Shannon Technology and Energy Park (STEP) Power Plant

Environmental Impact Assessment Report - Volume 2

Chapter 05 Land, Soils and Geology

Shannon LNG Limited

April 2024

Delivering a better world

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5.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) assesses the likely significant effects of the Proposed Development on the land, soils and geology of the Site of the Proposed Development and surrounding area. The hydrogeology-related likely significant effects are assessed under **Chapter 06** (Water).

In order to assess baseline conditions, a desk-based review of publicly available information and previous and directly relevant site investigation data pertaining to the Site was carried out. In assessing likely significant effects 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. A 'do nothing' scenario has also been considered. Mitigation measures are proposed in the form of avoidance, prevention, reduction, offsetting, and reinstatement or remedial measures and recommendations for monitoring are included where appropriate predicted residual effects are described.

The Site is located in the townlands of Kilcolgan Lower and Ralappane, between Tarbert and Ballylongford, Co. Kerry. The application Site boundary ('red line') encloses an area of approximately 41 hectares (ha) and is entirely owned by the Applicant.

Full details on the background, Site history and the Proposed Development is provided in **Chapter 02** (Description of the Proposed Development) and also the Planning Statement submitted with this planning application.

This Land, Soils and Geology chapter, reported herein, provides an outline of the legislative and policy framework relevant to the Proposed Development (**Section 5.4**), the assessment methodology (**Section 5.2**), the receiving baseline environment ground conditions (**Section 5.5**), the predicted impacts of the Proposed Development during the construction, operational and decommissioning phases (**Section 5.8**), any cumulative effects (**Section 5.11**), any proposed mitigation and enhancement measures (**Section 5.7**) and any residual effects (**Section 5.10**).

This chapter is supported by information in the following chapters, figures, and appendices of this EIAR:

- **Chapter 02** (Description of the Proposed Development).
- **Chapter 06** (Water).
- **Chapter 07A** (Marine Ecology).
- **Chapter 07B** (Terrestrial Ecology).
- **Chapter 08** (Air Quality).
- **Chapter 09** (Airborne Noise and Groundborne Vibration).
- **Chapter 10** (Landscape and Visual).
- **Chapter 11** (Traffic and Transport).
- **Chapter 16** (Waste Management).

- **Chapter 17** (Material Assets).
- **Appendix A2.3** Construction Environmental Management Plan (CEMP).
- **Appendix A2.5** Oil and NHS Spill Plan.
- **Appendix A2.6** Construction Equipment Onsite.
- **Appendix A5.1** Onshore Site Investigation Report.
- **Appendix A6.2** Groundwater and Surface Water 2020 Sampling Report.
- **Appendix A7A.6** NPWS Site Synopsis.
- **Appendix A11.1** Construction and Traffic Management Plan (CTMP).
- **Appendix A16.1** Resource and Waste Management Plan (RWMP).

5.1.1 Competent Expert

The Technical Team Lead for this chapter is Kevin Forde, Associate Hydrogeologist in the AECOM Environment, Water and Energy team and has more than 30 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.

5.2 Methodology

5.2.1 Data Collection

Establishment of the baseline environment has involved reference to existing data sources, consultation with statutory bodies and other organisations, a site walkover and existing fieldwork surveys. The following sources of information have been reviewed:

- 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.
- Environmental Protection Agency (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.
- Topography survey map (AECOM, March 2020).

[1] Available at: http://map.geohive.ie
[2] Available at: http://www.gsi.ie
[3] Available at: http://gis.epa.ie/EPAMaps/
[4] Available at: https://airomaps.geohive.ie/ESM/

5.2.2 Sensitivity of Receptors

The sensitivity of a geology or soil receptor is established through the identification and evaluation of the susceptibility of the receptors to changes arising from the Proposed Development, and the value attached to these. Susceptibility relates to the ability of a geology or soil receptor to accommodate change without undue consequences (significant profound negative or adverse impacts, as defined under Institute of Geologists of Ireland (IGI), "*Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements"*[5] (2013) Appendix C) (refer to **Table 5.1**).

Examples of sensitive geology or soil receptors (from Appendix C of the IGI, 2013 Guidelines) include:

- Soil and geological resources (e.g., international, national, or regionally designated sites, soils of high nature conservation or landscape importance, mineral reserves, demand on waste management infrastructure through disposal of soils).
- Receptors susceptible to land contamination and ground hazard impacts (e.g., human, vegetation, protected habitats and species, surface water and groundwater receptors).

The overall importance / sensitivity of these receptors is ranked as Very High, High, Medium, or Low based on such variables as the quality of the receptor or its value as a resource and in accordance with Table C2 (Criteria for Rating Site Importance of Geological Features (NRA, 2008)) in "*Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements"* by the IGI (2013). The descriptive scale for the importance / sensitivity of receptors is presented in **Table 5.2**.

5.2.3 Magnitude of Impact Criteria

The magnitude of potential impacts or changes to identified receptors, as associated with the Proposed Development, has been determined using Table C4 in the IGI guidance (Large Adverse, Moderate Adverse, Small Adverse, Negligible, Minor Beneficial, Moderate Beneficial, Major Beneficial), refer to the rating system in **Table 5.3.**

5.2.4 Quality of Impact

The quality of potential impacts or changes to identified receptors, as associated with the Proposed Development, has been determined using Table C1 in the IGI guidance (Positive, Neutral, Negative), refer to the rating system in **Table 5.4.**

5.2.5 Duration of Impact

The duration of potential impacts or changes to identified receptors, as associated with the Proposed Development, has been determined using Table C1 in the IGI guidance (Short-term, Medium-term, Long-term, Permanent and Temporary), refer to the rating system in **Table 5.5**.

[5] IGI (2013). *Guidelines for Preparation of Soils, Geology, Hydrogeology Chapters of Environmental Impact Statements*.

5.2.6 Significance of Effects

For each of the potential impacts identified, an assessment has been made of the likely level of significance of the resulting effects. The definition of effect significance has been made by combining both the importance / sensitivity of the receptor and the magnitude of the predicted impact.

The overall significance of predicted impacts is described as Large Adverse, Moderate Adverse, Small Adverse or Negligible from Table C5 of the IGI guidance, using the assessment matrix presented in **Table 5.6**.

In accordance with the IGI guidance, appropriate mitigation measures are identified to remedy potential impacts and residual impacts are determined. (Steps 10 to 12 of the IGI (2013) assessment process).

Table 5.1: Rating of Significance of Environmental Impacts at EIA Stage

Term	Description
Imperceptible	An impact capable of measurement but without noticeable consequences.
Slight	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate	An impact that alters the character of the environment in a manner consistent with existing and emerging trends.
Significant	An impact, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Profound	An impact which obliterates sensitive characteristics.

Source: (from IGI, 2013, Table C1)

Table 5.2: Sensitivity Rating of Geological Features

Sensitivity	Criteria	Geology	Soil Resources	Contamination
Very High	Attribute has a very high quality and rarity on international or national scale or high sensitivity.	Geological feature rare on a regional or national scale (NHA). Large existing quarry or pit. Proven economically extractable mineral resource.	Volume of peat and / or soft organic soil underlying route is significant on a national or regional scale.	Degree or extent of soil contamination is significant on a national or regional scale.
High	Attribute has a high quality, significance or value on a local scale.	Geological feature of high value on a local scale (County Geological Site). Moderately sized existing quarry or pit. Marginally economic extractable mineral resource.	Volume of peat and / or soft organic soil underlying route is significant on a local scale. Well drained and/ or high fertility soils.	Degree or extent of soil contamination is significant on a local scale. Contaminated soil on site with previous heavy industrial usage. Large recent landfill site for mixed wastes
Medium	Attribute has a medium quality, significance, or value on a local scale.	Sub-economic extractable mineral resource.	Moderately drained and / or moderate fertility soils. Volume of peat and / or soft organic soil underlying route is moderate on a local scale.	Degree or extent of soil contamination is moderate on a local scale. Contaminated soil on site with previous light industrial usage. Small recent landfill site for mixed wastes.
Low	Attribute has a low quality, significance, or value on a local scale.	Volume of peat and / or soft organic soil underlying route is small on a local scale.	Volume of peat and / or soft organic soil underlying route is small on a local scale.	Degree or extent of soil contamination is minor on a local scale. Large historical and / or recent site for construction and demolition wastes. Small historical and / or recent landfill site for construction and demolition wastes.

