Proposed Development site. It was also identified that archaeological deposits may be compacted due to construction traffic movement or materials storage and/ or damage through rutting of superficial deposits from construction traffic.

As discussed in Chapter 12 – Cultural Heritage, there is the possibility of negative effects to the setting of Ralappane House (RPS KY 003-001) is located to the south of the Proposed Development as a result of the construction traffic which could diminish the importance of this asset. This effect will be **short term** and will cease once construction is complete. In addition to this, during the construction phase, procedures will be adopted, as described in the OCEMP, to ensure that archaeological areas and sites are protected during construction.

The assessment also identified that all physical effects to known and unknown heritage assets will occur during the construction phase and there is no requirement for mitigation measures during the operational phase.

18.9.8 Population and Human Health

It was identified in the Chapter 13 – Population and Human Health, that the presence of construction traffic has potential to lead to severance between residential properties and the workplaces, community facilities and educational facilities which they frequently access. The Proposed Development was assessed to have a **negligible and imperceptible effect** on severance between local residents in the study area and the facilities which they use during the construction period. The additional construction traffic from the Proposed Development is not expected to result in any congestion considerable enough to deter local residents from accessing the workplaces, educational facilities or community facilities which they use. No additional effects from additional traffic on the existing road network on Population and Human Health during the construction and operational phase were identified during the assessment.

18.9.9 Climate

Chapter 15 – Climate concluded that there will be GHG emissions resulting from both the construction and operational phase of the Proposed Development; for example, from the introduction of construction vehicles and commuter vehicles during operation. With the implementation of identified mitigation measures during the construction, impacts associated with construction vehicles will likely not result in any adverse effects on climate.

There would be unavoidable GHG emissions resulting from commuter vehicles during the operational phase of the Proposed Development. No mitigation measures have been proposed to reduce or offset the effects from these emissions.

18.10 Major Accidents and Disasters

18.10.1 Land and Soils/ Water/ Biodiversity

A release of pollutants for example, from loss of containment of MFO, LNG and/ or contaminated firewater, may result in harm to the environment by discharging into the Shannon Estuary or surrounding land. However, the Major Accidents and Disasters (MADS) assessment (Chapter 14) identified that the engineering design of the Proposed Development will incorporate all of the appropriate standards and mitigation measures necessary to reduce the risks of accidents and disasters to an acceptable level, i.e. ALARP, which is the standard expected by the Regulatory Authorities.

Therefore, the consideration of embedded mitigation measures, and best practices has demonstrated that risk of a major pollution related accident on the receiving environment is low during the operational phase.

18.10.2 Air Quality

There is a potential interaction with MADS and such an event would give rise to emissions of pollutants to air. The air quality assessment does not include an emergency scenario specifically, as the risk of such an event is considered very low (as confirmed in Chapter 14 – Major Accidents and Disasters). In the unlikely event such an event does occur, there would likely a be short-term spike in nitrogen dioxide emissions and possibly PM_{10} and $PM_{2.5}$ emissions, that would increase the concentrations of these pollutants that the nearest receptors to the site are exposed to. However, due to the distance between the nearest air quality sensitive receptors and the potential sources of emissions, such an increase is unlikely to cause an exceedance of an air quality standard or Environmental Assessment Level.

18.11 Climate

18.11.1 Water

Potential climate risks to the Proposed Development (climate change resilience) during the operational phase include increased frequency and severity of extreme weather events (such as heavy and/ or prolonged precipitation). Increases in winter precipitation as well as sea level rise could also lead to surface water flooding and standing waters.

However, embedded mitigation measures for the Proposed Development resulted in **no residual impacts** that were identified in relation to climate change resilience.

18.11.2 Biodiversity

Potential development-related risks to biodiversity may be exacerbated by climate change during the construction and operational phases. For example an increase in the likelihood and severity of heat waves might have a negative impact on biodiversity. However, embedded mitigation measures for the Proposed Development resulted in **no significant** residual impacts in relation to combined impacts to biodiversity.

18.11.3 Landscape and Visual

Climate change may reduce the success of landscaping if unsuited vegetation is introduced. However, this is mitigated against by planting species more tolerant to changing climatic conditions. As such no residual interaction is identified in Chapter 10 – Landscape and Visual.

18.11.4 Population and Human Health

Chapter 15 – Climate outlines an assessment of the effects of the Proposed Development on climate change during its initial 28-year operational phase. The assessment states that operation of the Proposed Development will result in annual carbon emissions of approximately 859,161 tCO2e. As a standalone development, this represents a major adverse impact, however the impact of this development needs to be considered in the context of the key role it will play in assisting Ireland to transition to a low carbon economy. All future energy scenarios show gas power plant being required in the period to 2050 and beyond. The Proposed Development will diversify the supply of natural gas and electricity to the Irish market. It does not in itself increase demand for natural gas or electricity. In a 'business as usual' scenario, where the Proposed Development is not progressed, this demand would be met by alternative, and potentially more carbon intensive power suppliers. The efficiency of the Power Plant combined with its ability to operate at a low minimum generation capacity means that the Power Plant will be dispatched ahead of a less efficient OCGT power plant as it will provide lower direct emissions and also provide system inertia (and other system services) at a lower output allowing for higher instantaneous renewable (non-synchronous) generation that would otherwise be the case if the Power Plant was not developed. The ability of the Power Plant to operate at a 50% blend of hydrogen by design, offers the potential for the Power Plant to become even more efficient in emission terms over the period to 2050 as and when the required policies and supply chains for hydrogen are implemented. The Proposed Development has a unique location and flexible design that can easily transition to alternative low carbon fuels, subject to future planning applications, once the technology and public policies are established.

The population and human health assessment identified that measures in the OCEMP (Appendix A2-4, Vol. 4) related to climate change resilience will be implemented accordingly. The potential health impact during operation due to the generation of GHGs leading to climate change is therefore assessed to be **negative**.

18.11.5 Major Accidents and Disasters

Extreme weather conditions exacerbated by climate change could cause damage to the physical elements of the Proposed Development. However, embedded mitigation measures for the Proposed Development resulted in **no identified residual impacts** in relation to climate change resilience.

18.12 Waste

18.12.1 Land and Soils

Construction waste arisings including hazardous wastes have the potential to cause pollution if adequate storage and handling procedures are not followed. The mitigation measures detailed in Chapter 16 – Waste (such as preparing a Site Waste Management Plan) will reduce the significance of effect to **not significant**. This will include potential effects from wastewater, as discussed in Section 18.12.2 below.

18.12.2 Water

The risk of potential significant impacts on the water environment during the construction phase (in the absence of adequate management and mitigation measures) can arise from several activities; for example, from uncontained spillage of wastewater effluent and/ or runoff from chemical and waste storage or handling areas.

Mitigation measures for this risk are provided in Chapter 06 – Water, such as storing diesel and chemical odorants in bunded facilities/ tanks. As a result, the potential residual impact of the Proposed Development is considered to be **imperceptible**.

18.12.3 Traffic and Transport

A potential interaction associated with air and noise impacts of vehicles collecting waste is identified and considered as part of the overall construction traffic. **No additional effect** interaction has been determined.

18.12.4 Population and Human Health

The potential effects on human beings in relation to the generation of waste are that incorrect management of waste could result in littering which could cause a nuisance to the public and attract vermin. Mitigation is proposed in Chapter 16 – Waste in relation to measures for onsite management and temporary storage of waste. This will ensure appropriate management of waste and avoid any significant adverse effects on the local population.

18.13 Summary

A summary of the identified interactions between topics is provided in Table 18-1 below.

Table 18-1 Summary of Environmental Interactions

Environmental Aspect/ Interaction	Land & Soils		Water		Biodiversity		Air Quality		Noise & Vibration		Landscape & Visual		Traffic & Transport		Cultural Heritage		Population & Human Health		Major Accidents & Disasters		Climate		Waste		Material Assets	
	Con	Op	Con	Op	Con	Op	Con	Op	Con	Op	Con	Op	Con	Op	Con	Op	Con	Op	Con	Op	Con	Op	Con	Op	Con	Op
Land & Soils																										
Water	✓	✘																								
Biodiversity	✓	✓	✓	✘																						
Air Quality	✓	✘	✘	✘	✓	✓																				
Noise &	✓	✘	✘	✘	✓	✓	✘	✘																		
Landscape &	✓	✘	✘	✘	✘	✓	✘	✘	✘	✘																
Traffic &	✘	✘	✓	✘	✓	✓	✓	✓	✓	✓	✓	✓														
Cultural	✓	✘	✘	✘	✘	✘	✓	✘	✓	✘	✘	✘	✓	✘												
Population & Human Health	✓	✘	✘	✘	✘	✓	✓	✘	✓	✘	✓	✓	✓	✓	✘	✘										
Major Accidents & Disasters	✓	✘	✘	✓	✘	✓	✘	✓	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘								
Climate	✓	✘	✘	✓	✘	✓	✓	✓	✘	✘	✘	✓	✓	✓	✘	✘	✘	✓	✘	✓						
Waste	✓	✓	✓	✓	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✓	✓	✘	✘	✘	✘				
Material Assets	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘		

Con	Construction Phase	✓	Weak/ Some/ Strong Interaction
Op	Operational Phase	✘	No Interaction

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CHAPTER 19
Mitigation and Monitoring

Shannon LNG Limited
August 2021

Shannon Technology and Energy Park
Environmental Impact Assessment Report

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Figures

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Tables

19. Summary of Mitigation and Monitoring Measures

19.1 Introduction

This chapter of the EIAR details all of the mitigation and monitoring measures to be implemented during the construction and operation of the Proposed Development. The following environmental mitigation and monitoring measures are an integral element of the planning application. Any further design of the Proposed Development will ensure that there is no material change in terms of significant adverse effects on the environment. Opportunities may also be identified to further reduce the significance of adverse impact and, in some cases, improve the residual impact.

