Chapter 17

Land, Soils, Geology and Hydrogeology

Contents

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17. Land, Soils, Geology and Hydrogeology

17.1 Introduction

This chapter of the EIAR has considered the potential land, soils, geology and hydrogeology impacts associated with the Construction, Operational and Decommissioning Phases of the N25 Little Island Pedestrian and Cyclist Bridge (hereafter referred to as the Proposed Development).

Chapter 4, *Description of the Proposed Development* includes a full description of the Proposed Development while **Chapter 5**, *Construction Strategy* describes the proposed construction strategy for the Proposed Development.

During the Construction Phase, the potential land, soils, geology and hydrogeology impacts associated with the Proposed Development have been assessed. This includes the potential for the contamination of soils and groundwater, and the loss of natural soils from excavation activities associated with utility diversions, road resurfacing and road realignments.

During the Operational Phase, the potential land, soils, geology and hydrogeology impacts associated with changes to water supply and the pollution of groundwater and watercourses have been assessed.

During the Decommissioning Phase, the potential land, soils, geology and hydrogeology impacts associated with accidental leakage of oil, petrol or diesel have been assessed.

Potential impacts in the surface water environment are not considered in this assessment but are considered separately in **Chapter 16**, *Water*.

The assessment has been carried out according to best practice and guidelines relating to land, soils, geology and hydrogeology assessment, and in the context of similar scale infrastructural projects.

An assessment is made of the likely significant impacts associated with the Construction, Operational and Decommissioning Phases of the Proposed Development on these resources. Measures are presented to mitigate or eliminate the impacts of the Proposed Development on the soils, subsoils, bedrock, geological resources and geological heritage and hydrogeology.

17.2 Study Area

The land, soils, geology and hydrogeology study area for the Proposed Development extends to a radius of 2km from the planning (red line) boundary of the Proposed Development (refer to **Figure 17.1** in **Volume 3** of this EIAR) which is in line with the Guidelines for the Preparation of Soil, Geology and Hydrogeology Chapters of Environmental Impacts Statements (IGI, 2013) and the Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA, 2008).

The study area stretches from the Dunkettle Interchange in the west to Glounthaune Village in the east and Cork Harbour to the south. The Cork Midleton railway line and the N25 carriageway crosscut the Proposed Development in an approximately west-east direction.

17.3 Assessment Methodology

The following sections outline the legislation and guidelines considered, and the adopted methodology for defining the baseline environment and undertaking the assessment in terms of land, soils, geology and hydrogeology.

The potential impacts of the Proposed Development on land, soils, geology and hydrogeology have been assessed by classifying the importance of the relevant attributes and quantifying the likely magnitude of any impact on these attributes.

17.3.1 Relevant guidelines, policy and legislation

The main documents that have been followed for the preparation of the land, soils, geology and hydrogeology assessment are:

- European Communities (Water Policy) Regulations 2014 (S.I. No. 350 of 2014);
- European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9 of 2010), as amended by the European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2011 (S.I. No. 389 of 2011), the European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2012 (S.I. No. 149 of 2012) and the European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016 (S.I. No. 366 of 2016);
- European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272 of 2009) as amended by the European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2012 (S.I. No. 327 of 2012);
- European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2015 (SI No. 386 of 2015);
- European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003) as amended by the European Communities (Water Policy) (Amendment) Regulations, 2005 (S.I. No. 413 of 2005);
- European Communities (Water Policy) (Amendment) Regulations, 2008 (S.I. No. 219 of 2008);
- European Communities (Water Policy) (Amendment) Regulations, 2010 (S.I. No. 93 of 2010);
- European Communities (Drinking Water) Regulations 2014 (S.I. No 122 of 2014), as amended by the European Union (Drinking Water) (Amendment) Regulations 2017 (S.I. No. 464 of 2017);
- European Communities (Quality of Salmonid Waters) Regulations 1988 (SI no. 293 of 1988);
- European Union (Water Policy) (Abstractions Registration) Regulations 2018 (SI no. 261 of 2018) ;
- National Roads Authority (NRA 2008). Environmental Impact Assessment of National Road Schemes – A Practical Guide;
- Directive 2000/60/EC Water Framework Directive (WFD);
- Directive 2006/118/EC Groundwater Directive;
- Water Services Acts (2007 – 2017);
- CL:AIRE (2010a). Soil Generic Assessment Criteria for Human Health Risk Assessment;
- CL:AIRE / SuRF (2010b). A Framework for Assessing the Sustainability of Soil and Groundwater Remediation;
- CL:AIRE (2017). Petroleum Hydrocarbons in Groundwater: Guidance on assessing petroleum hydrocarbons using existing hydrogeological risk assessment methodologies;
- Environmental Protection Agency (EPA) (2008). A Framework for the Assessment of Groundwater-Dependent Terrestrial Ecosystems under the Water Framework Directive. EPA Strive Programme 2007-2013;
- EPA (2011a). Evaluating the Influence of Groundwater Pressures on Groundwater-Dependent Wetlands. EPA Strive Programme 2007-2013;
- EPA (2011b). Guidance on the Authorisation of Discharges to Groundwater;
- EPA (2013). Guidance on the Management of Contaminated Land and Groundwater at EPA Licenced Sites;
- EPA (2022). Guidelines on the Information to be contained in Environmental Impact Assessment Reports (EPA Guidelines);

- European Union Floods Directive, 2007/60/EC;
- European Communities (Assessment and Management of Flood Risks) Regulations 2010 (S.I. No. 122/2010); and
- Regulation 15 of S.I. No. 323/2020 – European Union (Waste Directive) Regulations 2020.

17.3.2 Data collection and collation

Data was compiled from publicly available datasets, the findings of ground investigations, design information, a scheme walkover survey and other sources, as outlined below.

17.3.2.1 Publicly available datasets

The publicly available datasets listed in **Table 17.1** have been acquired and consulted in the assessment of the baseline conditions. All datasets were accessed in April 2023.

Table 17.1: Publicly available datasets

Source	Name	Description
Ordnance Survey Ireland Geohive (OSI)	Current and historical ordnance survey maps	Current and historical survey maps produced by the OSI
	Aerial photography	Current and historical survey maps produced by the OSI
Google	Aerial photography	Current aerial imagery produced by Google
	Topography	Topography from transects in Google Earth.
Bing	Aerial photography	Current aerial imagery produced by Bing
Teagasc	Teagasc Soils Data	Surface soils classification and description
Geological Survey Ireland (GSI)	Quaternary Mapping	Geological maps of the site area produced by the GSI and available on GSI online map viewer
	Teagasc Classification	
	Bedrock Mapping	
	Aggregate Potential Mapping	
	Mineral Localities	
	Geotechnical Sites	
	Bedrock Aquifer Mapping	
	Groundwater Vulnerability	
	Groundwater Recharge	
	Groundwater Resources	
	Groundwater Flooding	
	National Landslide Database	
	Karst Database	
	Groundwater wells and springs	
	Historic Mine Sites - Inventory and Risk Classification	

Source	Name	Description
	Active Quarries and pits	
	County Geological Sites and Geological Heritage Areas	
	GSI, Memoirs	
	Historic Mine Sites - Inventory and Risk classification	
	LiDAR Digital Terrain Model (DTM)	
Environmental Protection Agency (EPA)	Corine Land Cover 2018	These datasets are based on interpretation of satellite imagery and national in-situ vector data
	Historic Mine Sites - Inventory and Risk classification	
	River Network Map	
	EPA Licence & Permit Databases	Information on any EPA IE/IPC licences and Permits in the area
	EPA HydroNet	Reports of groundwater level monitoring points
	Waste Boundaries	Boundaries of all waste facilities within Ireland that are or will be licensed by the EPA
	Radon Risk Map	This map shows the level of Radon across Ireland. High Radon Areas are shown in red.
National Parks and Wildlife Service	Designated Natural Heritage Areas (NHA), Special Protection Areas (SPA), Special Areas of Conservation (SAC) Sites	This dataset provides information on national parks, protected sites and nature reserves
National Monuments Service (2018) (Archaeological Survey of Ireland)	Archaeological Monuments	This dataset provides all recorded archaeological monuments
Department of Communications, Energy and Natural Resources	State Mining and Prospecting Facilities	A booklet contains a list of all current and prospecting mining facilities
	Historic Mine Sites - Inventory and Risk Classification	Inventory of Irelands Historic Mine Sites with investigations and potential risk posed by these sites

17.3.2.2 Scheme walkover

A scheme walkover survey was carried out on 17th February 2022 to inform and verify the review of publicly available datasets and the findings made during the initial stage of ground investigations in December 2022.