Source: (from IGI, 2013, Table C2)

Table 5.3: Magnitude of Impact on Geology Attribute

Magnitude Of Impact	Criteria	Geology	Soil Resources	Contamination
Large Adverse	Results in loss of attribute	Loss of high proportion of future quarry or pit reserves. Removal of entirety of geological heritage feature	Irreversible loss of high proportion of local high fertility soils. Requirement to excavate and replace high proportion of peat, organic soils and / or soft mineral soils beneath alignment.	Requirement to excavate / remediate entire waste site.
Moderate Adverse	Results in effect on integrity of attribute, or loss of part of attribute.	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 and replace moderate proportion of peat, organic soils and /or soft mineral soils beneath alignment.	Requirement to excavate / remediate significant proportion of waste site.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	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 and replace small proportion of peat, organic soils and / or soft mineral soils beneath alignment.	Requirement to excavate / remediate small proportion of waste site.
Negligible	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity.	No measurable changes in attributes.	No measurable changes in attributes.	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: (from IGI, 2013, Table C4)

Table 5.4: Rating of Quality of Environmental Impacts at EIA Stage

Term	Description
Positive	A change which improves the quality of the environment.
Neutral	A change which does not affect the quality of the environment.
Negative	A change which reduces the quality of the environment.

Source: (from IGI, 2013, Table C1)

Table 5.5: Rating of Duration of Environmental Impacts at EIA Stage

Term	Description
Short-term	Impact lasting one to seven years.
Medium-term	Impact lasting seven to fifteen years.
Long-term	Impact lasting fifteen to sixty years.
Permanent	Impact lasting over sixty years.
Temporary	Impact lasing for one year or less.

Source: (from IGI, 2013, Table C1)

Table 5.6: Rating of Significant Environmental Impacts at EIA Stage

		Magnitude Of Impact		
Importance of Attribute	Negligible	Small Adverse	Moderate Adverse	Large Adverse
Extremely high	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant / Moderate	Profound / Significant	Profound
High	Imperceptible	Moderate / Slight	Significant / Moderate	Profound / Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Moderate / Slight

Source: (from IGI, 2013, Table C6)

5.2.7 Assessment Assumptions and Limitations

The assessment has been based on the description of the Proposed Development presented within **Chapter 02** (Description of the Proposed Development).

AECOM has reviewed a number of previous site investigation reports as part of this assessment. These investigation reports were undertaken by third parties ((ARUP (2007) and Halcrow (2007)) 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.

The assessment undertaken in this chapter has been based on a desktop study including a site walkover. Site specific soil and geology data collected as part of an intrusive investigation at the Site of the Proposed Development in 2007 was reviewed as part of this assessment. This information is considered to remain relevant as there have been no subsequent changes to the Site which would have resulted in changes the underlying geology of the Site.

5.2.8 Study Area

The study area with regard to land, soils and geology encompasses the entire area within the boundary of the Site and outward to 2 km (the Wider Area, as specified in Step 2 of the IGI (2013) guidance). This area is considered appropriate for the consideration of historic and current potentially contaminative land uses in the context of the geological / hydrogeological environment as well as the scale of the Proposed Development and aligns with established industry guidance (IGI, 2013) and professional judgment for defining potential geological impact and land contamination study areas for the assessment.

5.3 Stakeholder Consultation

Lands directly related to the Site have been the subject of a planning application for separate power related development in recent years (Planning Ref. ABP-311233-21)[6], which has included the submission of an EIAR. In the preparation of this EIAR, cognisance has been undertaken of relevant formal consultation, consultee responses and third-party comments in relation to that separate project.

The consultation response received from the Geological Survey of Ireland (GSI) on 5th May 2021 prior to the submission of the EIAR indicated there were no County Geological Sites within the boundary of the Site, noted that bedrock aquifers classified as '*Locally Important'* underlie the Proposed Development and that groundwater vulnerabilities in the area of the Proposed Development are variable. Following submission of the EIAR, there was no further response received from GSI during the public consultation process.

The GSI note that:

> *Landslide susceptibility in the area of the proposed energy park is variable and is classed from Moderately Low to Moderately High at the coastal margins.*

The response also referred the Applicant generally to the online geological mapping resources provided by GSI.

5.4 Regulatory, Policy and Guidance Framework

In addition to sources listed in **Section 5.2.1**, the following legislation, planning policy and guidance documents are of direct relevance and have been considered in the preparation of baseline information, the assessment of effects of the Proposed Development on land, soils and geology, informing the design-development process and when identifying mitigation measures are presented in the sections below, as well as the EIA Regulations relevant to the Proposed Development.

5.4.1 Regulatory

This chapter has been prepared with reference to the European Union Water Framework Directive (WFD) (2000/60/EC).

[6] ABP Ref No. ABP-311233-21, for a 10-year permission for a Strategic Infrastructure Development (SID) comprising a power plant, battery energy storage system, regasification unit, jetty and onshore receiving facilities, and an AGI, which was refused by the Board on 15th September 2023, and is currently subject to Judicial Review proceedings.

The following legislation in Ireland is considered relevant as it 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) as amended in 2014 (S.I. No. 350 of 2014) and 2022 (S.I. No. 166 of 2022).
- European Communities Environmental Objectives (Surface Water) Regulations, 2009 (S.I. No. 272 of 2009 as amended), as amended in 2012 (by S.I. No. 327/2012), 2015 (by S.I. No. 386 of 2015), 2019 (by S.I. No. 77 of 2019) and 2022 (S.I. No. 288 of 2022).
- European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010) as amended in 2012 (by S.I. No. 149 of 2012) and 2016 (S.I. No. 366 of 2016).
- EC (2017). Environmental Impact Assessment of Projects – Guidance on Scoping (Directive 2011/92/EU as amended by 2014/52/EU).
- Planning and Development Act 2000 (S.I. No. 30 of 2000), as amended.
- Planning and Development Regulations 2001 (S.I. No. 600 of 2001), as amended.

5.4.2 Guidance

The following guidance has been used to inform the scope and content of this assessment and to assist the identification and mitigation of likely significant effects:

- Department of Housing, Planning and Local Government (DHPLG) (2018). *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment.*
- EC (2017). *Environmental Impact Assessment of Projects - Guidance on the preparation of the Environmental Impact Assessment Report.*
- EPA (2013). *Guidance on The Management of Contaminated Land and Groundwater at EPA Licensed Sites.*
- EPA (2022). *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports.*
- Institute of Environmental Management and Assessment (IEMA) (2022). *A New Perspective on Land and Soil in Environmental Impact Assessment.*
- IGI (2013). *Guidelines for Preparation of Soils, Geology, Hydrogeology Chapters of Environmental Impact Statements.*
- NRA (2008). *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.*

5.5 Baseline Environment

The description of baseline environmental conditions at the time of submission covers the following aspects of the geological and soil setting and features for the Proposed Development:

- Topography.

- Soil Geology.
- Subsoil Geology.
- Bedrock Geology.
- GSI Borehole, Well and Spring information.
- Ground Stability *i.e.,* potential for subsidence.
- Land Cover Mapping.
- Geological Heritage Areas.
- Geotechnical Site Records.
- Geological Hazards.
- Radon.
- Mineral and Aggregate Potential.
- Designated Sites.
- 2007 Site Investigation.
- Potential sources of contamination (including historic land use, waste sites, pollution incidents and permitted installations).
- Identified receptors.
- Conceptual site model.

The baseline conditions are based on a combination of data collected in 2007 and from publicly available sources reviewed in 2024.