Best practice referred to in this document refer to measures contained in modern guidance documents which set out the practice and procedures for environmental protection during construction and operational phases of a Proposed Development. Where legislation, standards or guidance documents are referred to it should be noted that at the time of construction or operation of the Proposed Development any amendments to these documents are applicable.

Embedded mitigation measures have been incorporated into the design of the Proposed Development throughout the design process. The environmental impact assessment of the Proposed Development, the methodology for which is described in Chapter 01 – Introduction, facilitated the identification of additional mitigation and monitoring measures to prevent or reduce likely significant effects identified in relation to the Proposed Development.

This chapter summarises the impacts assessed, and the mitigation and monitoring measures identified within Chapters 05 to 17 of this EIAR. The summary is presented in Table 19-1. The table also provides measures to be applied and/ or any anticipated residual impacts. The embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the Outline Construction Environmental Management Plan (OCEMP), see Appendix A2-4, Vol. 4. A detailed CEMP will be produced by the successful Contractor prior to the main construction works. The CEMP will detail the Contractor's overall management and administration of the works. The CEMP will also include any commitments included within the statutory approvals.

In addition to the mitigation and monitoring measures outlined in Table 19-1 below, the following combination of general measures and good practice will be implemented:

- Close adherence to the CEMP. The CEMP is designed to minimise any perturbations caused during the construction and is designed to meet best practice guidance and latest legislation. Specific roles, such as the Environmental (Ecological) Clerk of Works (ECoW), will be designated in the CEMP. The plan is to be updated a minimum of every 6 months over the duration of the construction process;
- The site compound will be located away from water courses and the storage of all fuels and potential contaminants on site will be done so in adherence to the mitigation measures outlined within this EIAR;
- Pedestrian access to the foreshore will be maintained throughout the construction period;
- In the construction process, the excavation and grading of all areas will be carried out in a sensitive manner to marry in the new formations with the existing landscape. Sharp ridges or overly steep embankments will be avoided where possible;
- Periodic water quality monitoring will be carried out at points of supply;
- The Proposed development will comply with the requirements of the Industrial Emissions licence, required during operation;

- During the transportation of abnormal loads, a Garda escort may be required. The timing of such transports to the Proposed Development site will be chosen to minimise disruption to other roads users. Hours are subject to agreement with KCC;
- The Contractor will prepare a landscape maintenance plan after the implementation of the Proposed Development. All landscape works will be in an establishment phase for the initial three years. This will include:
  (a) Weed and litter control including monitoring particularly during the early growing seasons of the landscape maintenance contract;
  (b) Grass cutting and replacement of failed plants; and
  (c) compliance with all health and safety standards in particular with regard to maintenance works during the operation phase of the road;
- The contractor will be obliged to put measures in place during the construction phase to ensure that there are no interruptions to existing services. When service suspensions are required during the construction phase, reasonable prior notice will be given to the residents in the area. The disruption to services or outages will be carefully planned so the duration is minimised;
- The OCEMP will set out information on the roles and responsibilities of key individuals, including the environmental management and reporting structure;
- An outline communication strategy will be in place, for example for the implementation of toolbox talks (environmental discussion on issues encountered onsite) by the contractor relating to environmental constraints and procedures to be adhered to onsite;
- An outline emergency response plan and procedure for environmental incidents including accidental spills will be in place; and
- The OCEMP sets out requirements for inspection and auditing, including an outline reporting programme and procedure to be updated by the appointed contractor.

Table 19-1 Environmental Impact Assessment Summary including Mitigation and Monitoring Commitments

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance	EIAR Chapter Reference
Construction	Changes to topography – excavation and infilling.	Low	Excavation and reuse of 480,000 m^3 of soil and rock. Permanent, direct, irreversible effect	Neutral	All surplus material will be processed (screened/ crushed) and reused onsite and there is no intention to import soil material to the Proposed Development site. Temporary storage of soil will be carefully managed in such a way as to prevent potential negative impact on the receiving environment. Spoil and temporary stockpiles including stone stockpile areas will be positioned in locations which are distant from the shoreline, drainage systems and retained drainage channels and away from areas subject to flooding, so as not to cause potential runoff to soils. Movement of material will be minimised in order to reduce degradation of soil structure and generation of dust. The OCEMP will outline proposals for the excavation and management of excavated material.	Slight	Chapter 05 – Land and Soils
Construction	Use of natural resources.	Low	Excavation and reuse of 480,000 m^3 of soil and rock. Irreversible effect, Permanent direct impact of neutral quality	Neutral	All excavated material will be reused onsite. Offshore pile arisings will be reused onshore as landscaping material to form a berm on the north-eastern edge of the site, subject to chemical suitability. 26,000 tonnes of aggregate will require to be brought to site from local quarries for the formation of access roads during construction. The source of this fill material will be vetted in relation to the environmental management status and regulatory and legal compliance status of the originating facility and include appropriate chemical testing if derived from recycled fill material. Certain to occur and irreversible, but will be imperceptible within wider environment	Not significant	Chapter 05 – Land and Soils
Construction	Accidental spills and leaks;	High	Adverse impact on soils underlying the	Medium	Spillages are unlikely to occur and, if they occur, will be confined to one-off releases. Hazardous materials	Imperceptible	Chapter 05 – Land and Soils

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance	EIAR Chapter Reference
	Spillage or leakage of stored oils and fuels; Spillage or leakage of oils and fuels from construction machinery or site vehicles; and Spillage of oil or fuel from refuelling machinery onsite.		Proposed Development site. Direct negative impact of temporary duration		will be controlled via the OCEMP and stored in bunded areas. Low impact on a low sensitivity environment and the significance of the impact is slight. In order to prevent spillages to ground of fuels, and to prevent any consequent soil or groundwater quality impacts, it will be necessary to adopt mitigation measures during the construction phase, which include: • Designating a bunded storage areas and handling procedures for all oils, solvents and paints used during construction; • Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles, will take place in a designated area with appropriate facilities; and • Refuelling outside of the designated area will be via a mobile double skinned tank with lockable fittings and an onboard spill kit.		
Construction	Use of concrete and lime.	Low	Lime and concrete (specifically, the cement component) is highly alkaline and can impact soil quality during piling and building construction. Direct effect of negative nature and temporary duration	Medium	Hazardous materials will be controlled via the OCEMP and stored in bunded areas. A suitable risk assessment for wet concreting will be completed prior to works being carried out, which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil or to the marine environment. Washout of concrete-transporting vehicles will take place at an appropriate facility offsite where possible, alternatively, where washout takes place onsite, it will be carried out in carefully-managed onsite wash out areas. Potential for low impact on a low sensitivity environment and the significance of the impact is slight.	Imperceptible	Chapter 05 – Land and Soils

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance	EIAR Chapter Reference
Construction	Impact on soil/ geology.	Low	Slight to moderate beneficial effect	Neutral	The opportunity to study and document regional glacial geology through cutting and foundation pit exposures in the glacial deposits and bedrock, which will add to the national records. Shallow soils are therefore considered to have a neutral to favourable effect on the Proposed Development and to be a minor beneficial effect on a low importance soil environment, and the significance of the effect is imperceptible. Unweathered bedrock is expected to provide a competent foundation medium, therefore bedrock quality is therefore considered to have a moderate favourable impact effect on the Proposed Development in a low importance bedrock environment, and the significance of the effect is slight.	Imperceptible to slight	Chapter 05 – Land and Soils
Operational	Accidental spills and leaks.	Medium	Spills during fuelling at diesel fuel tanks for the fire water pumps and generators can in theory discharge to ground. Direct negative impacts of temporary duration given that they will be confined to one off releases.	Medium	All hazardous or water-polluting materials will be handled or stored in a manner to prevent/ minimise potential impact on soil. Secondary containment and spill kits will be provided for other hazardous materials to be stored onsite, such as maintenance oils and cleaning chemicals. Diesel fuel tanks for the fire water pumps and generators will be stored within bunded areas. Fuel will be prevented from entering the soil around the generators, as drainage will be directed to an oil/ water interceptor prior to discharge to the storm water drainage system. In addition, there will be a shut off valve from the generator yard to the external surface water drainage network.	Imperceptible	Chapter 05 – Land and Soils
Operational	Removal of land from agricultural use.	Low	The Proposed Development is located in a	Medium	The removal of agricultural land can be considered to be permanent and the impact is considered negative; however, it is likely to be of low magnitude given the site is located within an agricultural setting where land use is predominantly of agricultural nature.	Slight	Chapter 05 – Land and Soils

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance	EIAR Chapter Reference
			603 acre landbank that is zoned for industrial development and will cover a development area of 41 ha (excluding the offshore elements) of the overall site. The total hardstanding area is estimated to cover 14 ha, with the remainder unsurfaced, landscaped or attenuation ponds. The removal of land from agricultural or other potential beneficial uses is considered a permanent, direct, negative impact.				
Construction	Dewatering due to cuttings.	Low	Cut faces into bedrock will lead to seepage of groundwater into platform localised dewatering of the bedrock within 10 to 50 m of the cut faces. Permanent, direct, irreversible moderate effect	Neutral	Localised dewatering of the bedrock within 10 to 50 m of the cut faces of the excavation is anticipated, however, as all groundwater in the bedrock aquifer in this area is flowing towards the Shannon Estuary under baseline conditions, the interception and discharge of groundwater discharging to the excavated platform area of the Proposed Development will not lead to a net change to the quantities of groundwater ultimately discharging to the Shannon Estuary from this portion of the Proposed Development site. Groundwater seepage from cut faces will be managed via the Proposed Development site drainage systems	Imperceptible	Chapter 06 – Water