The findings of the scheme walkover survey including photos and scheme walkover survey notes are included in **Appendix 17.1** in **Volume 4** of this EIAR.

17.3.2.3 Ground Investigation

A project-specific intrusive ground investigation was carried out during 2022 and 2023. The factual records received are contained in **Appendix 17.2** in **Volume 4** of this EIAR and discussed further in the assessment of the site-specific conditions in Section 17.4.3.

Two previous ground investigations conducted within the study area adjacent to the site were also used in the assessment of the baseline conditions. These previous reports are presented in **Table 17.2** and the relevant data included in **Appendix 17.3** in **Volume 4** of this EIAR. One of these reports (SIL, 1976) is publicly

available from the 'EXT GSI Geotechnical Sites layer' of the GSI Spatial Resources Map Viewer (GSI, 2019a).

Table 17.2 Existing ground investigations

GSI Report ID	Title	Year	Author	Location	Relevant scope
1530	Gas pipeline route from Powerhead Bay to Cork, Aghada and Marino Point	1976	Site Investigations Ltd.	Co. Cork	2 cable percussion boreholes
n/a	Dunkettle Advance ITS Works Ground Investigation – Factual Report.	2020	Priority Geotechnical Ltd.	Co. Cork	1 cable percussion borehole 1 rotary core borehole 3 slit trenches

17.3.3 Technical limitations

The land and soils baseline data included in this assessment comprises information available in the region and consolidated in the desk study. This review was completed by studying local geological maps, aerial photography, historic ground investigation and completing site walkovers to provide an understanding of the study area. By examining the previous information collected and understanding the geology and geomorphology of the site a ground model was constructed. This ground model was assessed and confirmed through the project specific ground investigation.

Based on the information collected in the desk study and site walkover, dedicated field surveys were commissioned for the Proposed Development. The locations and the spacing of the exploratory locations used as part of the intrusive investigation were chosen to gain an understanding of the land and soils within the study area. Between each point the baseline data from the intrusive investigation has been assessed by conservative interpretation. The findings from the investigations for most cases compared favourably with the desk study of existing information on the baseline conditions.

Based on the comparability of the results from the investigations commissioned for the Proposed Development and baseline conditions from the desk study, the information on the baseline conditions is sufficient to complete the assessment.

17.3.4 Appraisal method for the assessment of impacts

The likely significant impacts have been assessed by classifying the importance of the relevant attributes and quantifying the magnitude of any likely significant impacts on these attributes. This has been undertaken in accordance with the NRA (NRA, 2008a) and IGI Guidelines (IGI, 2013) as outlined in the following sections.

17.3.4.1 Baseline – initial assessment

In order to identify and quantify the likely significant impacts of the Construction Phase and Operational Phase of the Proposed Development, it is first necessary to undertake a detailed study of the (baseline) geological and hydrogeological environment of the study area for the Proposed Development.

The existing land, soils, geology and hydrogeology conditions in the study area have been interpreted from review of existing data, consultation, scheme walkover surveys and from Proposed Development specific ground investigations.

This assessment includes the development of a preliminary Conceptual Site Model (CSM), which describes the ground conditions expected throughout the study area of the Proposed Development based on existing literature. Also, as part of this initial assessment, the preliminary generic type of geological / hydrogeological environment is determined.

The IGI Guidelines (IGI, 2013) provide five types of environments as examples (Types A to E), as described in Step 3 of the IGI Guidelines. These assist the assessor by establishing the sensitivity of the environment and level of investigation required.

17.3.4.2 Baseline - direct and indirect site investigation

Information gathered on the baseline environment during specific ground investigations for the Proposed Development corresponds to the second element of the methodology; 'Direct and Indirect Site Investigation and Studies'.

As part of the second element, relevant site investigations and studies close to the Proposed Development are gathered and assessed. Then, the preliminary CSM is refined accordingly.

17.3.4.3 Gradation of impacts

The NRA Guidelines (NRA, 2008a) provide criteria and examples for determining likely significant impacts. The relevant tables from the NRA Guidelines (NRA, 2008a) are as follows:

- Box 4.1: Criteria for Rating Site Attributes – Estimation of Importance of Soil and Geology Attributes (refer to **Table 17.3**);
- Box 4.3: Criteria for Rating Site Attributes – Estimation of the Importance of Hydrogeology Attributes (refer to **Table 17.4**);

The magnitude of impacts should be defined in accordance with the criteria provided in the NRA Guidelines (refer to **Table 17.5**):

- Box 5.1: Criteria for Rating Site Attributes at Environmental Impact Assessment (EIA) Stage – Estimation of Magnitude of Impact on Soil / Geology Attribute (refer to **Table 17.6**);
- Box 5.3: Criteria for Rating Site Attributes at EIA Stage – Estimation of Magnitude of Impact on Hydrogeology Attributes (refer to **Table 17.7**); and
- Box 5.4: Rating of Significant Environmental Impacts at EIA Stage (refer to **Table 17.8**).

The NRA Guidelines criteria use similar significance terminology as the EPA Guidelines (EPA, 2022). However, it has intermediate steps to justify using that terminology:

- Step 1: Quantify the importance of a feature for geology (Box 4.1) and hydrogeology (Box 4.3);
- Step 2: Estimate the magnitude of the impact on the feature from the Proposed Development (Box 5.1, Box 5.3); and
- Step 3: Determine the significance of the impact on the feature from the matrix (Box 5.4) based on the importance of the feature and the magnitude of the impact.

Table 17.3: Criteria for rating the importance of identified geological features (Table C2 (IGI, 2013) and Box 4.1 (NRA, 2008a)).

Importance	Criteria	Typical example
Very High	Attribute has a high quality, significance or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and / or soft organic soil underlying route is significant on a national or regional scale.	Geological feature rare on a regional or national scale (NHA) Large existing quarry or pit Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and / or soft organic soil underlying route is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site) Well drained and / or highly fertility soils Moderately sized existing quarry or pit Marginally economic extractable mineral resource

Importance	Criteria	Typical example
Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and / or soft organic soil underlying route is moderate on a local scale.	Contaminated soil on site with previous light industrial usage Small recent landfill site for mixed wastes Moderately drained and / or moderate fertility soils Small existing quarry or pit Sub-economic extractable mineral resource
Low	Attribute has a low quality, significance or value on a local scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and / or soft organic soil underlying route is small on a local scale*.	Large historical and / or recent site for construction and demolition wastes Small historical and / or recent landfill site for construction and demolition wastes Poorly drained and / or low fertility soils. Uneconomically extractable mineral resource

Table 17.4: Criteria for rating the importance of identified hydrogeological features (Box 4.3 (NRA, 2008a))

Importance	Criteria	Typical example
Extremely High	Attribute has a high quality or value on an international scale	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g., cSAC or SPA status
Very High	Attribute has a high quality or value on a regional or national scale	Regionally important aquifer with multiple well fields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source
High	Attribute has a high quality or value on a local scale	Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers Locally important potable water source supplying >1000 homes Outer source protection area for regionally important water source Inner source protection area for locally important water source
Medium	Attribute has a medium quality or value on a local scale	Locally Important Aquifer Potable water source supplying >50 homes Outer source protection area for locally important water source
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer Potable water source supplying <50 homes
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