The soil, rock and geotechnical properties of the site have not changed over this period. The site land use has remained agricultural so the likelihood of the development of additional significant soil contamination is very low. Groundwater was resampled in 2020. The results of this sampling event are included in **Chapter 06** (Water).

5.5.1 Description of the Site

The Site covers an area of approximately 41 ha and is described in detail in **Chapter 02** (Description of the Proposed Development).

The area of the Site to be developed is characterised by predominantly improved grassland in an agricultural setting. The field boundaries predominantly consist of hedgerows with small drainage ditches. The Site is in pasture, comprising primarily improved grassland with some wet grassland adjacent to the Shannon Estuary.

The 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 road, with infrequent residential properties.
- To the west is agricultural land, beyond which is coastline.

A number of minor drainage channels are present on the location of the Proposed Development, with longer drainage features crossing the proposed access road. These are described in further detail in **Chapter 06** (Water).

5.5.2 Topography

The wider (2 km) study area surrounding the Proposed Development is generally low-lying, rolling agricultural pastureland.

The north-east of the Site slopes relatively uniformly from approximately 35 m above Ordnance Datum (m OD) in the south-east to a clifftop at approximately 5 m OD in the north. On the west of the Site, the land generally slopes from south-east to north-west. The parcel of land which will be occupied by the proposed access road is undulating, with topographic level highs at approximately 22 m OD.

5.5.3 Soil Geology

Soils mapping indicates the soils beneath the Site and wider 2 km area generally comprise acid brown earths / brown podzolics of the Kilrush soil series. The soils across the majority of the Site are classified as ‘well drained’, with pockets of ‘poorly drained’ soils to the north.

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 Site has been studied during previous investigation works on-site, with a more detailed description provided in **Section 5.5.14**.

5.5.4 Subsoil Geology

GSI mapping indicates that the local quaternary deposits beneath the Site and the wider 2 km study area comprise predominantly ‘*till derived from Namurian sandstones and shales*’. Small amounts of alluvium are also depicted at the Site, while no quaternary deposits are mapped in pockets on the north of the Site, where bedrock is indicated to outcrop. Where present, subsoils are classified as of low permeability.

The 2006 ARUP Geotechnical Desk Study Report noted a meltwater channel crossing the south of the access road and skirting the south-western Site boundary.

The land use has not changed from agricultural and there has been no significant changes to the Site that would have resulted in a change to the geology of the Site.

5.5.5 Bedrock Geology

According to the GSI database, the bedrock underlying the wider 2 km study area is described as mudstone, siltstone and sandstone of the Shannon Group, 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 Halcrow 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 10 m from the cliff edge.

Major faulting is not recorded on GSI mapping but local faulting is referenced in a site investigation report for the Site, which is reviewed in **Section 5.5.14**, along with a more detailed interpretation of the bedrock geology.

5.5.6 GSI Verified Boreholes, Groundwater Wells and Springs

There are no verified borehole records available on the GSI map viewer for the Proposed Development or surrounding 2 km study area.

Information on groundwater wells and springs is provided in **Chapter 06** (Water).

5.5.7 Land Cover Mapping

EPA Corine 2018 landcover mapping describes the landcover in the 2 km study area around the Proposed Development as 'agricultural areas' described as 'pastures', with an area of 'forest and semi-natural areas' described as 'coniferous forest' immediately easy of the Site.

An area of 'Wetlands' described as 'coastal wetlands' is located 1.3 km west of the Proposed Development. An area of forest and semi-natural areas described as 'scrub and / or herbaceous vegetation associations' is located 1.4 km west of the Proposed Development, immediately to the south of the 'coastal wetlands'.

5.5.8 Geological Heritage Areas

There are no Geological Heritage Sites (Audited or Unaudited) recorded by GSI within 2 km of the Site.

5.5.9 Geotechnical Site Records

There are no Geotechnical Site Records recorded by GSI within 2km of the Site.

5.5.10 Geological Hazards

There are no Landslide Events recorded within the 2 km study area around the Site on the GSI online Landslide Susceptibility Mapping (2007-2016).

The Landslide Susceptibility Classification assigned by GSI to the Site and immediately surrounding lands is generally 'Low', but with a small area mapped as 'Moderately Low' and 'Moderate' in the north of the Proposed Development within the redline boundary. These areas coincide with areas identified as having 'bedrock at surface'.

The 2006 Arup Desktop Study notes that "*Ireland as a whole and the west of Ireland in particular are areas of very low seismic hazard"* and "*The soil and rock materials occurring on the Shannon LNG site would generally be considered stable under the prevailing low-seismicity conditions. However, it would be prudent to avoid founding structures directly on alluvium or recent marine deposits as these may contain loose sand and silt layers with the potential to liquefy".*

A study[7] of the seismic hazard potential carried out in 2007 was reviewed as part of the 2010 ARUP geotechnical report[8]. The geotechnical assessment concluded that; *In general, typical structures built*

[7] Weston Geophysical Engineers (2007). P*robabilisitc Seismic Hazard Analysis for the Tarbert / Ballylongford, LNG Project "Shannon LNG Project".*
[8] ARUP (2010). *Shannon LNG Terminal On Shore Ground Investigation Interpretive Report Issue 2 dated January 2010*.

to comply with the existing design and construction codes will be capable of dealing with all reasonably expected seismic activity in Ireland.

5.5.11 Radon

The EPA national radon map was updated in May 2022. Prior to May 2022, the Site was considered to be entirely in a 'Low' radon area (*i.e.,* less than one per cent of the homes in this 10 km grid square were estimated to be above the Reference Level).

Prior to May 2022 radon levels were based on the predicted number of homes in a given grid square that exceed the national Reference Level. The updated maps, released in May 2022 are based on an analysis by the EPA of indoor radon measurements and geological information including, bedrock type, quaternary geology, soil permeability and aquifer type[9].

According to the updated EPA's online Radon Map, the Site is now primarily located in an area where about 10% 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 'Moderate' across the majority of the Proposed Development.

However, a small area to the in the north-western corner of the red line boundary is in an area where about 20% of homes are estimated to be above the reference level of 200 becquerels per cubic metre (Bq/m^3). Radon potential risk in this area of the Proposed Development is considered 'High'.

A radon test is legally required for ground floor and basement workplaces located in a high radon area[10].

The area where a radon test is legally required currently intersects with a HRSG exhaust stack and Turbine Hall, refer to **Chapter 02** (Description of the Proposed Development).

Radon protection measures such as radon testing, as required by S.I. Regulation 66 of S.I. No. 30 of 2019 and the installation of radon barriers, will be required for the Proposed Development.

5.5.12 Hydrogeology, Hydrology and Groundwater Resources

GSI mapping indicates that in the wider 2 km area, 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' (GSI terminology). As the bedrock is not limestone, karst occurrence is not of concern at the Proposed Development.

A more detailed assessment of the Site's hydrogeology is provided in **Chapter 06** (Water).

5.5.13 Mineral and Aggregate Potential

The north-eastern part of the Site is mapped as having *High* to *Very High* crushed rock aggregate potential.

Where present, subsoils are assessed by GSI as having no aggregate potential, other than areas of alluvium along the Ralappane Stream (to the west of the redline planning application boundary) mapped as having *Low* or *Very Low* granular aggregate potential.

[9] Available at: https://gis.epa.ie/EPAMaps/Radon?&lid=EPA:RadonRiskMapofIreland
[10] Regulation 66 of S.I. No. 30 of 2019

Four historic quarries are mapped within 2 km of the Proposed Development. Two are located on the east side of Ardmore Point, 350-400 m east of the Site. The remaining two historic quarries are mapped at Coolnanoonagh, 1.45 km south-east of the Proposed Development.

5.5.14 Site Investigation

A site investigation (ARUP, 2007) was undertaken in 2006 and 2007 and is considered relevant to contribute to baseline assessment data. It is noted that the site has remained in agricultural use since these investigations were undertaken. There was no evidence of likely contamination reported following the 2020 site walkover and groundwater sampling by AECOM staff. There have not been any significant activities such as major construction works, major excavation works or the creation of a quarry post-2007, therefore the soil and geology data collected as part of these investigations are considered to be representative of current geological conditions.