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance	EIAR Chapter Reference
					in such a way as to prevent potential negative impact on the receiving environment The OCEMP will outline proposals for the control and monitoring of groundwater seepages from the cut faces of the platform area.		
Construction	Sedimentation (suspended solids).	Extremely high	Runoff containing large amounts of suspended solids from site stripping, earthworks and material stockpiles can potentially adversely impact on surface water. Temporary small adverse effect to an medium extremely high sensitivity surface water environment.	Significant	Surface water runoff from working areas will not be allowed to discharge directly to the local watercourses. To achieve this, the drainage system, settlement ponds and surface water outfall will be constructed prior to the commencement of major site works. Spoil and temporary stockpiles will be positioned in locations which are distant from drainage systems and retained drainage channels, away from areas subject to flooding. Runoff from spoil heaps will be prevented from entering watercourses by diverting it through onsite settlement ponds and removing material as soon as possible to designated storage areas. Control of runoff from construction activities will be managed under the OCEMP therefore runoff containing large amounts of suspended solids is considered unlikely to occur and, shall it occur, is likely to be rare and short-term.	Imperceptible	Chapter 06 – Water
Construction	Accidental spills and leaks: • Use and storage of liquid chemicals; • Spillage or leakage of oils and fuels from construction machinery	Extremely high	Adverse effect on fish, aquatic flora and invertebrate communities. the Proposed Development. Direct negative small effect of temporary duration.	Significant	In order to prevent spillages to ground of fuels or other chemicals, and to prevent any consequent soil or groundwater quality impacts, it will be necessary to adopt mitigation measures during the construction phase, which include: • Designating a bunded storage areas and handling procedures for all oils, solvents and paints used during construction; • Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles, will take place in a designated area with appropriate facilities; and	Imperceptible	Chapter 06 – Water

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance	EIAR Chapter Reference
	or site vehicles; and • Spillage of oil or fuel from refuelling machinery onsite.				• Refuelling outside of the designated area will be via a mobile double skinned tank with lockable fittings and an onboard spill kit. Accidental spillages and leaks will be managed as outlined in the OCEMP and are considered unlikely to occur and, shall they occur, are likely to be a temporary.		
Construction	Use of concrete and lime.	Extremely high	Lime and concrete (specifically, the cement component) is highly alkaline and can impact surface water quality during construction. Direct negative small effect of temporary duration.	Significant	Hazardous materials will be controlled via the measures outlined in the OCEMP and stored in bunded areas. A suitable risk assessment for wet concreting will be completed prior to works being carried out, which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil or to the marine environment. Washout of concrete-transporting vehicles will take place at an appropriate facility offsite where possible, alternatively, where washout takes place onsite, it will be carried out in carefully-managed onsite wash out areas.	Imperceptible	Chapter 06 – Water
Operational	Hazardous materials storage: • Diesel; • Chemical odorant; and • Minor quantities of maintenance oils, greases,	Extremely high	Storage of materials that are potentially hazardous to the aquatic environment. Temporary small adverse effect to an extremely high sensitivity surface water environment.	Significant	The storage of materials hazardous to the aquatic environment during the operational phase will be in secondary contained area and will be controlled in accordance with any IE licence conditions. All hazardous or water-polluting materials will be handled or stored in a manner to prevent/ minimise potential impact on soil. Secondary containment and spill kits will be provided for other hazardous materials to be stored onsite.	Imperceptible	Chapter 06 – Water

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance	EIAR Chapter Reference
	lubricants, cleaning chemicals, etc.				Potentially hazardous materials will be stored and handled in compliance with the site's IE licence requirements during the operational phase.		
Operational	Accidental spills and leaks.	Extremely high	Spills during handling of fuels and other liquid chemicals can result in discharge to groundwater or the surface water environment. Direct negative small adverse effect of temporary duration.	Significant	• All hazardous or water-polluting materials will be handled or stored in a manner to prevent/ minimise potential impact on soil. • Secondary containment and spill kits will be provided for other hazardous materials to be stored onsite, such as maintenance oils and cleaning chemicals. • Diesel fuel tanks for the fire water pumps and generators will be stored within bunded areas. Fuel will be prevented from entering the soil around the generators, as drainage will be directed to an oil/ water interceptor prior to discharge to the storm water drainage system. In addition, there will be a shut off valve from the generator yard to the external surface water drainage network. • Potentially hazardous materials will be stored and handled in compliance with the site's IE licence requirements during the operational phase.	Imperceptible	Chapter 06 – Water
Operational	Flooding and drainage.	Extremely high	Direct discharges to the water environment during the operational phase will consist of: • Stormwater water runoff from the developed and undeveloped areas of the Proposed Development site;	Significant	• The proposed crossings of the watercourses within the Proposed Development along the access road have been adequately sized to have a minimal impact on the existing hydraulic regime in the area draining to the Ralappane Stream, and therefore the Proposed Development has a negligible impact on the existing flood regime in the area. • The LNG Terminal and Power Station site will have a constructed stormwater, effluent and sanitary drainage systems capable of handling anticipated effluent volumes and which will incorporate treatment facilities and monitoring equipment appropriate to each effluent stream (including silt	Imperceptible	Chapter 06 – Water

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance	EIAR Chapter Reference
			• Groundwater discharges from cut faces; • Foul water from welfare facilities on the Proposed Development site; and • Process effluent streams. Small adverse impact effect on an extremely high sensitivity environment.		trap, Class 1 hydrocarbon interceptor, a firewater retention facility, package waste water treatment plant and pH adjustment). • The site's drainage systems will be operated and monitored in compliance with the site's IE licence requirements during the operational phase.		
Operational	Combined operational stormwater, sanitary and process effluent discharges to surface water.	Extremely high	Direct discharges to the water environment during the operational combined Surface Water Outfall small adverse impact effect on a medium extremely high sensitivity environment.	Significant	• The LNG Terminal and Power Station site will have a constructed stormwater, effluent and sanitary drainage systems capable of handling anticipated effluent volumes and which will incorporate treatment facilities and monitoring equipment appropriate to each effluent stream (including silt trap, Class 1 hydrocarbon interceptor, a firewater retention facility, package waste water treatment plant and pH adjustment). • The Proposed Development site's drainage systems will be operated and monitored in compliance with the site's IE licence requirements during the operational phase.	Imperceptible	Chapter 06 – Water
Construction	Piling for offshore construction (suspended solids, concrete use).	Extremely high	Mobilisation of sediment due to installation of steel piles into bedrock to support offshore structures. pH effect due to the use of	Significant	Pile installation will use reverse circulation drilling to minimise loss of drilling spoil and generation of suspended sediment in the marine environment. Follow-on construction work will maximise the use of precast concrete elements, such as pile caps, beams, and deck planks, to minimize in-water construction.	Imperceptible	Chapter 06 – Water

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance	EIAR Chapter Reference
			concrete in the marine environment. Small adverse effect on an extremely high sensitivity environment.		Any in-situ concrete work would be staged in a manner to prevent concrete from entering the water.		
Operational	FRSU operational discharges to surface water.	Extremely high	Direct discharges to the marine environment during the operational combined surface water outfall. Small adverse impact effect on a medium extremely high sensitivity environment.	Significant	The LNG Terminal and Power Plant site will have a constructed stormwater, effluent and sanitary drainage systems capable of handling anticipated effluent volumes and which will incorporate treatment facilities and monitoring equipment appropriate to each effluent stream (including silt trap, Class 1 hydrocarbon interceptor, a firewater retention facility, package waste water treatment plant and pH adjustment). To reduce the build-up of sediment in the drainage network, trapped inlets will be used at all points of entry and key manholes will have sumps to collect material. A regular maintenance regime, including monitoring, will be put in place to remove any excess build-up of material. The Proposed Development site's drainage systems will be operated and monitored in compliance with the site's IE licence requirements during the operational phase.	Slight	Chapter 06 – Water
Construction	Release of pollutants during construction			Significant	Standard construction best practice mitigation measures to prevent release of sediments, chemical and pollutants during construction (see Chapter 07A and the OCEMP included in Appendix A2-4, Vol. 4).	Not significant	Chapter 07A – Marine Ecology
Construction	Release of spoil during piling			Not Significant	None	Not Significant	Chapter 07A – Marine Ecology
Construction & Operational	Effect of underwater noise on fish			Not Significant	None	Not Significant	Chapter 07A – Marine Ecology

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance	EIAR Chapter Reference
	Effect of underwater noise on marine mammals			Significant	Chapter 07A summarises standard mitigation required to minimise the risk potential impact to marine mammal species as outlined in DAHG, 2014: • Marine mammal observation period of 30 minutes minimum prior to start (or re-start after a break of 30 minutes) of any impact piling and any drilling; • A gap of at least 30 minutes required between last observation of a marine mammal and start of operations; • The observation zone is 1000 m for impact piling and 500 m for drilling (thus impact piling likely to require > 1 marine mammal observer); • Impact piling and drilling can only start in daylight conditions when visual monitoring can take place (i.e. when wind/ wave conditions mean observation is possible: NPWS guidance recommends 'sea conditions for effective visual monitoring by MMOs are WMO Sea State 4 (≈Beaufort Force 4 conditions) or less'; • For any source, including equipment testing, exceeding 170 dB re: 1μPa @1m an appropriate ramp-up procedure (i.e. 'soft-start') must be used. This should be a minimum of 20 minutes and no longer than 40 minutes; • Once piling or drilling has started it can continue into darkness and does not need to stop even if marine mammals are seen in the observation zone (in fact, an MMO is not required once the sound generating activity starts though continued observation can be beneficial for unexpected breaks or down-time as the 30 minute observation period can start immediately; • MMOs must be dedicated to and engaged solely in monitoring an operator's implementation of the NPWS technical guidance. A sufficient number of	Not Significant	Chapter 07A – Marine Ecology