Table 17.5: Definition of magnitude of impact (Table 5.1 (NRA, 2008a))

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

Table 17.6: Criteria for rating soil and geology impact significance and magnitude at EIA stage (Table C4 (IGI, 2013) and Box 5.1 (NRA, 2008a))

Magnitude of Impact	Criteria	Typical example
Large Adverse	Results in loss of attribute	Loss of high proportion of future quarry or pit reserves Irreversible loss of high proportion of local high fertility soils Removal of entirety of geological heritage feature Requirement to excavate / remediate entire waste site Requirement to excavate and replace high proportion of peat, organic soils and / or soft mineral soils beneath alignment
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Loss of moderate proportion of future quarry or pit reserves Removal of part of geological heritage feature Irreversible loss of moderate proportion of local high fertility soils Requirement to excavate / remediate significant proportion of waste site Requirement to excavate and replace moderate proportion of peat, organic soils and / or soft mineral soils beneath alignment

Magnitude of Impact	Criteria	Typical example
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 / remediate small proportion of waste site Requirement to excavate and replace small proportion of peat, organic soils and / or soft mineral soils beneath alignment
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	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

Table 17.7: Criteria for rating hydrogeological impact significance and magnitude at EIA stage (Box 5.1 (NRA, 2008a))

Magnitude of Impact	Criteria	Typical example
Large Adverse	Results in loss of attribute and / or quality and integrity of attribute	Removal of large proportion of aquifer Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems Potential high risk of pollution to groundwater from routine run-off Calculated risk of serious pollution incident during operation >2% annually
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Removal of moderate proportion of aquifer Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems Potential medium risk of pollution to groundwater from routine run-off Calculated risk of serious pollution incident during operation >1% annually
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Removal of small proportion of aquifer Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems Potential low risk of pollution to groundwater from routine run-off Calculated risk of serious pollution incident during operation >0.5% annually
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Calculated risk of serious pollution incident during operation <0.5% annually

Table 17.8: Rating of environmental impacts at EIA stage (NRA, 2008a)

		Magnitude of Impact			
		Negligible	**Small**	**Moderate**	**Large**
Importance of Attribute	**Extremely High**	Imperceptible	Significant	Profound	Profound
	Very High	Imperceptible	Significant / Moderate	Profound / Significant	Profound
	High	Imperceptible	Moderate / Slight	Significant / Moderate	Severe / Significant
	Medium	Imperceptible	Slight	Moderate	Significant
	Low	Imperceptible	Imperceptible	Slight	Slight / Moderate

17.3.4.4 Mitigation measures, residual impacts and final impact assessment

The third element of the recommended steps builds on the outcome of the preceding two elements, by identifying mitigation measures to address potential significant or profound impacts and then assessing the significance of any residual impacts. Embedded design measures which have been incorporated into the design for the Proposed Development are also considered in this Section 17.5.

The final impact assessment includes a description of any residual impacts. The significance of any residual impact is determined based on the same methodology and reported.

17.4 Baseline Environment

17.4.1 Introduction

This section describes the existing conditions and important features in terms of the land, soils, geology and hydrogeology associated with the Proposed Development.

A regional overview (Section 17.4.2) is followed by a description of the site-specific environment (refer to Section 17.4.3). Features are then identified, and their importance ranked in accordance with the NRA and IGI Guidelines, in Section 17.4.3.17.

17.4.2 Regional overview

This section discusses the regional conditions within the study area, that is defined as a 2km radius from the Proposed Development, as described in Section 17.2. The regional geomorphology, topography, soils and subsoils, bedrock geology and hydrogeology are discussed in this section. A list of regional figures used in this assessment is included in **Table 17.9**, with the figures presented in **Volume 3** of this EIAR.

Table 17.9: List of figures from the regional characterisation

Figure	Title
Figure 17.1	Land, Soils, Geology and Hydrogeology Study Area
Figure 17.2	Regional Land Use
Figure 17.3	Regional Topography and Geomorphology
Figure 17.4	Regional Soils (Teagasc Classification)
Figure 17.5	Regional Subsoils (Quaternary Sediments)
Figure 17.6	Regional Bedrock Geology (1:100k)

Figure	Title
Figure 17.7	Regional Crushed Rock Aggregate Potential
Figure 17.8	Regional Aggregate Resources
Figure 17.9	Regional Bedrock Aquifers and Abstractions
Figure 17.10	Regional Gravel Aquifers
Figure 17.11	Regional Groundwater Bodies
Figure 17.12	Regional Groundwater Vulnerability
Figure 17.13	Regional Groundwater Recharge
Figure 17.14	Regional NPWS Designated Sites

17.4.2.1 Regional land use, topography and geomorphology

The study area is centred on the N25 dual carriageway and the Cork to Midleton railway immediately west of Little Island train station, Little Island, Co. Cork, approximately 10km east of Cork City. According to the EPA Corine 2018 dataset, as shown on **Figure 17.2** in **Volume 3** of this EIAR, the study area is characterised by mixed land use classes, including large areas of artificial surfaces in the south and west, and agricultural land in the north and east. The study area is subdivided by the N25 itself and the parallel railway line, with the area to the North of the N25 predominantly agricultural and greenfield with increasing residential and mixed uses in Glounthaune to the east. The southern half of the study area is dominated by mixed use developments in Little Island. There are 12 no. EPA licensed facilities (refer to **Figure 17.2** in **Volume 3** of this EIAR) within the study area, indicating industrial land use throughout. Therefore, there are likely to be sources of contamination within the made ground throughout the study area.

The EPA 20m contour mapping, as shown in **Figure 17.3** in **Volume 3** of this EIAR, indicates a variable topography within the study area. The highest elevation of 130m is to the north of the study and then slopes down to approximately 10mOD in Little Island, to the south of the Proposed Development.

The river network of the study area is influenced by the underlying geology, resulting in a primarily east-west trending river network, with north-south trending rivers, such as the Glashaboy River, making use of north-south trending bedrock faults. The main surface drainage system directly connected to the Proposed Development is the Kilcoolishal Stream. The Kilcoolishal Stream drains the wetland area (close to the Proposed Development site) to the north of the N25 before discharging to Cork Harbour. The stream is completely culverted south of the N25 within Eastgate Business Park car park. **Chapter 16**, *Water* includes a full description of hydrological regime.

The GSI Quaternary Geomorphology mapping (refer to **Figure 17.3** in **Volume 3** of this EIAR), demonstrates that there are widespread glaciofluvial terrace deposits within the study area, mostly noticeably in Little Island to the south of the Proposed Development. The glaciofluvial terrace is associated with the 'Lee River system'. The study site is intersected by the Lee Buried Valley trending east-west (Long and Roberts, 2008).

17.4.2.2 Regional soils

The Teagasc national indicative soil map classifies the soils of Ireland into simplified categories. Soil information is categorised from the Irish Forest Soils (IFS) project, which indicates the predominant soil type for each area, and the drainage characteristics of the soil. The Teagasc soil database is available on the GSI public data viewer and can be seen on **Figure 17.4** in Volume 3 of this EIAR. The main soils within the study area are listed in **Table 17.10**. The Irish Soil Information System (SIS) classification related to soil property data in the study area is presented in **Table 17.11**.

The majority of the Proposed Development is underlain by alluvium (mineral). The observed alluvium continues to both the west and east of the Proposed Development roughly paralleling and surrounding the N25 carriageway and railway line and appears to follow the outline of the reclaimed historic river to the

southwest. However, the majority of these soils have been altered by reclamation of land and the construction of the railway, local roads and N25 dual carriageway. Immediately to the north and south there are deep well drained minerals (mainly acidic) with pockets of shallow well drained minerals (mainly acidic), rock outcrops and made ground to the north. The south of the study area is dominated by the made ground associated with the urban development of Little Island. The east of the study area is dominated by deep well drained mineral (basic) with pockets of shallow well drained mineral (basic) on the east of Little Island and made ground in Glounthaune Village.