The onshore investigation is included as **Appendix A5.1**, Volume 4, and comprised:

- Twenty-six (26 No.) rotary core holes.
- Thirty-three (33 No.) trial pits.
- Six (6 No.) geo-logging holes, to determine the condition and orientation of bedrock discontinuities.
- Scan lines along the coastal section.
- One (1 No.) pump test.
- 2-D Resistivity, Electromagnetic and Seismic Refraction Geophysical Survey.

The geotechnical testing was undertaken in relation to a separate planning application on the Site but the report and data provides useful information with regards to the geological properties of the Site.

The geology encountered during site investigation can be summarised as follows in **Table 5.7**.

Table 5.7: 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-	Small pocket	0.2 m - 2.0 m	Laminated sands and silts	The laminated silts were recorded by

Stratum	Extent	Thickness	Description	Properties
Glacial Deposits	on western boundary (recorded in trial pits TP09, TP10 and TP13.		and gravels with rounded to subangular cobbles and boulders, considered to be fluvioglacial in origin.	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 the 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, while sandstone and siltstone were dominant on the eastern Site section.	Total depth not proven.	Sandstone, siltstone and mudstone. Rotary corehole logs recorded argillaceous (clay) bands in the mudstone and interbedded in the siltstone-sandstone 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).	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 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 (2007) 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 (ARUP 2007) concluded that the soils and geology encountered were favourable for the construction and loading of built development indicating that infrastructure could be founded on the bedrock and that all excavated material would be suitable for re-use as general or structural fill.

It was recommended in the report (ARUP 2007) that at construction phase earthworks be undertaken in drier summer months, in view of the sensitivity of the overburden subsoils 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 additional investigation at the detailed design stage would be beneficial in order to address any potential data gaps.

5.5.15 Designated Sites

The Shannon Estuary to the north is designated as a Special Area of Conservation (SAC Lower River Shannon, Code 002165) and a Special Protection Area (SPA River Shannon and River Fergus Estuaries, code 002165). The outfall pipe (see **Section 5.6.2.2**) will extend into the SAC and SPA.

The SAC and SPA extends inland to the east and west of the Proposed Development outside of the red line boundary.

A proposed Natural Heritage Area (pNHA), Ballylongford Bay (code 001332) is located approximately 150 m to the west of the Site.

A foreshore licence was obtained for a proposed storm water outfall pipe in December 2010[11], which has not been constructed to date.

There are no other SAC, SPA, NHA or pHNA within 2 km of the Site.

The effects of the Proposed Development on SAC, SPA, NHA and pNHA are discussed in **Chapters 07A** (Marine Ecology) and **07B** (Terrestrial Ecology). The Water Framework Directive (WFD) designated features are discussed in **Chapter 06** (Water) of this EIAR.

5.5.16 Historic Land Use

The historical land use of the Proposed Development has been determined by examining the historical mapping for the area available on the OSI map viewer (GeoHive) and on Google Earth aerial photography.

A review of publicly available mapping suggests the Site and the surrounding area have historically been in predominantly agricultural use.

This review of historical mapping and aerial photography for the Site and surrounding study area does not indicate any historical potentially-contaminative land uses in the vicinity, other than the operation of a small vehicle machine shop approximately 250 m south of the Site.

5.5.17 Waste Sites

There is no active or former waste licenced facility with 2 km of the Site.

[11] FS006228 Construction of a seawater intake / outfall and FS006224 Drainage outfall.

The National Waste Collection Permit Office (NWCPO) website was reviewed to identify authorised waste facilities within the jurisdiction of Kerry County Council near the Site. The NWCPO website indicated that there are no waste facilities within a 2 km radius of the Site.

5.5.18 Permitted Sites

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 2 km of the Site.

5.5.19 Pollution Incidents

There were no recorded pollution incidents reported on-site. No evidence of contamination was reported in the 2007 ARUP site investigation.

AECOM completed one round of groundwater sampling in February 2020. The analytical results indicated that petroleum-range hydrocarbons are detected in excess of selected generic assessment criteria in wells BH05, BH19 and BH20 in the north of the Site and in well BR-11 in the west of the Site. No evidence of fuel hydrocarbon use or storage was observed on the Site during the sampling event, therefore it was concluded that 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 may be derived from breakdown and decay of organic material in vegetated, waterlogged areas of the Site and surroundings.

More information on the results of the groundwater and surface water sampling event is discussed in **Chapter 06** (Water). The AECOM groundwater report is attached as **Appendix A6.2**, Volume 4.

5.5.20 Identified Receptors

The principal land, soils and geological resource receptors which have the potential to be impacted upon by the Proposed Development during construction, operation, and decommissioning include:

- **Topography:** the Proposed Development will alter local topography through development of the 18 m OD platform. A cut and fill approach will be taken and the topography is considered to be of **Low** sensitivity.
- **Use of Natural Resources**: all excavated material will be reused on-site and no import of soil is required. However, approximately 26,000 tonnes of aggregate will be sourced from local quarries to facilitate construction of access roads.
- **Agriculture land soil resources**: the Proposed Development is located on current agricultural lands which are typical of the area. The Site consists of agricultural land in agricultural setting. Land use of this nature is abundant within the local area and is therefore **Low** sensitivity.
- **Designated sites**: a SAC (Lower River Shannon SAC) and a SPA (River Shannon and River Fergus estuaries SPA) and are located immediately to the north of the Proposed Development. The outfall pipe will extend into the SAC and SPA. In addition, a pNHA (Ballylongford Bay pNHA) is located to the west of the Proposed Development. Disturbance of the seabed below the low water mark will be small, arising primarily from the excavation of the

trench for the outfall and clearing and levelling of the ground to install the outfall pipe. This is discussed further in **Chapters 07A** (Marine Ecology) and **07B** (Terrestrial Ecology).

The land, soils and geology receptors which could be affected by contamination which is either created or affected by construction, operation and / or decommissioning of the Proposed Development are:

- **Geology**: The Proposed Development will impact on a **Low** sensitivity soil environment.
- **Surface water** and **groundwate**r risks and receptors are discussed in **Chapter 06** (Water).
- **Human Health:** The land uses close to the Site are agricultural, therefore risks with the associated human health considered to be of **Low** sensitivity.
- **Human Health**: Construction workers represent additional **High** sensitivity human receptors during the construction phase only.
- **Human Health**: Road users and agricultural workers by their very nature are transient and are therefore considered to be **Low** sensitivity.
- **Human Health**: Off-site residential users are considered to be of **Low** sensitivity with regards to effects of the Proposed Development on land, soils and geology. The effects of the proposed development on the following related topics are discussed in other chapters:
    - Effects on potable wells and hydrogeology (**Chapter 06** (Water)).
    - Dust generation (**Chapter 08** (Air Quality)).
    - Noise and Vibration during construction (**Chapter 09** (Airborne Noise and Groundborne Vibration)).
    - Changes in topography (**Chapter 10** (Landscape and Visual)).
    - Traffic during the importation of aggregate (**Chapter 11** (Traffic and Transport)).

Table 5.8 indicates the identified potentially-sensitive receptors to land soils and geology aspects of the construction, operational and decommissioning phases.

Table 5.8: Sensitive Receptors

Receptor Type	Key Receptors	Sensitivity	Potential to be Impacted	
			Construction* Phase	Operational Phase
Agricultural soil resources	Agricultural soils present at the Proposed Development.	Low	✓	x
Topography	Topography.	Low	✓	x
Human Health	Agricultural users, off site residential users and road users.	Low	✓	✓
	Construction workers.	High	✓	x

**Also applicable to Decommissioning Phase*

5.5.21 Conceptual Site Model (CSM)

A Conceptual Site Model (CSM) defines the plausible contaminant source, pathway, and receptor linkages, which are integral to identifying potential impacts of the Proposed Development. The CSM presents details of potential sources of contamination, potential receptors and potential contaminant

migration pathways that have been identified for the Proposed Development. **Table 5.9** lists the potential contaminant linkages and associated risks identified for the Proposed Development.