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance	EIAR Chapter Reference
					MMO personnel must be assigned to ensure that the role is performed effectively. Avoidance of observer fatigue is essential; and • Use trained and experienced marine mammal observers – the guidance states this should be a visual observer who has undergone formal marine mammal observation and distance estimation training (JNCC MMO training course or equivalent) and also has a minimum of 6 weeks full-time marine mammal survey experience at sea over a 3-year period in European waters. Additional mitigation measures to be implemented include: • No simultaneous impact piling (i.e. two rigs operating at the same time); • Pile installation will require a combination of techniques including impact piling, vibratory piling and drilling requiring breaks in activity as equipment is changed. Where an activity progresses to a lower sound level activity – i.e. from impact piling to vibratory piling or drilling, and the break between activities is less than 30 minutes a new period of observation is not required, and activities can be considered to be continuous; • For any impact piling taking place during August, an additional MMO will be present at Moneypoint to undertake additional observations for mother-young dolphin pairings. There is known presence of neonatal bottlenose dolphin in the estuary between July and September, peaking in August, and though numbers are low there is potential for presence in the region of the Proposed Development. There will be full communication between the Moneypoint MMO and the construction team to ensure no impact piling		

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance	EIAR Chapter Reference
					commences until animals have moved away from a 1000 m radius observation zone (ensuring the full width of the estuary is observed in August); • Whilst all blasting is land based there will be propagation of sound into the underwater environment. Thus, the standard mitigation measures for blasting will be adopted as a precautionary measure – qualified MMO, a 1000 m observation zone and an observation period of 30 minutes. As only single blasts will take place in each event (not a series), a soft-start is not included; and • The marine mammal monitoring programme, currently being undertaken by the Irish Whale and Dolphin Group (in the vicinity of the project using CPODs) will be continued into the construction phase for the validation of predictions (based on observations from other studies – see impact assessment) that any animals displaced from an area return after the construction activity stops.		
Construction and Operational	Seabed habitat loss	Low	Not assessed	Not Significant	Negligible loss of habitat pending decommissioning of the development and natural recolonisation of reinstatement of the affected habitat areas.	Not Significant	Chapter 07A – Marine Ecology
Construction and Operational	Introduction of invasive species	Low	Not assessed	Significant	Before and after use, all relevant equipment will be thoroughly cleaned using Virkon Aquatic to guard against the spread of fish viruses, bacteria, fungi, and moulds. All water used in the cleansing, testing or disinfection of structures or machinery shall be rendered safe prior to discharge, particularly any chlorinated water. A post consent verification invasive species survey will be undertaken within the Proposed Development boundary by a competent ecologist.	Not Significant	Chapter 07A – Marine Ecology

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance	EIAR Chapter Reference
					the appointed Contractor will ensure biosecurity measures are implemented throughout the construction phase to ensure the introduction and translocation of invasive species is prevented. The appointed ECoW will carry out a toolbox talk which will identify invasive species and will also implement biosecurity measures such as the visual inspection of vehicles for evidence of attached plant or animal material prior to entering and leaving the works area. To ensure the spread of invasive species is avoided a 'Check, Clean, Dry' protocol will be undertaken by the appointed ECoW with all equipment, machinery and vehicles entering and leaving the Proposed Development boundary.		
Operational	Vessel physical disturbance and collision injury	Low	Not assessed	Not Significant	None	Not Significant	Chapter 07A – Marine Ecology
Operational	Discharge of treated cooled seawater	Low	Not assessed	Not Significant	None	Not Significant	Chapter 07A – Marine Ecology
Operational	Entrainment and impingement of fauna by the FSRU seawater system	Low	Not assessed	Not Significant	None	Not Significant	Chapter 07A – Marine Ecology
Operational	Discharge of Wastewater and Power Plant Process Heated Water Effluent	Low	Not assessed	Not Significant	None	Not Significant	Chapter 07A – Marine Ecology

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance	EIAR Chapter Reference
Operational	Accidental large scale oil or LNG spill	Low	Not assessed	Significant	Established protocols to manage the risk of accidental spill and potential environmental impact.	Not Significant	Chapter 07A – Marine Ecology
Construction	General mitigation measures.	Low	Not assessed	Not assessed	An OCEMP has been prepared (included in Appendix A2-4 of Volume 4). The OCEMP contains the construction mitigation measures, which are set out in this EIAR and the NIS. This will have particular emphasis on the protection of habitats and species of the cSAC, SPA and pNHA which adjoin the Proposed Development site. These sites are by definition internationally/ nationally important for their habitats and the species they support. It is essential that all construction staff, including all sub-contracted workers, be notified of the boundaries of these Natura 2000 sites and be made aware that no construction waste of any kind (rubble, soil, etc.) is to be deposited in these protected areas and that care must be taken with liquids or other materials to avoid spillage. Mitigation and monitoring measures (of relevance in respect of any potential ecological effects) will be implemented throughout the project, including the preparation and implementation of detailed method statements. The works will incorporate the relevant elements of the guidelines outlined below: • Control of water pollution from construction sites. Guidance for consultants and contractors (C532). CIRIA. Masters-Williams *et al* (2001) • Control of water pollution from linear construction projects. Technical guidance (C648). CIRIA. Murnane, *et al.* (2006) All personnel involved with the Proposed Development will receive an onsite induction relating to construction and operations and the environmentally sensitive nature of European sites and to re-emphasise the precautions that are required	Not significant	Chapter 07B – Terrestrial Ecology

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance	EIAR Chapter Reference
					as well as the precautionary measures to be implemented. Site managers, foremen and workforce, including all subcontractors, will be suitably trained in pollution risks and preventative measures. All staff and subcontractors have the responsibility to: • Work to agreed plans, methods and procedures to eliminate and minimise environmental impacts, • Understand the importance of avoiding pollution onsite, including noise and dust, and how to respond in the event of an incident to avoid or limit environmental impact; • Respond in the event of an incident to avoid or limit environmental impact; • Report all incidents immediately to the project manager and the Environmental (Ecological) Clerk of Works (ECoW); • Monitor the workplace for potential environmental risks and alert the site manager if any are observed; and • Co-operate as required, with site inspections.		
Construction	Bridge and culvert construction.	Medium	Culverting of two drainage ditches and bridging of Ralappane Stream	Moderate	Bridge construction on the Ralappane Stream will use a single span, pre-cast concrete bridge near the southern boundary of the Proposed Development site. Two drainage ditches within the Proposed Development site will be culverted. In addition to the general measures described above, the following specific mitigation measures will be implemented for crossing of the Ralappane Stream and drainage ditch: • Works will comply with The IFI's Guidelines on protection of fisheries during construction works in and adjacent to waters (IFI, 2016) • No instream works will take place.	Not significant	Chapter 07B – Terrestrial Ecology

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					• Appropriate silt control measures such as silt barriers (e.g. straw or silt fence) will be employed where required. • Construction activities will be undertaken during daylight hours only. This will ensure that there is potential for undisturbed fish passage at night. The works will be temporary and will not create a significant long-term barrier to fish movement. • An appropriate native grass seed mix as determined by the ECoW based on ground conditions, will be utilised to re-vegetate any disturbed areas along the bank of the Ralappane Stream; and • Although no Common Frog were observed in drainage ditches within the Proposed Development site boundary, they will be surveyed prior commencement of site works by the ECoW as a precautionary measure. Any Common Frog, if recorded, will be moved to suitable habitat in the wider landscape under licence from NPWS.		
Construction	Lighting.	Medium	Disturbance and/ or displacement of sensitive fauna	Moderate	Lighting associated with the site works could cause disturbance/ displacement of fauna. If of sufficient intensity and duration, there could be impacts on reproductive success. Site lighting will typically be provided by tower mounted temporary portable construction floodlights. The floodlights will be cowled and angled downwards to minimise spillage to surrounding properties. Lighting mitigation measures will follow Bats & Lighting Guidance Notes for: Planners, engineers, architects and developers (Bat Conservation Ireland, 2010). The following measures will be applied in relation to construction works lighting: • Lighting will be provided with the minimum luminosity sufficient for safety and security	Slight	Chapter 07B – Terrestrial Ecology

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					purposes. Where practicable, precautions will be taken to avoid shadows cast by the site hoarding on surrounding footpaths, roads and amenity areas; • Motion sensor lighting and low energy consumption fittings will be installed to reduce usage and energy consumption; and During construction, lighting will be positioned and directed so that it does not to unnecessarily intrude on adjacent ecological receptors and structures used by protected species. The primary area of concern is the potential impact at the cSAC/ SPA boundary, the Ralappane Stream as well as hedgerows, treelines. With the exception of the jetty dock, there will be no directional lighting focused towards these areas and cowling and focusing lights downwards will minimise light spillage.		
Construction	Habitats.	Medium	Removal of habitat	Slight to moderate	The Wildlife Act 1976, as amended, provides that it is an offence to cut, grub, burn or destroy any vegetation on uncultivated land or such growing in any hedge or ditch from 1st March to 31st August. Exemptions include the clearance of vegetation in the course of road or other construction works or in the development or preparation of sites on which any building or other structure is intended to be provided. Where possible, vegetation will be removed outside of the breeding season and in particular, removal during the peak-breeding season (April-June inclusive) will be avoided. This will also minimise the potential disturbance of breeding birds outside of the Proposed Development site boundary. Particular care will be taken at the boundary between the Proposed Development site and the cSAC, SPA and pNHA so that construction activities do not cause damage to habitats in this area. These habitats will be securely fenced off early in the construction phase.	Not significant to slight	Chapter 07B – Terrestrial Ecology

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					The fencing will be clearly visible to machine operators. The Ralappane Stream runs from the Proposed Development site through the cSAC and pNHA to the sea, it is important that construction activities do not result in pollution of this watercourse, either through siltation, which interferes with water flow, vegetation growth and aquatic fauna, or pollution (e.g. chemical). Refer to Chapter 06 Section 6.10 for further details on mitigation. Any disturbance to cliff habitat from vehicular access should be minimised and will require a detailed method statement which will be agreed with the NPWS prior to commencement of works To prevent incidental damage by machinery or by the deposition of spoil during site works, hedgerow, tree and scrub vegetation which are located in close proximity to working areas will be clearly marked and fenced off to avoid accidental damage during excavations and site preparation. The ECoW will specify appropriate protective fencing where required. Habitats that are damaged and disturbed will be reinstated and landscaped once construction is complete. Disturbed areas will be seeded or planted using appropriate native grass or species native to the areas where necessary. Natural regeneration of vegetation will also occur. There will be a defined working area which will be fenced off with designated haul routes to prevent inadvertent damage to adjoining habitats. Tree root systems can be damaged during site clearance and groundworks. Materials, especially soil and stones, can prevent air and water circulating to the roots. No materials will be stored within the root protection area/ dripline of trees. The ECoW will specify appropriate protective fencing where required.		