Table 17.10: Soils within the study area (Teagasc classification)

Soil type	Notes / description	Location
Made Ground - Made	Associated with urban development	Widespread under the Proposed Development
Alluvium – (Mineral)	Typically found along current and historic watercourses	Widespread under the Proposed Development
Deep or shallow well drained mineral (mainly acidic or basic)	Typically found in agricultural areas at higher elevations.	Little Island and hill / ridge north of the Proposed Development

Table 17.11: Summary of soil types within the study area (SIS national soil)

Classification	Description	Location
Marine alluvium	Marine alluvium	Through the centre and west of the study area along the valley base
Clonroche	Fine loamy drift with siliceous stones	Northern side of the study area
Clashmore	Coarse loamy drift with siliceous stones	South and east of the study area where not replaced with urban.
Tidal Marsh	Mineral alluvium	To the east in the mudflats
Urban	Urban	Glounthaune Village and Little Island

17.4.2.3 Regional subsoils

The subsoil comprises the unconsolidated geological deposits which overlie the solid geology. These subsoils, as classified by the GSI Quaternary mapping, are presented in **Figure 17.5** in **Volume 3** of this EIAR.

The majority of the north of the study area is underlain by Glacial Till derived from Devonian Sandstones. Large areas of the southern study site are classified as urban. The southeast of the study area is underlain by Glacial Till derived from limestones. The centre of the study area, including the Proposed Development, is characterised by more recent alluvial deposits, and Gravels derived from Devonian sandstone. The list of subsoil types as classified by the GSI Quaternary mapping are listed in **Table 17.12**.

Subsoil depths in the study area can be highly variable within short distances due to the underlying bedrock levels which were extensive eroded during Quaternary glaciation that resulted in a large east-west trending valley (Long and Roberts, 2008). This valley is located within the centre of the study area. Areas with minimal subsoil deposits with bedrock outcrop at or near the surface are indicated in the northern portion of the study area. The subsoil thickness in areas of deeper subsoil, such as in the centre of the study area, can only be determined from ground investigations.

Table 17.12: Subsoils within the study area

Subsoil type	Description	Location
Made Ground - Urban	Associated with urban development	Widespread to the south of Little Island
Estuarine silts and clays	In tidal areas	To the east of the Proposed Development
Alluvium – (Mineral)	Typically found along current and historic watercourses	Widespread under the Proposed Development running in an east-west direction
Gravels GDS	Gravels derived from Devonian sandstones	Immediately to the south and north of the Proposed Development
Glacial till -TDs	Till derived from Devonian sandstones	Hill immediately north of Proposed Development and small area of Little Island
Glacial till -TLs	Till derived from Limestone	East of Little Island

17.4.2.4 Regional bedrock

The regional bedrock geology derived from the GSI 1:100K bedrock mapping (refer to **Figure 17.6** in **Volume 3** of this EIAR) indicate that the study area is underlain by several geological formations of the Upper Devonian and Lower Carboniferous. The study area is traversed by the east-west trending geological fold known as the Cork Syncline that dominates the geology at a regional scale. The Cork Syncline comprises Carboniferous Limestone and Lower Limestone Shales which were brought down in a deep infold between older Devonian Old Red Sandstone (ORS) rocks of the corresponding fold known as the Central Anticline. The syncline is about 3km wide in the study area (Lampugh *et al*., 1905).

There are frequent occurrences of rock close to the surface within the study area, as displayed in **Figure 17.6** in **Volume 3** of this EIAR. However, the depth to rock beneath the Proposed Development is expected to be in excess of 20mBGL (Davis, *et al*., 2006). A summary of the geological formations within the study area is shown in **Table 17.13**.

Table 17.13: Summary of the bedrock geology within the study area

Geological period	Formation	Rock type	Approximate thickness (m)	Description	Stage	Location
Carboniferous	Cuskinny Member (KNcu)	Sandstone	200-235m	Flaser-bedded sandstone & mudstone. Sand dominant	Courceyan	North and east of the Carrigada Fault. Occurs in the north of the study area
	Ballysteen (BA)	Limestone	100-200m	Dark muddy limestone, shale	Courceyan	Poorly exposed in South Cork. Occurs in the north and south of the study area
	Waulsortian Limestone (WA)	Limestone	Typically, 300-500m. >1200m in the Shannon Estuary area	Massive, unbedded lime-mudstone	Tournaisian – lower Visean	It is the centre of the Cork Syncline and underlying the whole Proposed Development site and most of the study area
	Cork Red Marble Formation (CK)	Limestone	80m	Red brecciated calcilutite limestone	Chadian	It is found in the Cork Syncline separating the Waulsortian Limestones from the Little Island Formation. Occurs in the south of the study area

Geological period	Formation	Rock type	Approximate thickness (m)	Description	Stage	Location
	Little Island formation (LI)	Limestone	500m	Massive and crinoidal fine limestone	Chadian – Asbian	The formation occurs to the south of the study area and extends from the west end of the Cork Syncline to Youghal.
	Clashavodig Formation (CV)	Limestone	180m	Oolitic, peloidal, cherty, fine limestone	Asbian	The formation is only known from the Cork Syncline between Little Island and Midleton.
Devonian	Ballytrasna (BS)	Mudstone	360-1500m	Dusky red to purple mudstone & siltstones with subordinate fine-grained pale-red sandstone	Famennian	South Cork on either side of the Cork Syncline, and as far west as Awboy River Fault. Occurs in both the south and north of the study area
	Gyleen (GY)	Siltstone	<460m	Sandstone with mudstone and siltstone	Strunian	Along the edges of the Cork Syncline in the north of the study area

17.4.2.5 Regional mineral / aggregate resources

The following datasets were consulted in order to assess the impact of the Proposed Development on the economic geology of the study area:

- GSI: aggregate potential mapping (GSI, 2016b);
- GSI: mineral localities (GSI, 2014);
- GSI active quarries (GSI, 2019); and
- GSI APM pits and quarries (GSI, 2016c).

The crushed rock aggregate potential (refer to **Figure 17.7** in **Volume 3** of this EIAR) throughout the majority of the study area is considered to be of very high potential. However, this drops to high potential beneath the Proposed Development. Considering the depth to rock expected and the urban nature of the Proposed Development, crushed rock aggregate potential is not considered further. The granular aggregate potential (refer to **Figure 17.8** in **Volume 3** of this EIAR) within the study area is centred on the location of the Proposed Development due to the presence of the glaciofluvial gravel terraces. The potential ranges from low to very high but due to the urban nature of the Proposed Development, granular aggregate potential is not considered further in this assessment.

There is one non-metallic mineral locality in the south of the study area (refer to **Figure 17.8** in **Volume 3** of this EIAR), as presented in **Table 17.14**.

Table 17.14: Mineral / aggregate resources within the study area

Mineral type	Description	Location
Limestone (in general)	Several quarries where Cork Red Marble was produced. Most quarries are located in industrial estate with no potential for further development.	Southern portion of the study area in Little Island.

17.4.2.6 Regional geological heritage

The GSI maintains a register of geological / geomorphological sites in need of protection through Natural Heritage Area (NHA) designation and are classified as Geological Heritage sites. There are two unaudited County Geological Sites (CGS) located within the study area, as shown in **Figure 17.8** in **Volume 3** of this EIAR and summarised in **Table 17.15**. Due to the nature and distance of the geological heritage sties from the Proposed Development, the GSI Geological Heritage Sites is not considered further in this assessment.