Table 5.9: Potential Sources-Pathways-Receptors of Contamination Associated with the Proposed Development

Potential Source	Description	Pathway	Description	Potentially Exposed Receptors
Existing soil contamination	No indication of soil contamination was identified during the Site walkover or during previous site investigations, however soil data is limited. Land use was historically agricultural, therefore significant soil contamination is unlikely, but cannot be completely discounted.	Dermal contact.	Direct contact with contaminated ground soils, soil-derived dust, soil leachate and perched water in the subsoil.	Construction Workers Agricultural and Future site users
		Inhalation.	Inhalation of made ground derived dust, organic vapours or ground generated gas.	Construction workers Agricultural and Future site users Off-site residential land users
		Leaching and infiltration into water environment.	Rainfall infiltration can generate and mobilise made ground soil leachate into groundwater within underlying aquifers.	Surface watercourses Groundwater Known / unknown water supplies
Existing groundwater contamination	Groundwater sampling of 9 on-site wells in February 2020. Petroleum hydrocarbons were detected in 4 wells above GAC with the nearest potential source of fuel hydrocarbons being either domestic / agricultural use to the south (upgradient) of the site or a vehicle maintenance facility to the south of the Site (also upgradient).	Abstraction via potable water wells – if developed on site.	Consumption of potentially impacted groundwater.	Construction workers
		Lateral migration via bedrock fractures.	Contamination of bedrock aquifers and surface water receptors.	Surface water Groundwater Unknown water supplies
Off-site sources	Pollution incidents at off-site sources could result in contamination reaching soil and / or groundwater in direct contact with the Proposed Development, infrastructure or services.	Introduction of new sources of contamination to subsurface.	Pollution incidents at off-site sources could result in contamination reaching soil and groundwater in direct contact with the Proposed Development infrastructure or services.	Construction workers Future site users Surface water Groundwater Unknown water supplies
On-site sources – Construction and Decommissioning	Construction activities with the potential to contaminate soils and groundwater on the Proposed Development.		Pollution incidents on-site during construction could result in contamination reaching soil and groundwater in direct contact with the Proposed Development infrastructure or services.	
On-site sources - Operation	Loses of stored materials with the potential to contaminate soils and groundwater on the Proposed Development including diesel.		Pollution incidents on-site during construction could result in contamination reaching soil and groundwater beneath the Proposed Development.	Future site users Surface water Groundwater Unknown water supplies

5.5.22 Summary of Baseline Conditions

A summary of baseline conditions at the Site is presented in **Table 5.10**.

Table 5.10: Summary of Baseline Conditions

Item	Description
Context	The Site is currently largely undeveloped grassland, which covers an area of approximately 41 ha. 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 Site. The 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 (outfall pipe) 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 land 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 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 2 km of the Site.
Significance	The Site consists of agricultural land in an 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 Site is not in a Geological Heritage Area and no active quarries or mineral locations are mapped within 2 km. The Site has not been designated as a pNHA. The offshore Proposed Development (outfall pipe) extends into the Shannon Estuary to the north, which is a SAC and SPA. The SAC extends inland immediately to the west of the Site. The geological significance of the site is therefore considered to be **Low**.
Sensitivity	Ground conditions beneath the onshore and offshore portions of the Site generally consist of topsoil overlaying glacial 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 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 Site from M ’Moderate’ to X ‘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 Description of the Proposed Development

The Proposed Development is outlined in **Chapter 02** (Description of the Proposed Development), and comprises the following key elements:

- Three (3 No.) 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.
- A 120 MWh (1-hr) Battery Energy Storage System (BESS).
- High voltage 220 kV GIS Substation.
- Auxiliary Boiler.
- Raw water treatment and storage.
- Firewater storage tanks and fire water pumps.
- Ancillary buildings.
- Secondary Fuel Storage Tanks - two (2 No.) storage tanks (~5,000 m^3 each) and three-day tanks (~2,000 m^3 each) within a bunded area.
- Wastewater outfall pipe, extending offshore to 5 m below low tide level.
- Above Ground Installation (AGI) connection to the Gas Transmission Network.

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 relates solely to the outfall pipe, extending offshore to 5 m below low tide level is situated in the Shannon Estuary coastal marine environment.

5.6.2 Construction Activities

The construction programme of the Proposed Development is expected to take approximately 32 months, subject to seasonal and other planning constraints. The civil works of relevance to land, soils 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

Approximately 26,000 tonnes of imported aggregate will be delivered from local quarries along the L1010 road from the Tarbert direction, to facilitate the formation of access roads during construction.

The overburden will be, in places, quite thin and to create the level platforms for the entire Power Plant facility, approximately 475,000 m^3 of overburden soils and rock will be excavated and placed as fill.

The overburden will be, in places, quite thin and to create the level platforms for the facilities it is expected that limited blasting will be required, to excavate some of the rock which may not be possible to remove by rock breaking equipment mounted on tracked excavators. Any blasting will be carried out in a controlled manner in accordance with a pre-approved plan, and in a controlled manner to manage noise and ground vibration. This is done by designing a blast pattern with a small charge in many holes drilled into 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 one blast is 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).

All excavated material will be used onsite and no import of soil is expected. Excess rock and soil material is anticipated to be used in the laydown area.

Excavated material will be temporarily stockpiled on the Site for re-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 and excavation.

5.6.2.2 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 Site.

It will consist of a 900 mm diameter concrete drainage pipe laid in a trench across the foreshore and extending approximately 5 m beyond the low water mark at a water depth of approximately 2.4 m. Refer to **Figure F2.5**, Volume 3 for an overview of the proposed drainage at the Site.

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 to a maximum depth of approximately 2.4 m 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 development works and it is proposed to backfill the excavated trench 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. 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 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.

5.6.2.3 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 will be used as fill in other site areas.

5.6.2.4 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 the operational phase, the Proposed Development will comply with the requirements of the EU (Large Combustion Plants) Regulations 2012, S.I. No. 566 of 2012, under an IE licence. The emissions which have the potential to impact to air, soil, surface water and groundwater and human health, will be mitigated against and avoided where possible.

An IE Licence is required for operation of the Proposed Development in accordance with Activity 2.1 of the First Schedule of the EPA Act as amended '*Combustion of fuels in installations with a total rated thermal input of 50 MW or more*'.

The IE licence will be in place prior to commencement of operations and will be the result of an application process to the EPA, including an EIA process. Sampling and analysis of pollutants will be carried out where required including monitoring of exhaust emissions levels using Continuous Emission Monitoring Systems (CEMS) prior to discharge from the stacks, in accordance with the IE licence.

During operation, the fuel supply to the Proposed Development will normally be from the gas grid through the AGI.

To comply with Commission for Regulation of Utilities (CRU) requirements, low sulphur gas oil will be required as a backup fuel in the event of interruption to natural gas supply, *i.e.*, the loss of a flow from the transmission pipeline during a period of high electricity demand or disruption to the UK Gas Interconnector pipelines.

The storage or use of hazardous materials during the operational phase of the Proposed Development will be limited to:

- Distillate oil (Low Sulphur Gas Oil): Secondary fuel supply contained in two (2 No.) storage tanks (~5,000 m^3 each) and three-day tanks (~2,000 m^3 each).
- Diesel: Firewater pumps, black start generator and emergency generators will be powered by diesel.
- 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.

Natural gas itself is not considered to be a potential source of contamination to soils, because it's extremely low vaporisation temperature (approximately -160°C) means 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.

Access to the Site will be located off the existing L1010 road (Coast Road) to the south of the Site.

5.7 Embedded Mitigation Measures

Embedded control measures are set out in **Chapter 02** (Description of the Proposed Development) Sections 2.7 to 2.9.