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Construction	Badger.	Medium	Sett removal/ mortality/ injury disturbance and/ displacement	Significant	This will require exclusion of Badgers from subsidiary/ outlier setts, however in both instances both social groups of Badgers would be expected to continue to use their main setts. Badger sett tunnel systems can extend up to approximately 20 m from sett entrances. Therefore, no heavy machinery should be used within 30 m of Badger setts (unless carried out under licence); lighter machinery (generally wheeled vehicles) should not be used within 20 m of a sett entrance; light work, such as digging by hand or scrub clearance should not take place within 10 m of sett entrances. During the breeding season (December to June inclusive), none of the above works should be undertaken within 50 m of active setts nor blasting or pile driving within 150 m of active setts. Affected Badger setts will be clearly marked and the extent of bounds prohibited for vehicles clearly marked by fencing and signage. The most recent surveys show that the two main Badger setts are located outside of the Proposed Development site boundary and the two setts to be directly affected are subsidiary setts. The bait marking survey indicates that the setts are linked as follows: • Sett 4 (main sett) is located to the east of the Proposed Development. Sett 1 is located within the Proposed Development site boundary. These setts are used by the same social group. • Sett 3 (main sett) is located to the east of the Proposed Development. Sett 2 is located within the Proposed Development site boundary. These setts are used by the same social group. The presence of alternative setts within the particular social group’s territory is required to ensure that excluded Badgers are able to relocate to a suitable	Significant	Chapter 07B – Terrestrial Ecology

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					alternative refuge. The objective is to allow the Badgers to remain within their territory, even though a portion of their current territory may be lost as a result of a particular development. There is a standard methodology which can be utilised to exclude Badgers from setts. A methodology for the exclusion of Badgers from affected setts and displacement of Badgers to artificial setts is outlined in the National Roads Authority Publication Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes (NRA 2005a). Detailed mitigation measures including method statements will be agreed with the NPWS prior to implementation as part of a licence application. Exclusion of Badgers from any currently active sett will only be carried out during the period of July to November (inclusive) in order to avoid the Badger breeding season. In the instance of disused setts or setts verified as inactive, and to prevent their reoccupation, the entrances may be lightly blocked with vegetation and a light application of soil (soft blocking). The purpose of soft-blocking is to confirm that an apparently inactive sett is not occupied by Badgers. If all entrances remain undisturbed for approximately five days, the sett should be destroyed immediately using a mechanical digger, under the supervision of the licensee. Should there be any delay in sett destruction, the soft-blocked entrances should be hard-blocked and the sett destroyed as soon as possible, again under the supervision of the licensee. Hard-blocking is best achieved using buried fencing materials and compacted soil with further fencing materials laid across and firmly fixed to blocked entrances and surrounds		

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					Where field signs or monitoring reveal any suggestion of current or recent Badger activity at any of the sett entrances, the sett requires thorough evacuation procedures. Inactive entrances may be soft and then hard-blocked, as described for inactive setts, but any active entrances should have one-way gates installed (plus proofing around sides of gates as illustrated) to allow Badgers to exit but not to return. The gates should be tied open for three days prior to being set to exclude. Sticks should be placed at arm's length within the gated tunnels to establish if Badgers remain within the sett. Gates should be left installed, with regular inspections, over a minimum period of 21 days (including period with gates tied open) before the sett is deemed inactive. Any activity at all will require the procedures to be repeated or additional measures taken. Gates might be interfered with by other mammals or members of the public - hence the importance of regular exclusion monitoring visits. Sett destruction should commence immediately following the 21-day exclusion period, provided that all Badgers have been excluded. Badgers will often attempt to re-enter setts after a period, and if gates are left in place for any long period, they may attempt to dig around them or even create new entrances and tunnels into the sett system. Where an extensive sett is involved, an alternative method of evacuating Badgers is to erect electric fencing around the sett (ensuring all entrances are included) with one-way Badger-gates installed within the electric fence at points where the fence crosses Badger paths leading to and from the sett. The exclusion should again take place over a minimum		

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					period of 21 days before sett destruction; this monitoring period would be contingent upon no Badger activity being observed within the fenced area. Fencing may not be practical in many situations due to the topography or the terrain – and can be difficult to install effectively. If no activity is observed, then the sett may be destroyed, under supervision by the licensed wildlife expert. The destruction of a successfully evacuated Badger sett may only be conducted under the supervision of qualified and experienced personnel under licence from the NPWS. The possibility of Badgers remaining within a sett must always be considered; suitable equipment should be available on hand to deal with Badgers within the sett or any Badgers injured during sett destruction. Destruction is usually undertaken with a tracked 12-25 tonne digger, commencing at approximately 25 m from the outer sett entrances and working towards the centre of the sett, cutting approximately 0.5 m slices in a trench to a depth of 2 m. Exposed tunnels may be checked for recent Badger activity, with full attention paid to safety requirements in so doing. The sett should be destroyed from several directions, in the above manner, until only the central core of the sett remains. Once it is ensured that no Badgers remain, the core may then also be destroyed and the entire area back-filled and made safe. Sett excavation should, preferably, be concluded within one working day, as Badgers may re-enter exposed tunnels and entrances. A report detailing evacuation procedures, sett excavation and destruction, and any other relevant issues should be submitted to the NPWS, in fulfilment of usual wildlife licence conditions.		

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					Construction activities within the vicinity of affected setts may commence once these setts have been evacuated and destroyed under licence from the NPWS. Where affected setts do not require destruction, construction works may commence once recommended alternative mitigation measures to address the Badger issues have been complied with. Badger access points will be provided to allow Badgers to access the development area once complete. Monitoring of Badger setts will be carried out during construction works and a five-year post-construction monitoring programme will be implemented.		
Construction	Bats.	High	Disturbance/ displacement	Not significant	During the site works, general mitigation measures for bats will follow the National Road Authority's 'Guidelines for the Treatment of Bats during the Construction of National Road Schemes' NRA (2005c) and 'Bat Mitigation Guidelines for Ireland: Irish Wildlife Manuals, No. 25' (Kelleher, C. & Marnell, F. (2006)). These documents outline the requirements that will be met in the pre-construction (site clearance) stage to minimise negative effects on roosting bats, or prevent avoidable effects resulting from significant alterations to the immediate landscape. A Common Pipistrelle colony was recorded in a farm building southwest of the Proposed Development site. This building will not be affected. No bat roosts were recorded within the site boundary. Mitigation measures will be agreed with the National Parks and Wildlife Service prior to any demolition works and will include the following: Two buildings within the Proposed Development site will be demolished as part of the development. No signs of bats were recorded within these buildings. However as a precautionary measure, the following	Not significant	Chapter 07B – Terrestrial Ecology

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					measures will be implemented prior to and/ or during demolition: • In all cases immediately in advance of demolition a bat specialist will undertake an examination of the building. If bats are present at the time of examination it is essential to determine the nature of the roost (i.e. number, species, whether it is a breeding population) as well as its exact location. • If bats are recorded in buildings earmarked for demolition, special mitigation measures to protect bats will be put in place and a license to derogate from the conservation legislation will be sought from the NPWS. • The contractor will take all required measures to ensure works do not harm individuals by altering working methods or timing to avoid bats, if necessary. • If roosting habitat for bats is removed, replacement habitat will be provided. • A number of trees will be removed prior to construction. Although mature trees with the potential of be value as bat roosts are absent from the site, the following precautionary measures will be implemented. • The bat specialist will work with the contractor to ensure that the loss of trees is minimised and that trees earmarked for retention are adequately protected. • Tree-felling will ideally be undertaken in the period September to late October/ early November. During this period bats are capable of flight and may avoid the risks of tree-felling if proper measures are undertaken. • Felled trees will not be mulched immediately. Such trees will be left lying several hours and preferably		

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					overnight before any further sawing or mulching. This will allow any bats within the tree to emerge and avoid accidental death. The bat specialist will be on-hand during felling operations to inspect felled trees for bats. If bats are seen or heard in a tree that has been felled, work will cease and the local NPWS Conservation Ranger will be contacted. • Tree will be retained where possible and no 'tidying up' of dead wood and spilt limbs on tree specimens will be undertaken unless necessary for health and safety. • Treelines outside the Proposed Development area but adjacent to it and thus at risk, will be clearly marked by a bat specialist to avoid any inadvertent damage. • During construction directional lighting will be employed to minimise light spill onto adjacent areas. Where practicable during night-time works, there will be no directional lighting focused towards watercourses or boundary habitats and focusing lights downwards will be utilised to minimise light spillage. • If bats are recorded by the bat specialist within any trees no works will proceed without a relevant derogation licence from the NPWS. As noted in 7.5.1.5, lighting mitigation measures will follow Bats & Lighting Guidance Notes for: Planners, engineers, architects and developers (Bat Conservation Ireland, 2010). All mitigation measures including detailed method statements will be agreed with the NPWS prior to commencement of works, which could affect any bat populations onsite.		