Table 17.15: GSI Geological Heritage Sites within the study area

Geological Heritage Site	Description	Location	Distance from Project Area
Rock Farm Quarry, Little Island	A series of limestone quarries which display three distinctive zones of the Visean (Lower Carboniferous)	Little Island. Southern portion of the study area	Approximately 1.5km to the south of the Proposed Development
Little Island	Little Island provides the type section for the Cork Red Marble Formation.	Little Island. Southern portion of the study area	Approximately 1.8km to the south of the Proposed Development

17.4.2.7 Regional aquifer type and classification

The GSI system for classifying the aquifers in Ireland is based on the hydrogeological characteristics, size, and productivity of the groundwater resource. There are three principal types of aquifers, corresponding to whether they are major, minor, or unproductive resources, whereby:

- Regionally Important Aquifers are capable of supplying regionally important abstractions (e.g., large public water supplies), or excellent yields (>400 m^3/d);
- Locally Important Aquifers are capable of supplying locally important abstractions (e.g., smaller public water supplies, group schemes), or good yields (100–400 m^3/d); and
- Poor Aquifers are capable of supplying small abstractions (e.g., domestic supplies), or moderate to low yields (<100 m^3/d).

The aquifers present within the regional study area are presented in **Figure 17.9** and **Figure 17.10** in **Volume 3** of this EIAR and summarised in **Table 17.16**.

Table 17.16: GSI Aquifers within the study area

Aquifer Type	Description	Code	Location
Regionally Important Aquifer	Karstified (diffuse)	(Rkd)	Southern portion of the study area. Area is underlain by Carboniferous calcareous geological formations of the Cork Syncline.
Locally Important Aquifer	Bedrock which is Moderately Productive only in Local Zones	(Ll)	Northern portion of the study area.
Locally Important Gravel Aquifer	Highly permeable gravel aquifer with a continuous area of between 1-10km^2 and may supply excellent yield but is limited due to the extends of the gravel	(Lg)	Central part of study area mostly overlying the locally important bedrock aquifer.

Groundwater bodies (GWBs) are delineated and described by the GSI (GSI, 2004) as Water Framework Directive (WFD) groundwater management units to manage and protect groundwater and linked surface waters. There are three GWBs present within the study area, which are listed in **Table 17.17** and shown in **Figure 17.11** in **Volume 3** of this EIAR.

The Ballinhassig East GWB extends across the uplands of the Lee catchment and its tributaries comprising predominantly of Devonian Old Red Sandstones and Dinantian Mudstones & Sandstones (Cork Group). Groundwater flow is concentrated in the upper 15m of the bedrock, where permeability is higher, although deeper groundwater flows can be encountered at depth associated with faults and major fractures. Fractures, joints and faults provide the main pathways for groundwater to flow through the aquifer. Fracturing is confined to local zones and the connectivity between fractures can be limited. Therefore, flow paths are expected to be relatively short (30-300m) and groundwater typically discharges to springs or streams which traverse the aquifer. Groundwater is generally unconfined and follows the surface topography.

GSI groundwater body descriptions are not available for the Industrial Facility (P0016-02) or Little Island GWBs.

The WFD status for the Ballinhassig East groundwater body is 'good' and is currently 'At Risk' regarding the maintenance of that status. The WFD status for both the Industrial Facility (P0016-02) and the Little Island GWBs is 'Good' and currently 'Not at Risk' regarding the risk of not maintaining that status. The water quality status and risk for these water features is summarised in **Table 17.17**.

Table 17.17: EPA WFD Groundwater Body status and risk

Water feature	European code	WFD risk	WFS status (2016–2021)	Location
Ballinhassig East	IE_SW_G_004	At risk	Good	Northern portion of the study area
Industrial Facility (P0016-02)	IE_SW_G_089	Not at risk	Good	Southern portion of the study area
Little Island	IE_SW_G_090	Not at risk	Good	South-eastern portion of the study area

17.4.2.8 Regional aquifer vulnerability

Aquifer vulnerability of a groundwater body is a term used to describe the intrinsic geological and hydrogeological characteristics which determines the ease with which a groundwater body may be contaminated by human activities.

The vulnerability is determined by the travel time and the attenuation capacity of the overlying deposits, mostly by the permeability and thickness of the subsoils that underlie the topsoil. For example, bedrock with a thick, low permeability, clay-rich overburden is less vulnerable than bedrock with a thin, high permeability, gravelly overburden.

Aquifer vulnerability classification guidelines, as published by the GSI, are presented in **Table 17.18**.

The regional groundwater vulnerability varies significantly across the study area, as shown in **Figure 17.12** in **Volume 3** of this EIAR, ranging from low to extreme and with pockets of rock at or near the surface at higher elevations.

Table 17.18: Aquifer vulnerability classification (DELG, EPA & GSI, 1999)

Vulnerability rating	Hydrogeological conditions				
	Subsoil permeability (type) and thickness			Unsaturated zone	Karst features
	High permeability (sand / gravel)	Moderate permeability (e.g., sandy subsoil)	Low permeability (e.g., clayey subsoil, clay, peat)	Sand / gravel aquifers only	(<30m radius)
Extreme (E)	0 – 3.0m	0 – 3.0m	0 – 3.0m	0 – 3.0m	-
High (H)	>3.0m	3.0 – 10.0m	3.0 – 5.0m	>3.0m	Not applicable
Moderate (M)	Not applicable	>10.0m	5.0-10.0m	Not applicable	Not applicable

Vulnerability rating	Hydrogeological conditions				
	Subsoil permeability (type) and thickness			Unsaturated zone	Karst features
	High permeability (sand / gravel)	Moderate permeability (e.g., sandy subsoil)	Low permeability (e.g., clayey subsoil, clay, peat)	Sand / gravel aquifers only	(<30m radius)
Low (L)	Not applicable	Not applicable	>10.0m	Not applicable	Not applicable

17.4.2.9 Regional recharge

Recharge is the amount of rainfall that replenishes a groundwater aquifer. Recharge is a function of the effective rainfall (i.e., rainfall minus evaporation and runoff), the permeability and thickness of the subsoil, and the aquifer characteristics.

The GSI annual groundwater recharge map of the study area is presented in **Figure 17.13** in **Volume 3** of this EIAR. Groundwater recharge is between 150 and 200 mm/year across much of the study area, particularly to the north where the area is underlain by locally important aquifer (Ll) which has a groundwater recharge cap of 200mm. Recharge rates are more variable in the southern portion of the study area underlain by the regionally important aquifer (Rkd), ranging from 100 to 600 mm/year.

17.4.2.10 Regional groundwater abstractions

Groundwater resources describe any large well, spring or borehole which is used as groundwater abstraction source by domestic, agricultural, commercial, industrial, local authority or group water scheme users (refer to **Figure 17.9** in **Volume 3** of this EIAR).

The GSI holds records of groundwater wells drilled, however these records do not state which wells are currently used for abstraction and the database does not contain all groundwater wells. The GSI lists approximately seven wells and springs within the study area. The yield rates for most of these wells and springs are unknown. One well in the north of the study area has a yield of 32.7 m^3/day, which is classified as a poor yield.

Based on available data sources from the GSI there are no Public Water Supply or National Federation of Group Water Scheme groundwater source protection areas within the study area.

17.4.2.11 Regional karst

Karst is a type of geological feature characterised by caves, caverns and other types of underground drainage resulting from the dissolution of the underlying calcareous bedrock. This typically occurs in areas of high rainfall with soluble rock. There are no karst features identified within the study area in the GSI karst database (GSI, 2020). There is a Regionally Important Aquifer which displays diffuse karstification underlying much of the calcareous geological formations of the Cork Syncline in the south of the study area.

17.4.2.12 Regional environmentally sensitive sites

The National Parks and Wildlife Services (NPWS) is responsible for the designation of environmentally protected sites in Ireland and maintains a publicly available database of these sites. These sites include Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Natural Heritage Areas (NHAs). In addition to these sites, the NPWS also maintains a database of proposed Natural Heritage Areas (pNHAs).

Further information regarding the designated sites within the study area are detailed in **Chapter 9**, *Biodiversity*.