5.7.1 Embedded Construction and Commissioning Mitigation Measures

Construction works will be undertaken in accordance with the following environmental management technical guidance documents:

- CIRIA (2001). *Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors (C532).*
- CIRIA (2006). *Control of water pollution from linear construction projects. Technical guidance (C648).*
- CIRIA (2023). *Environmental Good Practice on site pocketbook (C811).*
- EPA (2021). *Best Practice Guidelines for The Preparation of Resource Management Plans for Construction & Demolition Projects.*

Key control measures relating to Land and Soil during the construction phase are outlined in the Construction Environmental Management Plan (CEMP), refer to **Appendix A2.3**, Volume 4.

In addition:

- A resource and waste management plan (RWMP) will be developed for the Site.
- A construction management team will be onsite for the duration of the construction.
- Construction materials will be sourced locally from authorised quarries.
- Temporary surface water drainage (including dewatering measures) and silt ponds will be constructed to control runoff from the earthworks stage.

5.7.2 Embedded Operation Mitigation Measures

Key control measures during the operational phase relating to Land and Soil are:

- Routing of road runoff from the approach road north-ward to the Proposed Development, rather than to natural drainage leading west to the Ralappane Stream.
- Separation of sealed road drainage from other forms of stormwater drainage.
- Provision of an attenuation system, including a Class 1 interceptor fitted with control valves.
- Provision of a firewater impoundment basin.
- Provision of tertiary containment and 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 land, soils and geology 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 to **Chapter 16** (Waste Management).

5.8.1 Do Nothing Scenario

In the absence of the Proposed Development, land soils and geology will remain in their current state and there will be no change.

5.8.2 Construction Phase

The scoping process has identified that the introduction of the Proposed Development would potentially result in different types and durations of impact on soils and geological receptors, during the construction phase. Likely predicted impacts are described below.

During the construction phase, the following predicted impacts on soils and geological receptors are likely to occur, without the proposed mitigation:

- Changes to topography – excavation and infilling.
- Use of natural resources.
- Accidental spills and leaks.
- Use of concrete and lime.
- Removal of agricultural land.
- Impacts of construction on geological hazards.
- Impacts of soil and geology on the Proposed Development.

Impact resulting from construction activities in relation to risk of groundwater flooding or recharge as a result of any below ground excavations and on fluvial and overland flow paths as a result of works associated with the construction of the Proposed Development are assessed under **Chapter 06** (Water).

5.8.2.1 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 Site, it will be necessary to cut into the bedrock, through mechanisms such as rock breaking and blasting. Filling, where possible using site-won materials, will be required on the north of the 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 5.11**.

Table 5.11: Estimated Material Volumes

Material	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*
Note: Importation of 26,000 tonnes of fill material will be sourced from local quarries

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 Site.

The visual impact of the Proposed Development is considered in **Chapter 10** (Landscape and Visual).

Excavation and infilling will result in a **Moderate** impact of **Permanent** duration and **Neutral** quality on an environment of **Low** sensitivity and the significance of the impact is **Slight**.

5.8.2.2 Use of Natural Resources

All excavated material will be reused onsite and no import of soil is expected. However, approximately 26,000 tonnes of aggregate will be sourced from local quarries to facilitate construction of access roads. These will be delivered along the L1010 road 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:

Table 5.12: Nearby Quarries

Quarry Name	Quarry Address	Distance & Direction from the Proposed Development
Ardfert Quarry Products	Ardfert, Co. Kerry	38 km south-west of the Proposed Development.
O'Mahoney Quarries	Tralee, Co. Kerry	39 km south-west of the Proposed Development.
Roadstone, Foynes	Foynes, Co. Limerick	31 km east of the Proposed Development.
Liam Lynch	Adare, Co. Limerick	52 km east of the Proposed Development.

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 38 million tonnes of aggregates annually (ICF, 2019), of which the Proposed Development's required 26,000 tonnes represent just 0.07%. Use of natural resources will result in a **Small** impact of **Permanent** duration and **Neutral** quality on an environment of **Low** sensitivity and the significance of the impact is **Imperceptible**.

5.8.2.3 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.
- Spillage of oil or fuel from refuelling machinery on Site.

Accidental spills or leaks can potentially result in the impact of soils underlying the Site and, if it occurs, will be confined to one-off releases. An accidental spill or leak will be considered a **Small Adverse** impact of **Temporary** duration and **Negative** quality on an environment of **Low** sensitivity and the significance of the impact is **Imperceptible**.

The potential for accidental spills and leaks to impact on the hydrological and hydrogeological environment is considered in **Chapter 06** (Water), **Chapter 14** (Major Accidents and Disasters) and the Major Accidents to the Environment (MATTE) section of the Quantitative Risk Assessment (QRA)

submitted to the Health and Safety Authority as part of this application, refer to **Appendix A2.4,** Volume 4.

5.8.2.4 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 use of concrete and lime will result in a **Small Adverse** impact of **Temporary** duration and **Negative** quality on an environment of **Low** sensitivity and the significance of the impact is **Imperceptible** 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.

5.8.2.5 Impacts of Construction on Geological Hazards

The Landslide Susceptibility Classification assigned by GSI to the Proposed Development and immediately surrounding lands is generally ‘Low’, but with a small area mapped as ‘Moderately Low’ and ‘Moderate’ in the north of the Proposed Development within the redline boundary. These areas coincide with areas identified as ‘bedrock at surface’.

The creation of the platform will include the removal of potentially unstable shallow overburden and weathered rock at the surface reducing the likelihood of landslides.

The creating of the platform and removal of potentially unstable material would have a **Moderate Beneficial** impact of **Permanent** duration and **Positive** quality on an environment of **Low** sensitivity and the significance of the impact is **Slight**.

5.8.2.6 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 Site where the superficial soils comprise predominantly glacial till. Two types of glacial till have been identified on the 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.

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 **Minor Beneficial** impact of **Permanent** duration and **Neutral** to **Positive** quality on an environment of **Low** sensitivity and the significance of the impact is **Imperceptible.**

Bedrock

The bedrock beneath the Site has not been identified as of particular importance. The 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 planning application for a separate power related development in recent years. 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 Beneficial** impact of **Permanent** duration and **Positive** quality on an environment of **Low** sensitivity and the significance of the impact is **Slight**.

5.8.3 Operational Phase

5.8.3.1 Accidental Spills and Leaks

The Proposed Development includes two (2 No.) storage tanks (~5,000 m^3 each) and three-day tanks (~2,000 m^3 each) containing low sulphur gas oil (distillate oil) as a secondary fuel source. These tanks will be bunded in accordance with IE Licence Requirements and the EPA Guidance Document *Storage and Transfer of Materials for Scheduled Activities*. Specially, these tanks will be in a tertiary containment system. Additional smaller diesel fuel tanks for the fire water pumps and generators will also be stored within bunded areas. The diesel fuel unloading bay will be designed to contain spillages and storage tanks will be fitted with level indicators and oil detection sensors with alarms will be fitted in bunds.

Roadways, parking areas, the laydown area and process areas will drain to an attenuation system and will pass through a Class 1 hydrocarbon interceptor before entering the firewater retention pond. Rainwater from roofs, unpaved non process areas of the site will drain to a series of swales and catch bases and be conveyed directly to the firewater retention pond.

The outlet from the firewater retention pond will close automatically in the event of the activation of the fire alarm. In addition, there will be a shut off valve from the generator yard to the external surface water drainage network providing tertiary containment. 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 a **Moderate Adverse** impact of **Short-Term** duration and **Negative** quality on an environment of **Low** sensitivity and the significance of the impact is **Slight**.

5.8.3.2 Removal of Land from Agricultural Use

The removal of 41 ha of land from agricultural or other potential beneficial uses can result in a **Permanent** effect on existing land use in the area.

The removal of agricultural land can be considered to have a **Small Adverse** impact of **Permanent** duration and **Negative** quality on an environment of **Low** sensitivity and the significance of the impact is **Imperceptible**. Additional information on impacts on land use and properties can be found in **Chapter 17** (Material Assets).

5.8.4 Decommissioning Phase

As outlined in **Chapter 02** (Description of the Proposed Development), 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 Proposed Development. Examples of the measures that will be implemented are outlined in **Chapter 02** (Description of the Proposed Development).