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Construction	Otter.	Medium	Disturbance/ displacement	Not significant	No signs of Otter or Otter holts were noted within 150 m of the Proposed Development site. Although Otter were recorded along the Ralappane Stream and to the west of the Proposed Development site. A detailed pre-construction survey will be carried out no more than 10-12 months prior to the commencement of construction works to confirm the absence of Otter holts within 150 m of the site. If Otter holts are recorded at that time, the ECoW will determine the appropriate means of minimising effects i.e. avoidance, moving works, timing of works etc. If required the ecologist will obtain a derogation licence from the NPWS, to facilitate licenced exclusion from the breeding or resting site in accordance with a plan approved by the NPWS. Any holts found to be present will be subject to monitoring and mitigation as set out in the NRA publication Guidelines for the Treatment of Otter prior to the Construction of National Road Schemes (2008). If found to be inactive, exclusion of holts may be carried out during any season. No wheeled or tracked vehicles (of any kind) will be used within 20 m of active, but non-breeding, Otter holts. Light work, such as digging by hand or scrub clearance will also not take place within 15 m of such holts, except under licence. The prohibited working area associated with Otter holts will be fenced and appropriate signage erected. Where breeding females and cubs are present no evacuation procedures of any kind will be undertaken until after the Otters have left the holt, as determined by the ECoW. Breeding may take place at any season, so activity at a holt must be adjudged on a case-by-case basis. On occasion, Otter holts may be directly affected by the scheme. To ensure the welfare of Otters, they must be evacuated from any holts present prior to any construction works commencing. The exclusion process, if required,	Not significant	Chapter 07B – Terrestrial Ecology

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					involves the installation of one-way gates on the entrances to the holt and a monitoring period of 21 days to ensure the Otters have left the holt prior to removal.		
Construction	Common Frog.	Medium	Habitat loss/ mortality/ injury	Moderate	A visual search of the wet grassland habitat to be removed will be carried out in the days prior to commencement of development and any frogs will be removed to alternative wet grassland habitat elsewhere within the landholding. This will be carried out under licence from the NPWS.	Not significant	Chapter 07B – Terrestrial Ecology
Construction	Birds.	Medium	Mortality or injury, Disturbance / displacement Direct loss of breeding/ foraging habitat	Not significant to moderate	As noted in Section 7.75.1.6, where possible, vegetation will be removed outside of the breeding season and in particular, removal during the peak-breeding season (April-June inclusive) will be avoided. This will also minimise the potential disturbance of breeding birds outside of the Proposed Development site boundary. As a biodiversity enhancement measure ten bird nesting boxes (various types) will be located within the Proposed Development site boundary at locations specified by the ECoW. It is noted that provision of woodland planting and the use of more diverse grassland planting will provide additional nesting and feeding sites for birds, particularly as these habitats mature. A detailed method statement will be drawn up by the ECoW and agreed with the NPWS prior to commencement of works. The method statement will specify the timing of blasting operations and the need, if any, for ecological supervision. As noted in Chapter 07A Section 7.7.2 a soft-start will be required for piling works or any source, including equipment testing, exceeding 170 dB re: 1 μPa @1 m an appropriate ramp-up procedure (i.e. 'soft-start')	Not significant	Chapter 07B – Terrestrial Ecology

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					must be used. This should be a minimum of 20 minutes and no longer than 40 minutes.		
Construction	Biodiversity and landscaping	Low		Slight positive	Details of the landscaping plan for the Proposed Development are included in Figure F2-4 in Volume 3. This includes detailed areas of native woodland and native scrub habitat as well as native grassland planting. The woodland planting mix will be dominated by native species including Scots Pine *Pinus sylvestris*, Willow, Pedunculate Oak *Quercus r*obur and Sessile Oak *Quercus petraea*, Alder, Rowan *Sorbus* spp. and Crab Apple *Malus* spp. The woodland edge planting mix will include Hazel *Corylus* spp., Hawthorn, Blackthorn, Elder *Sambucus* spp. and Holly *Ilex* spp. The objective of these elements is to create natural, multi-layered woodland habitat which will be of local ecological value and has the potential to support native flora and fauna. A linear strip of woodland along the southern boundary will help to maintain connectivity (east to west) between habitats in the wider landscape. Additional native specimen trees (Willow, Wild Cherry *Prunus avium*, Rowan, Whitebeam *Sorbus subg*. Aria and Silver Birch) will be planted on peripheral areas such as the road edge and administration area. As detailed in Figure F2-4 in Volume 3 a native wildflower/ grass mix will be utilised to provide a more diverse sward which is of higher ecological value for invertebrates and birds. Perennial Rye Grass or other vigorous amenity/ agricultural grass species will not be utilised as they tend to over-dominate the sward and reduce overall biodiversity. The final grassland/ wildflower mix for same will be specified by the ECoW based on final ground conditions including alkalinity, fertility and moisture levels.	Slight positive	Chapter 07B – Terrestrial Ecology

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					Based on the seed mix utilised and on prevailing ground conditions, the ECoW will specify the management regime, including weed control and mowing regime, necessary to maximise biodiversity and habitat value. Five insect nesting boxes suitable for Hymenoptera spp. (bees and wasps) will be put in place within the site boundary as a biodiversity enhancement measure.		
Construction	Invasive species	Slight		Not significant	Prior to the commencement of construction works invasive species survey will be undertaken within the Proposed Development boundary by a competent ecologist to determine if invasive species listed under Part 1 of the Third Schedule of S.I No. 477 of 2011 have established in the area in the period between pre-planning and post consent. In the event that invasive species are identified within the works area a site-specific Invasive Species Management Plan will be developed and implemented by a competent specialist on behalf of the Contractor. In addition, in order to comply with Regulations 49 and 50 of the European Communities (Birds and Natural Habitat) Regulations (2011) the appointed Contractor will ensure biosecurity measures are implemented throughout the construction phase to ensure the introduction and translocation of invasive species is prevented. The appointed ECoW will carry out a toolbox talk which will identify invasive species and will also implement biosecurity measures such as the visual inspection of vehicles for evidence of attached plant or animal material prior to entering and leaving the works area.	Not significant	Chapter 07B – Terrestrial Ecology
Operation	General.	Medium	Displacement/ disturbance	Slight	During the operational phase the site environmental management system will address management of potentially contaminating materials such as fuel, lubricating oils, solvent, etc. and ensure such material	Not significant	Chapter 07B – Terrestrial Ecology

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					is appropriately controlled, in accordance with regulatory requirements and industry best practice. The drainage design for the Power Plant will consider the magnitude of the changes in infiltration and runoff characteristics and the significance of potential impacts at the wetland. Further details on operational water management are included in Chapter 06 – Water. Lighting shall be provided in plant areas where safe access and safe conditions for work activities is required at night. Lighting will also be required on the water around the jetty dock to detect spillage and possibly unauthorized craft. The onshore receiving facilities would have area lighting installed on a down angle to cover the LNG Terminal and Power Plant. The terminals will have a level of lighting sufficient to ensure that all ship/ shore interfaces activities can be safely conducted during periods of darkness. Lighting levels will meet national and international engineering standards as a minimum. The principal mitigation measures required for the development in relation to noise concern selection of equipment, sound containment, and acoustic attenuators, in order to achieve the required limits. The predicted noise levels, as outlined in Chapter 09 – Airborne Noise and Groundborne Vibration are considered to be readily technically achievable using standard methods.		
Construction	Dust.	High	Negligible	Slight	Standard practice dust mitigation measures as recommended by the Institute of Air Quality Management and listed in Section 8.6.1 (excluding those that are not practical for this site) and the section 9.2.9 of the OCEMP. These include, but are not limited to: • Production of and adherence to a site-specific dust minimisation control plan (AKA Dust Management	Negligible	Chapter 08 – Air Quality

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					Plan), setting out the control measures to implemented across the site and associated procedures; and • A proportionate level of dust monitoring relative to the risk of dust impacts, to ascertain the effectiveness of measures included with in the OCEMP and dust minimisation control plan. Dust deposition monitoring will be in place during construction. This could include passive dust deposition monitoring at potential locations shown on Figure 8-5 in Chapter 08 - Air Quality.		
Operation	Site and road traffic emissions.	High	Negligible to Moderate	Negligible to slight adverse	Design embedded mitigation measures including: • Emission release heights for the largest and most frequent sources of emissions to air have been designed to encourage good dispersion, through height above ground level and height above nearby buildings and structures; • The layout of the onshore site maximises distance between the main continuous sources of emissions to air and the nearest air quality sensitive receptors; • The layout of the offshore site also provides a good setback distance between sources of emissions to air and the nearest air quality sensitive receptors; • Whilst the air quality assessment has assumed continuous operation of the Power Plant throughout the year, in reality the CCGT plant will only operate for the energy demand required at the time; • The majority of plant and all continuous and frequently operational plant will be fuelled by natural gas. Liquid fuel will only be used for start-up, maintenance and emergency purposes; and	Negligible to slight adverse[1]	Chapter 08 – Air Quality