The protected areas within the study area are shown on **Figure 17.14** in **Volume 3** of this EIAR and are listed in **Table 17.19**. These protected sites do not contain groundwater dependant habitats in the vicinity of the site development. While these sites may not be groundwater dependent, they may receive groundwater flow from within the study area, with the exception of Rockfarm Quarry, Little Island. The gravel aquifer which underlies the site extends to the east and west along the former river channel. The gravels in Cork are

considered to be highly permeable with a hydraulic conductivity in the order of 0.005m/s (Long *et al.*, 2015). Therefore, the gravels have the potential to provide a pathway for contamination to migrate towards downgradient ecologically sensitive habitats.

Rockfarm Quarry, Little Island is located upgradient of the site and is underlain by the Regionally Important aquifer. It is therefore unlikely have a hydrogeological connection to the study site and will not be assessed any further.

Table 17.19: Ecological designated sites within the study area

Designated Site	Designation code	Status	Description	Location	Justification for further assessment
Cork Harbour	004030	SPA	Internationally important wetland site/bay system which stretches from the two main estuaries of the River Lee, near Cork City in the northwest, and the Owenacurra River, near Midleton, in the northeast.	Southern portion of the study area, along the coastline of Little Island	Potential hydrogeological connection through gravels
Great Island Channel	001058	SAC and pNHA	[1140] Tidal Mudflats and Sandflats [1330] Atlantic Salt Meadows	Southern portion of the study area, along the coastline of Little Island	Potential hydrogeological connection through gravels
Dunkettle Shore pNHA	001082	pNHA	Mudflats	West of the study area	Potential hydrogeological connection through gravels
Rockfarm Quarry, Little Island	001074	pNHA	Habitats include grassland, scrub woodland and exposed rock and spoil of quarries.	Southern portion of the study area.	Not considered further

17.4.3 Site specific environment

This section discusses the site-specific conditions within the study area for the Proposed Development as defined in Section 17.2. Where applicable, the importance of the attributes for which the impact of the Proposed Development is to be assessed are reported in this section. A list of site-specific figures used in this assessment is included in **Table 17.20**, with the figures presented in **Volume 3** of this EIAR.

Table 17.20: List of figures from the site specific environment

Figure	Title
Figure 17.15	Site-Specific Topography and Geomorphology
Figure 17.16	Site-Specific Soil (Teagasc Classification)
Figure 17.17	Site-Specific Subsoil (Quaternary Sediments)
Figure 17.18	Site-Specific Bedrock Geology (1:100k)
Figure 17.19	Site-Specific Historic and Project Specific Ground Investigations
Figure 17.20	Site-Specific Radon Risk
Figure 17.21	Site-Specific Bedrock Aquifers and Abstractions
Figure 17.22	Site-Specific Gravel Aquifers

Figure	Title
Figure 17.23	Site-Specific Groundwater Vulnerability
Figure 17.24	Site-Specific Groundwater Recharge

17.4.3.1 Current and historic land use

The current and historic land use is discussed in order to give context to any potential changes to land, soils, geology and hydrogeology that have the potential to influence the importance of a feature and the magnitude of any impacts. The current land use is based on current aerial imagery and mapping available from Ordnance Survey Ireland (OSI) (OSI, 2020), Google (Google, 2020), Bing (Bing, 2020) and the Corine Land Cover maps (EPA, 2018). The historic land use is based on the following OSI (OSI, 2020) historic aerial imagery and historic maps:

- OSI 6-inch mapping produced between 1837 and 1842;
- OSI 25-inch mapping produced between 1888 and 1913;
- OSI 6-inch Cassini mapping produced between 1830 and 1930s;
- OSI mapping produced between 1945-1962; 1977-1980; 1991 and 1992; and
- OSI 1995, 1999–2003, 2004–2006 and 2005-2012 aerial photography.

There has been considerable altering of the land use through the reclamation of land, infilling of waterbodies and the construction of the railway line and N25 dual carriageway since the middle of the 19th century.

The Corine land mapping (EPA) indicates that there are variable land use classes across the Proposed Development. The N25 carriageway is classified as ‘road and rail network’. To the north of the N25, the Proposed Development lands are classified as ‘discontinuous urban fabric’. The Proposed Development is bordered by ‘pasture’ lands to the north. To the south of the N25 carriageway, the lands in the Proposed Development are classified as ‘industrial and commercial units’.

The OSI 6" historical map (1837–1842) shows a river trending approximately from east / southeast to west/northwest through the Proposed Development adjacent to, and north of the present-day railway line. The river redirects on the western boundary of the Proposed Development to trend southwards. A quarry was located approximately 120m west / northwest of the Proposed Development.

The OSI 25" historical map (1888–1913) shows that the river was infilled, with the Great Southern and Western Railway line and Little Island station constructed. The quarry to the west/northwest of the Proposed Development is still documented.

The OSI Aerial Map (1995) shows the N25 carriageway under construction and commercial development around the Proposed Development.

The OSI Aerial Maps (2000–2012) show progressive residential and commercial development surrounding the Proposed Development.

The site walkover indicated that little change has occurred to the site since the construction of the N25 carriageway. The northern portion of the site is a public green space showing localised areas of ponding. A number of partially filled drainage ditches were located running parallel to the railway and N25 dual carriageway. Immediately south of the N25 carriageway is a densely wooded area and then a number of paved car parks, showing possible signs of settlement. There are a number of services identified in the area both above and below ground including a watermain running east west through the green space to the north. The depth of the watermain indicated by the records suggests an extensive area of cut and fill was carried out to install it resulting in a large proportion of the green area being likely made ground.

17.4.3.2 Geomorphology and topography

The geomorphology and topography are discussed to give context to any potential changes to land and soils that could influence the importance of a feature and the magnitude of any impacts. The geomorphology (GSI, 2016a) and the topography are shown on **Figure 17.15** in **Volume 3** of this EIAR.

The topography of the Proposed Development has been heavily altered from a relatively flat alluvial valley floor overlying the glaciofluvial terrace deposits to one that consists of a series of parallel ditches and embankments running east west through the centre of the Proposed Development and a variation in levels between the car parks to the south of the Proposed Development.

Levels at the tie in with the Little Island train station are approximately +2.2mOD. In the north of the site is an amenity parkland area, this park slopes from north to south with levels dropping from approximately 2.9mOD to 1.7mOD along the southern Irish Rail Boundary. The main crossings are over the Irish Rail tracks with max top of rail level approx. 3.2mOD, and over the N25 with max carriageway level of approx. 3.94mOD. There is a drop off in levels in the southern wooded area which raises again to meet the Radisson Blu Hotel car park at approx. 5.2mOD. On the southwest of the site there is a 1m drop in elevation between the Radisson Blu Hotel car park and the adjacent Eastgate Business Park car park (5mOD to 4mOD).

17.4.3.3 Soils (Teagasc soil classification)

The soils beneath the Proposed Development site, as classified by Teagasc (Teagasc, et al., 2017), are presented on **Figure 17.16** in **Volume 3** of this EIAR and listed in **Table 17.21** along with their importance with respect to drainage and fertility. Where these soils are important features with respect to possible soft ground or contamination, their importance is detailed in Section 17.4.3.7 and Section 17.4.3.8.

Several soil typologies are encountered across the Proposed Development site. The majority of the site is historically underlain by mineral alluvium (AlluvMIN), associated with the river that historically flowed through the site with deposits of deep well drained mineral soils that are mainly acidic (AminDW) located along the northern boundary and in the southern section of the Proposed Development site. However, due to the extensive development of the Proposed Development to date the majority of the site is expected to be underlain by made ground with some topsoil overlying this in the amenity parkland area to the north and southern wooded area. The existing alluvium was either excavated and replaced with made ground or buried during the land filling.