Prior to any decommissioning, the IE licence will require a Decommissioning Plan (including a Decommissioning Environmental Management Plan) be produced and agreed with the EPA as a routine part of the Site closure and licence surrender process. An environmental Baseline Assessment report at time of commencement of operations will be referred to and updated to determine if any contamination has occurred and what, if any, rehabilitation is required prior to IE licence surrender.

The predicted impacts on land, soils and geological receptors likely to occur during the decommissioning phase are anticipated to be similar to those likely to occur during the construction phase, with the exception of the impacts relating to unidentified contamination. The likely predicted impacts are as follows without the proposed mitigation:

- Temporary impacts of soil structure due to soil stripping, smearing and compaction.
- Temporary impacts on soil chemistry as a result of spillages of oils, fuels, or other construction chemicals, or through the mobilisation of potential contamination following ground disturbance.
- Temporary impacts on surface and groundwater quality through the migration of introduced contaminants as a result of spillages.

Impact type, receptor sensitivity and unmitigated effects will be as for the Construction Phase outlined in **Section 5.6.2**.

The Gas AGI will be managed as part of the national gas networks. At the end of its design life, it is expected that the gas connection may have residual life remaining and the operational life may be extended if appropriate and / or the asset refurbished and retained as part of the national transmission network.

5.9 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 **Chapter 06**

(Water). **Chapter 16** (Waste Management) is also deemed an interaction in some of these considerations.

5.9.1 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.
- 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, outfall, road and culvert construction.
- Use of natural resources: Sources of fill and aggregates for the Proposed Development.

5.9.1.1 Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) has been prepared for the Proposed Development which incorporates relevant environmental avoidance or mitigation measures to reduce potential environmental impact. The CEMP 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. A Resource Waste Management Plan (RWMP) and Surface Water Management Plan will be prepared 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.

5.9.1.2 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 and in accordance with industry best practise, further detailed site investigation will be undertaken to provide design parameters for the Proposed Development.

5.9.1.3 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 CEMP 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 CEMP 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 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 Site.
- Segregate different grades of soil where they arise and topsoil will first be stripped from any land to be used for storing subsoil.
- 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 CEMP 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.
- Manage groundwater and surface water flows through drainage channels.

5.9.1.4 Bedrock Excavation

Where bedrock is to be removed as part of the cut / fill exercise on the Site, it is anticipated that rock breaking and blasting will be required to achieve the 18 m OD formation level. Mitigation measures

relating to the associated noise impacts are set out in **Chapter 09** (Airborne Noise and Groundborne Vibration). Groundwater seepages from bedrock cut faces will be managed by surface water drainage swales installed close to the toe of the cut faces, as set out in **Chapter 06** (Water).

5.9.1.5 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.
- 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.

5.9.1.6 Control of Concrete and Lime

In order to prevent impact from the use of concrete products, it will be necessary to adopt mitigation measures during the construction phase, which include:

- 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.
- The Construction Manager, the Environmental Manager and appropriate engineer will supervise all concrete pours.
- 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 the CEMP. All such water will be tested for pH by contractors, and discharging water must go through a series of filtration systems before final discharge.

- 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.

5.9.1.7 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.
- 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).

5.9.1.8 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.

5.9.2 Operational Phase

5.9.2.1 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 and in accordance with EPA *Guidance Note on Storage and Transfer of Materials for Scheduled Activities.*

With regard to the secondary fuel source and 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.

The secondary fuel will be received via road tanker at an unloading station adjacent to the storage tank area and transferred to the storage tanks via a set of unloading pumps.

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 and 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 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.

5.9.2.2 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.

5.10 Residual Impacts and Effects

5.10.1 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 impacts 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.

5.10.2 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 impacts during the operational phase is therefore considered to be **Moderate Adverse** to **Negligible** on an environment of **Low** sensitivity, therefore the significance of the potential effect of the Proposed Development is considered to be **Slight** to **Imperceptible** on the surrounding land and geological environment.

5.11 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 Site is presented in **Appendix A1.2**, Volume 4.

Applications in relation to smaller planning applications predominantly for extensions or alterations to existing dwellings are not considered to be relevant to the cumulative assessment within this EIAR, given their small scale. Therefore, only projects of sufficient size and scale that may potentially act in-combination with the Proposed Development and are assessed herein.

Most of the projects listed in **Appendix A1.2** Volume 4 are sufficiently distant and of a nature and scale that there are no pathways for these to act in-combination with the Proposed Development in relation to impacts to Land, Soils or Geology.

Significant developments which are relatively close to the Proposed Development, *i.e.*, within c. 2 km of the Site are addressed overleaf.

5.11.1 Summary of Schemes Considered in Cumulative Impact Assessment

5.11.1.1 SLNG Strategic Gas Reserve Facility

The location of the Proposed Development is the subject of a SID pre-application for a Proposed Shannon Technology and Energy Park (STEP) Strategic Gas Reserve Facility (APB-319245-24) comprising of a floating storage and regasification unit (FSRU), jetty and access trestle, onshore receiving facilities, and all ancillary works.

A pre-application was submitted to An Bord Pleanála (ABP) on 8th March 2024, and a request for a pre-application consultation meeting is pending from the Board. The Proposed STEP Strategic Gas Reserve Facility (APB-319245-24) will include onshore facilities, jetty and FSRU which will extend into the Shannon Estuary at the north-east corner of the Site.

It is important to note the Power Plant (the Proposed Development) is not functionally dependent on the Strategic Gas Reserve Facility. The Strategic Gas Reserve Facility, Data Centre Campus, the High Voltage 220 kV and the Medium Voltage (10 / 20 kV) cables (discussed below) have been considered as part of the cumulative impact assessment within this chapter.

5.11.1.2 SLNG Gas Pipeline

Planning permission exists for the development of a 26 km Natural Gas Pipeline which will facilitate connection from the Site to the GNI transmission network at Leahy's, located to the west of Foynes, Co. Limerick. The application was accompanied by an Environmental Impact Statement (EIS).

No significant residual effects were identified to geology and soils in the EIS for the Natural Gas Pipeline. A revised assessment and an updated EIAR of the permitted pipeline will be included within the required future application to CRU for consent under Section 39A of the Gas Act 1976 (as amended).

5.11.1.3 Data Centre Campus

The Masterplan for the Shannon Technology and Energy Park (STEP) will integrate the Proposed Development and a (future) Data Centre Campus, **Figure F1.1**, Volume 3. Note – The potential future Data Centre Campus is not included in this application and will therefore be subject to a separate planning application.

It is important to note the Proposed Development)is not functionally dependent on the Data Centre. The Strategic Gas Reserve Facility, Data Centre Campus, the High Voltage 220 kV and the Medium Voltage (10 / 20 kV) cables have been considered as part of the cumulative impact assessment within this chapter.

5.11.1.4 High Voltage 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.

Shannon LNG executed a 600 MW 220 kV grid connection agreement with EirGrid for the Proposed Development Power Plant on 14th April 2023. The exact route cannot be confirmed until the detailed design is completed and approved by Eirgrid and other stakeholders. This process is currently underway. The development of the grid connection will be subject to a separate planning application and associated EIAR by the Applicant once the precise connection details are known. This sequencing is standard and the connection details will be confirmed at a later date. The current

proposal is that the connection point will be the ESBN / EirGrid Kilpaddoge 220 kV substation which is located approximately 5 km east of the Site with connection provided via a 220 kV cable(s) under the L1010 road.

If the 220 kV grid connection is not available medium voltage (10 / 20 kV) grid connection will be used 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.

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.

Further details on the proposed 220 kV and medium voltage power transmission networks can be found in **Section 2.3.12.1** of **Chapter 02** (Description of the Proposed Development).