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					• Start-up and emergency plant will only operate with use of low and ultra-low sulphur liquid fuel.		
Construction	Construction noise.	Sensitive	Negative	Significant	Scheduling of works such that noisy activities do not occur between 1300- and 1400 on Saturdays, and to comply with noise limits and criteria set out in Chapter 09 during weekdays. Fixed and semi-fixed ancillary plant will be located away from sensitive receptors wherever possible. All plant shall be regularly maintained and shut down when not in use. Approximately three to four long term noise monitoring stations and one to two long term vibration monitors will be set up on the construction site boundary.	Not Significant	Chapter 09 – Airborne Noise and Groundborne Vibration
Construction	Construction vibration.	Sensitive	Neutral	Imperceptible	None required. See below for mitigation measures associated with blasting.	Imperceptible	Chapter 09 – Airborne Noise and Groundborne Vibration
Construction	Construction traffic noise on existing roads.	Sensitive	Negative	Significant	Construction traffic from this and other concurrent development will be coordinated to minimise traffic and site noise impacts where possible.	Significant	Chapter 09 – Airborne Noise and Groundborne Vibration
Construction	Blasting induced noise/ air overpressure.	Sensitive	Negative	Significant	Process management and community liaison including a dedicated Public Liaison Officer. A protocol for community relations with regards to blasting will be adopted such that prior warning of blasting operations is given to members of the public. All noise complaints will be logged and followed up in a prompt fashion by the Liaison Officer. Only single blasts will take place in each event and monitoring will be in place as described in Chapter 09.	Not Significant	Chapter 09 – Airborne Noise and Groundborne Vibration
Construction	Blasting induced vibration.	Sensitive	Negative	Significant	Limiting of Maximum Instantaneous Charge (MIC). It is noted there may be blasting charge limits imposed as a result of the underwater acoustic assessment. If	Not Significant	Chapter 09 – Airborne Noise and

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					these limits differ, the more stringent limit of the two will be adopted.		Groundborne Vibration
Operational	Operational noise.	Sensitive	Negative	Significant	Various forms of mitigation (inc. silencers, plant selection, relocation, barriers enclosures) as detailed in the relevant chapter. Long term monitoring will be undertaken for a period of at least 12 months from the commencement of site operations and again following any subsequent substantive change in site operations. After 12 months the need for long term monitoring will be reviewed with the relevant authority. Short term measurements will take place at the commencement of site operations and again following any subsequent substantive change in site operations. They will then be repeated no less than once a year.	Not Significant	Chapter 09 – Airborne Noise and Groundborne Vibration
Operational	Operational traffic noise on existing roads.	Sensitive	Negative	Not Significant	Best practice measures will be adhered to during operation, including avoiding vehicle idling and adhering to speed limits on internal roads.	Not Significant	Chapter 09 – Airborne Noise and Groundborne Vibration
Construction	Changes to the baseline landscape and views.	Sensitive	Negative	Significant	Visual mitigation measures at construction include the following: • Existing tree protection measures during construction shall be carried out in accordance with BS 5837:2012; • Minimise external lighting related to construction works; and • Regular cleaning or public roads to remove any track out and to reduce temporary effects on visual amenity.	Moderate	Chapter 10 – Landscape and Visual
Operational	Alteration of a view from a viewpoint/ cumulative effective of	Sensitive	Negative	Very Significant	Landscape mitigation measures have been developed in order to screen the lower sections of the proposed range of buildings and the proposed access road to help the integration into the landscape.	Moderate	Chapter 10 – Landscape and Visual

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	planned development on landscape.				Planting of Ash (*Fraxinus elcelsior*) is currently prohibited. Plants selected for the landscape treatments will be similar to those found in the existing landscape and appropriate to the local soil types and climatic conditions. These details will be further developed at detailed design.		
Construction	Increased construction traffic flows on the road network resulting in a reduction of the junction capacity and increase to queuing at the junctions.	Low	Negative	Slight	Prior to the construction phase, a section of L1010 is to be upgraded by KCC with the only access to the site to be by way of a new vehicular priority junction off the L1010. The main construction works will start after the L1010 upgrades have been completed. A Construction Traffic Management Plan (CTMP) will be prepared by the appointed contractor and will be agreed in writing with KCC roads department. An outline CTMP has been included within this application Based on the information provided by Sisk, the construction traffic times will be agreed with KCC in advance to avoid coinciding with the peak time associated with Tarbert Comprehensive School.	Slight	Chapter 11 – Traffic and Transport
Operational	Increased operational traffic flows on the road network resulting in a reduction of the junction capacity and increase to queuing at the junctions.	Low	Neutral	Not significant	Junction Analysis undertaken demonstrating existing network has ample capacity for Proposed Development.	Imperceptible	Chapter 11 – Traffic and Transport

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Operational	Potential overspill of car park.	Low	Neutral	Not significant	Car parking provided for the proposed land uses will be agreed with KCC.	Imperceptible	Chapter 11 – Traffic and Transport
Operational	Increased public transport patronage associated with the Proposed Development.	Low	Neutral	Imperceptible	None	Imperceptible	Chapter 11 – Traffic and Transport
Operational	Increased pedestrian movement on the local road network.	Low	Neutral	Imperceptible	None	Imperceptible	Chapter 11 – Traffic and Transport
Operational	Increased cycle movement on local road network.	Low	Neutral	Imperceptible	None	Imperceptible	Chapter 11 – Traffic and Transport
Construction	CHS 4 farm complex/ destruction through groundworks.	Low	Very high	Significant	This asset has already been subject to recording in the form of upstanding building survey to satisfy the condition upon Planning Permission (Condition 32 C 08.PA0002). While this asset would be significantly impacted by the Proposed Development, no further mitigation is required.	Moderate	Chapter 12 – Cultural Heritage
Construction	CHS 5 possible archaeological feature/ destruction through groundworks.	Low	Very high	Significant	Full resolution of all archaeological sites and areas identified during archaeological testing within the scheme boundary would be carried out at the pre-construction phase. All archaeological works (which would be agreed by the Archaeological Consultant and the NMS) would be carried out in compliance with the National Monuments Acts 1930 – 2004 (and Policy and Guidelines on Archaeological Excavation	Moderate	Chapter 12 – Cultural Heritage

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance	EIAR Chapter Reference
					(Department of Arts, Heritage Gaeltacht and the Islands, 1999).		
Construction	CHS 6 Well/ destruction through groundworks.	Low	Very high	Significant	It is recommended that a photographic survey and written description of CH6 Well be carried out in advance of groundworks within the vicinity of this asset. It is also recommended that the dismantling of the well be carried out in an orderly fashion under the supervision of a suitably qualified archaeologist.	Moderate	Chapter 12 – Cultural Heritage
Construction	CHS 7 Gun Emplacement/ destruction through groundworks.	Low	Very high	Significant	This asset has already been subject to recording in the form of upstanding building survey to satisfy the condition upon Planning Permission (Condition 32 C 08.PA0002). While this asset will be significantly impacted by the Proposed Development, no further mitigation is required.	Moderate	Chapter 12 – Cultural Heritage
Construction	CHS 15 Well/ destruction through groundworks.	Low	Very high	Significant	This asset has already been subject to recording in the form of upstanding building survey to satisfy the condition upon Planning Permission (Condition 32 C 08.PA0002). While this asset will be significantly impacted by the Proposed Development, no further mitigation is required.	Moderate	Chapter 12 – Cultural Heritage
Construction	Known areas of archaeological potential/ destruction through groundworks.	Low	Very high	Significant	Full resolution of all archaeological sites and areas identified during archaeological testing within the scheme boundary will be carried out at the pre-construction phase. All archaeological works (which will be agreed by the Archaeological Consultant and the NMS) will be carried out in compliance with the National Monuments Acts 1930 – 2004 (and Policy and Guidelines on Archaeological Excavation (Department of Arts, Heritage Gaeltacht and the Islands, 1999).	Moderate	Chapter 12 – Cultural Heritage
Construction	Previously unknown archaeological features/	Low	Very High	Significant	A General Watching Brief (GWB) will be carried out for ground works by a suitably qualified archaeologist in compliance with the National Monuments Acts 1930 – 2004 (and Policy and Guidelines on Archaeological	Moderate	Chapter 12 – Cultural Heritage

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	destruction through groundworks.				Excavation (Department of Arts, Heritage Gaeltacht and the Islands, 1999).		
Construction	CH10 Ringfort (KE003-004).	Low	Very High	Significant	Embedded mitigation in design comprising a buffer zone established around the asset to preserve in situ. The buffer zone will be defined by a permanent fence line.	No effect	Chapter 12 – Cultural Heritage
Construction	Anomaly identified during marine geophysical survey.	Low	Low	Low	Asset is located over 200 m from the Proposed Development construction works. Embedded mitigation in design comprising a 50 m buffer zone established around the asset to prevent incursion during construction.	No effect	Chapter 12 – Cultural Heritage
Construction	Land Use – negative impacts due to loss of agricultural grazing land and on views from Wild Atlantic Way	Low	Slight	Slight	Mitigation and monitoring measures relating to visual impacts are detailed in Chapter 10 – Landscape and Visual Impacts.	Slight	Chapter 13 – Population and Human Health
Construction	Severance.	N/A	Negligible	Imperceptible	Mitigation and monitoring measures relating to construction traffic (e.g. relating to traffic routing) are to be detailed in the Construction Traffic Management Plan prepared by the appointed contractor.	Imperceptible	Chapter 13 – Population and Human Health
Construction	Employment.	N/A	Moderate	Moderate	None required	Moderate	Chapter 13 – Population and Human Health
Construction	Human Health – negative nuisance and noise impacts due to the	N/A	N/A	N/A	Mitigation and monitoring measures are detailed in Chapter 09 – Airbourne Noise and Groundbourne Vibration, Section 9.8.1.	N/A	Chapter 13 – Population and Human Health

Proposed Development Stage	Aspect/ Impact Assessed	Existing Environment/ Receptor Sensitivity	Effect/ Magnitude	Significance (Prior to Mitigation)	Mitigation and Monitoring Measures (the Proposed Development design embedded environmental controls and all mitigation and monitoring measures detailed herein are included in the OCEMP)	Residual Impact Significance	EIAR Chapter Reference
	presence of construction traffic.						
Construction	Human health – positive employment and training impacts.	N/A	N/A	N/A	Ensure opportunities are provided to the local workforce, to increase the Proposed Development's local impact. See Section 2.12 of Chapter 02 – Project Description.	N/A	Chapter 13 – Population and Human Health
Operation	Land Use – negative impacts due to loss of agricultural grazing land and on views from Wild Atlantic Way	Low	Slight	Slight	Mitigation and monitoring measures relating to visual impacts are detailed in Chapter 10 – Landscape and Visual Impacts.	Slight	Chapter 13 – Population and Human Health
Operation	Employment.	N/A	Slight	Slight	None required.	Slight	Chapter 13 – Population and Human Health
Operation	Human health – positive employment and training impacts.	N/A	N/A	N/A	Ensure opportunities are provided to the local workforce, to increase the Proposed Development's local impact.	N/A	Chapter 13 – Population and Human Health
Operation	Human health – generation of GHGs leading to climate change.	N/A	N/A	N/A	Embedded mitigation measures to reduce GHG emissions are set out in Chapter 15 – Climate, Section 15.9.	N/A	Chapter 13 – Population and Human Health