Table 17.21: Summary of soil types within the Proposed Development site (Teagasc classification)

Soil code	Description	Location	Importance	Justification for importance rating
Made ground	Associated with urban development	Northwest boundary of the Proposed Development site	Low	Poorly drained and / or low fertility soils
AminDW	Acid Brown Earths / Brown Podzolic	Northern boundary and southern section of the Proposed Development site	High	Deep well drained mineral (mainly acidic)
AlluvMIN	Mineral alluvium	Central section of the Proposed Development site	Medium	Moderately drained and / or moderate fertility soils

17.4.3.4 Subsoils (GSI quaternary classification)

Superficial deposits (subsoil) comprise the unconsolidated geological deposits which overlie the solid bedrock geology. The subsoils within the Proposed Development site, as classified by the GSI Quaternary mapping (GSI, 2016), are presented on **Figure 17.17** in **Volume 3** of this EIAR. They are also listed in **Table 17.22**, along with their importance with respect to feature quality and significance as deemed by Table C2 Criteria for Rating Site Importance of Geological Features (NRA, 2008; IGI, 2003). Where these subsoils are important features with respect to possible soft ground or contamination, their importance is detailed in Section 17.4.3.7 and Section 17.4.3.8.

The GSI Quaternary mapping indicates that the Proposed Development site is underlain by recent alluvium over deep glaciofluvial gravel deposits in the historic glacial channel. However, it is expected that portions of the alluvium have been excavated and replaced with made ground as part of the previous developments and over buried.

Table 17.22: Summary of soil types within the Proposed Development site (Teagasc classification)

Soil type	Description	Location	Importance	Justification for Importance rating
A	Alluvium	Underlying the mineral alluvium in the centre of the Proposed Development site.	Low	Low value on a local scale. Widespread throughout the study area.
GDSs	Gravels derived from Devonian sandstones	Large deposit location in the southern section of the Proposed Development site, to the south of the N25 carriageway. Potential for minor deposits in the northwest of the site.	Low	Low value on a local scale. Widespread throughout the study area.
TDSs	Till derived from Devonian sandstones	Northern edge of the Proposed Development	Low	Low value on a local scale. Widespread throughout the study area.

17.4.3.5 Bedrock geology

The Proposed Development lies on the centre of the Cork Syncline on the boundary between two distinct bedrock groups, the Carboniferous Cuskinny Member (sandstone) and the much older Devonian Gyleen Formation (siltstone) (refer to **Figure 17.18** in **Volume 3** of this EIAR). A summary of the geological formations within the study area is shown in **Table 17.23**. The Proposed Development is dissected by a fault running east west between these two formations. The GSI bedrock mapping indicates that there is a north south fault running slightly to the west of the bridge alignment resulting in the east west fault to the west being offset slightly either side of the railway line. The exact location of the faults is not known. Due to the depth of the bedrock beneath the Proposed Development (>20m) (Davis, *et al.*, 2006), it is unlikely that the bedrock will be encountered during the construction works.

Table 17.23: Summary of the bedrock geology within the Proposed Development

Geological period	Formation	Rock Type	Approximate depth to top of strata (m)	Location	Importance	Justification for Importance rating
Carboniferous	Cuskinny Member (KNcu)	Sandstone	>30m	North and west of the Proposed Development	Low	Low value on a local scale. Widespread throughout the study area.
Devonian	Gyleen (GY)	Siltstone	<30m	South of the Proposed Development.	Low	Low value on a local scale. Widespread throughout the study area.

17.4.3.6 Local geology (historic and project specific ground investigations)

In addition to the project specific ground investigation (refer to **Appendix 17.2** in **Volume 4** of this EIAR), the following site-specific ground investigations have been completed within and adjacent to the Proposed Development (refer to **Appendix 17.3** in **Volume 4** of this EIAR):

- Site Investigations Ltd, 1976. Intrusive ground investigation, carried out within the Proposed Development to collect information to inform the design of earth works for the installation of a gas pipeline. Within the Proposed Development the investigation comprised the excavation of two cable percussion boreholes to depths of 6.50m and 7.00m depths BGL; and
- Priority Geotechnical Ltd, 2020. Intrusive ground investigation, carried out within the Proposed Development to collect information to inform the design of earth works and collect geo environmental

information as part of the Dunkettle Advance ITS Works. Within the Proposed Development, the investigation comprised the excavation of one cable percussion with a follow-up Rotary Core to a depth of 24.00m BGL.

The locations of the boreholes are shown on **Figure 17.19** in **Volume 3** of this EIAR. An interpreted generalised stratigraphy based on the results of these ground investigations is presented in **Table 17.24** and is broadly consistent with the baseline data presented within this chapter.

The boreholes carried out on the N25 embankment are consistent with expectations, showing approximately 3m of made ground (embankment and land reclamation fill) overlying 5.5 to 7m of alluvial clays and silts over glacial sands and gravels to 31.2mBGL. Boreholes and trial pits in the northern amenity park area show made ground overlying clays and silts to 6.2 to 15m BGL overlying either glacial till and or glacial sands and gravels suggesting the boundary between the glaciofluvial gravels and the glacial till indicated on the GSI quaternary mapping may be further south than indicated (refer to **Figure 17.17** in **Volume 3** of this EIAR). South of the N25 is characterised by made ground to 3m BGL overlying 4m of alluvial gravel over clay and silts to 21m BGL over glacial gravels to 30m BGL. Rock was not encountered during the historical and project-specific ground investigations, indicating that bedrock depths are in excess of 31.2m BGL at the Proposed Development.

Table 17.24: Summary of the ground model within the Proposed Development

Stratum	Depth to top of stratum (mOD)	Depth to base of stratum (mOD)	Estimated stratum thickness (m)
Topsoil	2.6 to 1.9	2.3 to 1.6	0.2 to 0.3
Made ground	5.3 to 1.6	4.1 to 0.2	0.3 to 3.2
Clay and silt (alluvium)	3.1 to -2.1	1.7 to -15.7	0.45 to 15
Sands and gravels	4.1 to -15.7	3.1 to -28.1	1.0 to 27

17.4.3.7 Soft and / or unstable ground

Soft soils consist of peat, fine grained alluvium, or very soft cohesive material. Their presence beneath the Proposed Development could result in an impact on nearby important features if they require excavation or dewatering. Various sources of information were consulted in establishing these areas within the Proposed Development namely:

- GSI mapping;
- Ground investigation data; and
- Scheme walkover survey.

The site history shows a tributary of the River Lee running north of Little Island, directly through the Proposed Development. Historic GI also shows several metres of soft alluvium underlying the areas adjacent to the Proposed Development. It was noted that the field north of site was damp during the site walkover.

Soft ground was encountered as alluvial clays and silts across the site during the project-specific ground investigation. **Table 17.25** presents the soft soils encountered within the study area.

Table 17.25: Soft soils within the Proposed Development

Feature	Description	Location	Importance	Justification for Importance rating
Soft ground: Alluvial deposits	Typically found along current and historic watercourses	Throughout Proposed Development beneath the made ground	Medium	Volume of soft soil underlying the Proposed Development is moderate on a local scale

The GSI database (GSI, 2017) shows no recorded landslide events within the study area and therefore unstable ground is not considered further in this assessment.

17.4.3.8 Soil contamination

The following sources of information were consulted in assessing the potential for areas of contaminated land:

- CORINE land cover mapping (EPA, 2018);
- Teagasc soil map (Teagasc *et al*., 2017);
- Historical landfill sites and dump sites (EPA viewer - online);
- OSI mapping (OSI, 2019); and
- The project specific Ground Investigation (GI) carried out to inform the Proposed Development and EIAR is listed in **Table 17.24**. This provides verification for the data already compiled relating to the baseline environment.

The known potential sources of contamination relevant to the Proposed Development identified within the study area are detailed in **Table 17.26** along with their importance as determined by the NRA Guidelines Box 4.1 (NRA, 2008).