5.11.2 Construction Impacts

The proposed development and nearby consented projects are located in an environment of **Low** sensitivity. It is noted that:

- The SLNG Natural Gas Pipeline was subject to an EIS. **No Significant** impacts, in relation to Land, Soils and Geology, were identified.
- The potential future STEP Strategic Gas Reserve Facility will be constructed on the platform created as part of this Proposed Development, therefore additional significant impacts that will act in combination with the Proposed Development to Land, Soils and Geology are not expected.
- The Proposed Development and nearby consented projects will not result in the loss of a geological attribute.
- The potential future data centre is likely to result in changes topography and the removal of agricultural land in an area of **Low** environmental sensitivity.
- The construction of the SLNG Natural Gas Pipeline and electricity transmission lines will result in the **Temporary** removal of agricultural lands of **Low** sensitivity during construction.
- As outlined in **Section 5.9.1** above, mitigation measures proposed to manage and control potential impacts during the Proposed Development will reduce the potential magnitude and significance of effects from the Proposed Development.
- The potential future Data Centre Campus, and potential future STEP Strategic Gas Reserve Facility will be subject to their own EIAR and planning permission submissions. Similar construction mitigation measures, including the preparation of a CEMP, will be required for these developments.

The magnitude of the cumulative impact of the Proposed Development and the other schemes considered as defined by the IGI Guidance document (see **Table 5.3**) will result in **Small Adverse** or **Moderate Adverse** impacts on a **Low** sensitivity environment; therefore, the significance of the effects has been assessed as **Imperceptible** or **Slight**.

5.11.3 Operational Impacts

The proposed development and nearby consented projects are located in an environment of **Low** sensitivity. It is noted that:

- **No significant** impacts, in relation to Land, Soils and Geology were identified by the SLNG Natural Gas Pipeline EIS.
- **No significant** operational impacts, in relation to Land, Soils and Geology are likely from the proposed Electricity Transmission development.
- The Proposed Development and nearby consented projects will not result in the loss of a geological attribute during the operational phase.
- As outlined in **Section 5.9.2** above, mitigation measures proposed to manage and control potential impacts during the Proposed Development will reduce the potential magnitude and significance of effects from the Proposed Development.
- The potential future Data Centre Campus, and potential future STEP Strategic Gas Reserve Facility will be subject to its own EIAR and planning permission. Similar operational mitigation measures including the preparation of an Environmental Management Plan (EMP) will be required for these developments.

The magnitude of the cumulative impact of the Proposed Development and the other schemes considered as defined by the IGI Guidance document (see **Table 5.3**) will result in **Small Adverse** or **Moderate Adverse** impacts on a **Low** sensitivity environment; therefore, the significance of the effects has been assessed as **Imperceptible** or **Slight**.

5.12 Summary

The Site covers an area of approximately 41 ha and comprises grassland on the southern shore of the Shannon Estuary, with an outfall pipe extending into the marine environment. Onshore and offshore geological / geotechnical site investigations were undertaken at relevant locations on the Site in 2006 and 2007. No subsequent development has taken place on the Site therefore the findings of these intrusive geological investigations are considered to still be relevant.

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 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 Development 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 (springs/boreholes) across the Site.

Groundwater vulnerability varies across the Site from 'Moderate' to 'Rock at or near Surface or Karst' (GSI terminology[12]) and depth to rock onshore varies from 0.75 m in the east of the 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 north-west to south-east, 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 as moderately strong, crushable and suitable for use as aggregate and engineered fill onsite.

Seismic and tsunami potential risks are considered **Low**. Radon risks are considered **High** in the north-east of the Proposed Development and Moderate elsewhere on the Site. Therefore, workplace radon testing and radon protection measures will be required.

Soils and geology encountered at the Site are considered favourable for the construction of Proposed Development, 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 land and geology within the redline boundary is considered to be of low sensitivity with respect to existing soils and geology.

Construction stage spill and leaks, including the use of concrete and lime products and fuels, will be managed in accordance with the CEMP are expected to result in a **Small Adverse** impact 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, rock breaking and material stockpiles on the Site in terms of rock slope stability and silt runoff. The removal of land from agricultural or other potential beneficial uses is considered a **Permanent** effect. Temporary storage of soil and crushed rock will be stored in low sensitivity areas distant from features such as the shoreline, drainage systems, retained drainage channels or areas subject to flooding and will be carefully managed in accordance with the CEMP to prevent potential negative effect on the receiving environment.

Operational Phase risks to soils and geology will arise principally from storage of diesel fuel (low sulphur gas oil) and as a diesel fuel tanks for the fire water pumps and generators. All fuel oils 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 will also interact with waste management and water aspects of the development, see **Chapter 06** (Water), **Chapter 16** (Waste Management) and **Chapter 18** (Interactions).

A CEMP 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.

[12] Note As the bedrock is not limestone, karst occurrence is not of concern at the Proposed Development.

- 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.
- Any fill material brought on to the 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, maintenance oils and cleaning chemicals.
- An Environmental Management Plan will be prepared for the operational phase.

Cumulative impacts arising from the related SLNG Natural Gas Pipeline, Data Centre Campus, SLNG Strategic Gas Reserve Facility and medium voltage (10 / 20 kV) / 220 kV power supply developments envisaged under the STEP Masterplan 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 **Imperceptible** to **Slight**.

Should the Proposed Development not take place, the land, 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, soils and geological environment is considered to be **Imperceptible** at the construction and decommissioning stage and **Imperceptible** to **Slight** at the operational phase.

Table 5.13: Summary

Proposed Development Phase	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 CEMP)	Residual Effect Significance
Construction	Changes to Topography – Excavation and Infilling	Low	Excavation and reuse of 480,000 m^3 of soil and rock. Permanent, irreversible, moderate effect of neutral quality.	Neutral - Slight	All surplus material will be processed (screened / crushed) and reused onsite and there is no intention to import soil material to the 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 CEMP will outline proposals for the excavation and management of excavated material.	Neutral - Slight
Construction	Use of Natural Resources	Low	Excavation and reuse of 480,000m^3 of soil and rock. 26,000 tonnes of aggregate will be sourced from local quarries to facilitate construction of access roads. Permanent, irreversible, small effect, of neutral quality.	Neutral - Imperceptible	All excavated material will be reused onsite. Approximately 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.	Neutral - Imperceptible
Construction	Accidental Spills and Leaks Spillage or leakage of stored oils and fuels. Spillage or leakage of oils and fuels from construction	Low	Negative impact on soils underlying the Site. Temporary, negative small adverse effect.	Negative - Imperceptible	Spillages are unlikely to occur and, if they occur, will be confined to one-off releases. Hazardous materials will be controlled via the CEMP 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	Negative - Imperceptible

Proposed Development Phase	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 CEMP)	Residual Effect Significance
	machinery or site vehicles. Spillage of oil or fuel from refuelling machinery on site.				appropriate facilities. 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. Small adverse effect of negative nature and temporary duration.	Negative - Imperceptible	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 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.	Negative - Imperceptible
Construction	Impact on Soil / Geology including Geological Hazards	Low	Permanent, moderate beneficial effect on the removal of potentially unstable shallow soils Permanent, small beneficial effect provided by the opportunity to study and document regional glacial geology deposits and records which can be added to national records	Positive - Imperceptible to slight	The Site will be constructed on a platform which will allow for the removal of potentially unstable elements. A geotechnical investigation will be completed prior to detailed design. 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. Un-weathered 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.	Positive - Imperceptible to slight
Operational	Accidental Spills and Leaks	Low	Spills during fuelling at diesel fuel tanks for the fire water pumps and generators can in theory discharge to ground.	Negative - Slight	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	Negative - Slight

Proposed Development Phase	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 CEMP)	Residual Effect Significance
			Negative small adverse effect of temporary duration (given that they will be confined to one off releases). Worst case losses from secondary fuel sources could involve significant volumes of diesel lost to the environment resulting in a moderate adverse, short-term effect on lands and soils		cleaning chemicals. Diesel and low sulphur gas oil will be stored within tertiary containment and bunded areas. Unexpected losses from secondary containment 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.	
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 removal of land from agricultural or other potential beneficial uses is considered to have a permanent, small adverse negative effect.	Negative - Imperceptible	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.	Negative - Imperceptible

5.13 References

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