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Operation	Fires following the accidental release of LNG or natural gas into the receiving environment.	Low	Very High	Significant	The key preventative and mitigating measures to prevent major accidents and disasters, are summarised as follows: • No LNG storage tanks will be installed onshore, minimising the inventory of LNG; • The natural gas pipelines will have integral isolation valves which can be closed very quickly in an emergency to isolate the inventory and reduce the consequences of an accident; • The FSRU can be safely disconnected from the jetty in the event of adverse weather conditions such as storms; • Fires are the most significant hazards associated with natural gas and therefore the inventory has been minimised to store as little flammable material as possible at the onshore site; • Appropriate segregation distances will be provided onshore between the natural gas systems and other operators, including the Power Plant; and • In the event of a release of LNG, rapid vaporisation and dispersion will result in very limited potential for this material to enter environmental receptors, such as the protected areas encompassing the estuaries, mudflats and other features along the coast.	Minor adverse	Chapter 14 – Major Accidents and Disasters
Construction	GHG emissions.	High		Minor adverse	• Development and implementation of the OCEMP, where measures to reduce GHG emissions are detailed; • Encouragement of green transport options for commuting, installation of energy efficient measures and engage the supply chain to reduce the number of vehicle movements relating to site material. Waste management plan:	Minor adverse	Chapter 15 – Climate

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					• Maximising reuse and recycling of waste, i.e. reuse of excavated soil where possible; and • Using locally sourced materials, using Ground Granulated Blast Furnace See Section 2.4.1 of Chapter 02 – Project Description.		
Construction	In-combination climate change Impacts.	Not assessed/ Not applicable		Not assessed- No Significance	• Development and implementation of the OCEMP, where measures to reduce impacts to sensitive receptors are detailed; • Undertaking construction works with all legal, regulatory and licence conditions. • See Section 2.4.1 of Chapter 02 – Project Description.	Not assessed – No Significance	Chapter 15 – Climate
Construction	Climate change resilience.	Not assessed/ Not applicable		Not assessed- No Significance	• Development and implementation of the OCEMP, where measures to protect construction assets and materials are detailed; • Ensure an outline emergency response plan and procedure for environmental incidents such as flooding or storms are in place; • Storage of topsoil and other construction materials to protect against high rainfall and flooding events, or sea level rise; • Suitable storage and bunding of pollutants to protect from high rainfall events or sea level rise; • Laydown and welfare areas will be laid will permeable membranes to protect the Proposed Development site from high rainfall and flooding events or sea level rise; and • Undertaking construction works within all legal, regulatory and licence conditions.	Not assessed – No Significance	Chapter 15 – Climate
Operational	GHG emissions.	High	• The Proposed Development will diversify	Major adverse	• Expected reduced operating hours over the life of the Power Plant; • Only 2 of 3 generators (CTG1, CTG2, & CTG3) will be in operation at any point in time;	Major adverse	Chapter 15 – Climate

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			the supply of natural gas and electricity to the Irish market. It does not in itself increase demand for natural gas or electricity. • As the use of coal and peat for electricity generation will cease by 2025 under the 2019 Climate Action Plan, natural gas has been identified in the Climate Action Plan, and the National Energy and Climate Plan, as the only remaining dispatchable power source		• Diesel Firewater Pump is operated in emergency only and will not be running during normal operations; • Black Start Diesel Generator used for initial start-up only and would not be running during normal operations; • Auxiliary Boiler is only operated when all CTG/ HRSG Trains are not in operation to facilitate a unit start; • The Proposed Development will operate in the EU ETS scheme, with an EU-wide cap currently reducing by 2.2% annually. Sufficient allowances to cover an installation's annual emissions must be surrendered each year. Power generators are not eligible for any free allocation of allowances, so all allowances to cover the direct emissions from the Proposed Development must be purchased at auction; • In a 'business as usual' scenario, where the Proposed Development is not progressed, this demand would be met by alternative, and potentially more carbon intensive power suppliers; • The efficiency of the Power Plant combined with its ability to operate at a low minimum generation capacity means that the Power Plant will be dispatched ahead of a less efficient OCGT power plant as it will provide lower direct emissions; • The proposed Power Plant will not operate at 100% capacity all year round; • As the level of renewable generation on the system at any one time increases, thermal power plant has their dispatch quantities decreased by EirGrid to facilitate the output of the renewable power plants. However, a certain number of dispatchable plants must remain on the system to		

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			capable of providing significant security of electricity supply when wind sources are insufficient.		provide the services mentioned above. 'Positioning' is when the grid operator keeps a power plant running so as to be on standby to provide these services to the grid operators in real time. This is a vital process for grid stability; however, with inflexible power plants it can lead to larger than necessary power plants being positioned. This causes increased emissions, increased curtailment of renewables (to make room for the positioned Power Plant) and increased costs; • The ability of the Power Plant to operate at a 50% blend of hydrogen by design, offers the potential for the Power Plant to become even more efficient in emission terms over the period to 2050 as and when the required policies and supply chains for hydrogen are implemented; and • The Proposed Development has a unique location and flexible design that can easily transition to alternative low carbon fuels, subject to future planning applications once the technology and public policies are established. • See Section 2.4.1 of Chapter 02 – Project Description.		
Operational	In-combination climate change impacts.	Assessed by other disciplines		No significance	• Detailed within other discipline assessments; and • Undertaking operations within all legal, regulatory and licence conditions. • See Section 2.4.2 of Chapter 02 – Project Description.	No significance	Chapter 15 – Climate
Operational	Climate change resilience.	Not assessed/ Not applicable		No significance	• Electrical connections will be buried underground, insulating against overheating in times of heatwaves; • The Proposed Development will be designed with any specific drainage terms and conditions of the IE licensed, as determined by the EPA and	No significance	Chapter 15 – Climate

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					associated planning conditions, to protect again high rainfall events or sea level rise; and • Undertaking operations with all legal, regulatory and licence conditions. • See Section 2.4.2 of Chapter 02 – Project Description.		
Construction	Non-hazardous waste.	Waste facility	N/A	Slight	The following best practice measures would be implemented to manage the CDW produced by the Proposed Development: • EU, National and Irish policy and legislation require the waste hierarchy (Figure 16-1) to be applied to all waste arisings. Widely implemented best practice is to adopt a Site Waste Management Plan (SWMP) to reduce the amount of waste generated and follow the waste hierarchy in for far as practicable. A SWMP would be developed and implemented for the Proposed Development and include the following details: – Statutory requirements, the Applicant's corporate requirements and mitigation and monitoring measures defined within this EIAR where applicable to waste management; – Waste types and procedures for classification, segregation, containment, storage, transportation and disposal. This would include details on the measures to prevent impacts to the receiving environment. The Contractor would apply the principles of the 'Waste Hierarchy' (Prevention, Preparing for Re-use, Recycling, Other Recovery, Disposal) to minimise waste generation, maximise re-use of site-won materials onsite and minimise the need for disposal of waste. Where re-use is not possible onsite, alternative re-use and	Slight	Chapter 16 – Waste
Construction	CDW waste arisings.	Waste facility	N/A	Not Significant		Not Significant	Chapter 16 – Waste
Operation	Ballast water.	Shannon Estuary and waste facilities	N/A	Not Significant		Not Significant	Chapter 16 – Waste
Operation	Non-hazardous and hazardous waste.	Waste facility	N/A	Not Significant		Not Significant	Chapter 16 – Waste

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					recycling options would be sought offsite with the final disposal option; ▪ Roles and responsibilities; ▪ Training requirements; ▪ Waste handling procedures; ▪ Waste compound maintenance measures; ▪ Emergency planning and response; ▪ Monitoring, reporting and document control procedures; and ▪ Corrective action process. • As part of the document control procedures, a comprehensive docketing system (including waste transfer notes) would be detailed in the SWMP. The documentation to be maintained in relation to waste material removed from the site will include the following: – The names of the agent(s) and the transporter(s) of the wastes; – The name(s) of the person(s) responsible for the ultimate treatment of the wastes; – The ultimate destination(s) of the wastes; – Written confirmation of the acceptance and treatment of the hazardous waste consignments; – The tonnages and List of Wastes (LoW) code for the waste materials; – Details of each individual consignment dispatched from the Proposed Development site; ▪ Description of waste (cell number/ AEC number, stockpile number or origin of waste) ▪ Date and time of dispatch from the Proposed Development site		

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					▪ Name of haulage company ▪ Details of contractor and haulier docket numbers ▪ Vehicle registration number and driver name ▪ Volume/ weight of waste removed ▪ Name of waste receiving facility ▪ Date and time of arrival at waste receiving facility – Details of any rejected consignments; – Waste transfer forms for hazardous wastes transferred from the Proposed Development site (stamped at receiving facility); and – The transfrontier shipment of waste forms (where exported). The SWMP would include procedures for monitoring the overall CDW recovery rate. Ballast water will be dealt with in line with the IMO ballast water management convention (see also Chapter 07 Biodiversity).		

[1] Moderate adverse impact predicted at 2 of 48 air quality sensitive receptors. At those 2 locations, there is no risk of an exceedance of an air quality standard or Environmental Assessment Level.

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