Table 17.26: Summary of potential sources of contaminated land within the Proposed Development

Feature	Description	Location	Importance	Justification for importance rating
Made ground	Made ground associated with the historic development of the existing infrastructure.	Throughout the Proposed Development	Medium	Predominately non-hazardous waste. Imported inert soils and stone material to reclaim land and construct the various existing infrastructure. Degree or extent of soil contamination is moderate on a local scale

The Proposed Development is underlain by made ground due to the reclamation of land, construction of the railway, N25 dual carriageway, installation of various underground services and the construction of various roads and car parks. There were no signs of uncontrolled stockpiling of material on the site during the walkover and the observations from the ground investigation to date is that there are pockets of possibly contaminated ground as expected given the history of the location.

Nine geo-environmental samples were taken during the ground investigation. Seven of these samples were described as made ground, with two samples described as natural ground. The geo-environmental results were interpreted as follows:

- Of the seven made ground samples tested, six of the samples are suitable for disposal to an inert licenced landfill, and one sample requires disposal to a non-hazardous licenced landfill; and
- Of the two natural ground samples tested, one sample is suitable for disposal to a Soil Recovery Facility (SRF), whilst the other requires disposal to an inert licenced landfill.

17.4.3.9 Radon gas

Radon is a radioactive gas that is harmful to human health. Radon gas is formed in the ground by the radioactive decay of uranium which is present in all soil and rocks. The EPA radon risk mapping, as shown in **Figure 17.20** in **Volume 3** of this EIAR, indicates that much of the study area is at a medium radon risk with the edges deemed to be high risk.

However, as the Proposed Development does not include for a building or enclosed structure, the radon risk is deemed negligible and will not be further assessed.

17.4.3.10 Aquifer type and classification

The GSI Aquifer mapping for the study area (refer to **Figure 17.21** and **Figure 17.22** in **Volume 3** of this EIAR) indicates that there are two aquifer types considered within the assessment, as summarised in **Table 17.27** along with their importance as determined by the NRA Guidelines Box 4.3.

The GSI Bedrock Aquifer mapping suggests that most of the site is underlain by a Locally Important Gravel (Lg) aquifer. The bedrock underlying the gravel aquifer is a Locally Important aquifer (Ll) where bedrock is moderately productive only in local zones.

According to the GSI mapping the gravels are located at the base of the slope of the Gyleen formation bedrock. The gravels lie at an elevation of approximately 0mOD and the ground to the north rise steeply to 120m within 1km to the north. There is also evidence from historical mapping of former streams rising close to or within the site boundary and flowing to the east and west, discharging into Lough Mahon and Cork Harbour. This indicates that the site is an area of groundwater discharge where the flows are now contained within a modified drainage network.

Considering the presence of the former stream along the base of the it is likely that the site is a groundwater discharge area.

Table 17.27: Summary of aquifer types beneath the Proposed Development

Feature	Potential	Location	Importance	Justification for importance rating
Locally Important Gravel Aquifer	Gravel which is moderately productive only in local zones (Lg)	Throughout	Medium	Attribute has a medium quality or value on a local scale
Locally Important Aquifer	Bedrock which is moderately productive only in local zones (Ll)	Throughout	Medium	Attribute has a medium quality or value on a local scale

17.4.3.11 Groundwater vulnerability

Groundwater vulnerability is indicated to be high at the Proposed Development as shown on **Figure 17.23** in **Volume 3** of this EIAR.

17.4.3.12 Groundwater quality and levels

The national groundwater monitoring network is maintained by the EPA. There are no active groundwater level monitoring points within the study area.

As part of the project-specific ground investigation, one set of groundwater level readings were taken after the fieldworks. A summary of the groundwater readings across the Proposed Development is outlined in **Table 17.28**.

Table 17.28: Groundwater monitoring readings

Hole ID	Ground level (mOD)	Standpipe response zone stratum	Groundwater level (mBGL)		Groundwater level (mOD)	
			10/07/2023	10/08/2023	10/07/2023	10/08/2023
RC03	2.73	Gravel	2.00	0.80	0.73	1.93
RC09	3.44	Gravel	2.55	2.53	0.89	0.91
RC10	1.63	Gravel	0.87	1.76	0.76	-0.13

Groundwater quality sampling and analysis was completed from groundwater monitoring boreholes drilled as part of the project-specific ground investigation. The results were compared to a suite of Generic Assessment Criteria (GACs), including:

- Groundwater Threshold Values from the Groundwater Regulations;
- Drinking Water Standards from the Drinking Water Regulations; and
- Thresholds for Petroleum Hydrocarbons in Groundwater – CL:AIRE 2017 (WHO TPHCWG fractions in drinking water).

The majority of the samples tested have test results below the GAC threshold values. The test results demonstrate that there are four volatiles with the limit of detected (LOD) above the GAC threshold values. These results indicate that there are low concentrations of these volatiles, but there is potential for concentrations to be above the GAC threshold values. The results with LOD exceeding the GAC threshold values are presented in **Table 17.29**. A full breakdown of the groundwater quality test results is presented in **Appendix 17.2** in **Volume 4** of this EIAR as part of the ground investigation results.

Table 17.29: Groundwater quality tests with limit of detection above GAC threshold values

Test	Units	LOD	GAC threshold	Maximum
Total Petroleum Hydrocarbons	µg/l	10	7.5	<10
Vinyl Chloride	µg/l	1.0	0.375	<1.0
cis 1,2-Dichloroethene	µg/l	1.0	0.375	<1.0
Benzene	µg/l	1.0	0.75	<1.0

17.4.3.13 Groundwater recharge

The rate of groundwater recharge corresponds to the soil type as shown in **Figure 17.24** in **Volume 3** of this EIAR. The study area has an annual recharge range between 150 and 200 mm/year.

17.4.3.14 Karst

Karst is a type of geological feature characterised by caves, caverns and other types of underground drainage resulting from the dissolution of the underlying bedrock. This typically occurs in areas of high rainfall with soluble rock.

There are no karst features identified within the study area in the GSI Karst database. The site is underlain by bedrock which is not associated with karst features. Therefore, the risk of karst is deemed negligible and will not be further assessed.

17.4.3.15 Groundwater resources (abstraction)

There are no groundwater abstractions or identified by the GSI within the study area.

Source Protection Zone (SPZ) reports have been produced by the GSI and the EPA for groundwater sources, particularly public water supplies, group water schemes or important industrial supplies. The reports aim to guide development planning and regulation to provide protection to groundwater sources. To date, no SPZ reports have been produced for any location within the study area.

17.4.3.16 Environmentally sensitive sites

There are no groundwater dependant habitats within the study area. However, there are environmentally sensitive sites which may receive groundwater from the site where a hydrogeological connect is present. The gravel aquifer extends along the former river channel between the Dunkettle Shore pNHA and Harbour SPA in the west of Little Island to the Great Island Channel SAC and pNHA and Cork Harbour SPA in the northeast of Little Island (refer to **Figure 17.14** in **Volume 3** of this EIAR). The gravels present a potential pathway for contamination from the site to migrate to these environmentally sensitive areas.

The sites considered within the assessment are summarised in **Table 17.30** along with their importance as determined by the NRA Guidelines Box 4.3.

Table 17.30: Summary of environmentally sensitive sites which may receive flow from the Proposed Development

Designated Site	Designation code	Status	Description	Importance	Justification for importance rating
Cork Harbour	004030	SPA	Internationally important wetland site/bay system which stretches from the two main estuaries of the River Lee, near Cork City in the northwest, and the Owenacurra River, near Midleton, in the northeast.	Extremely High	Groundwater supports wetland and/or surface water body ecosystem of international importance.
Great Island Channel	001058	SAC and pNHA	[1140] Tidal Mudflats and Sandflats [1330] Atlantic Salt Meadows	Extremely High	Groundwater supports wetland and/or surface water body ecosystem of international importance.
Dunkettle Shore pNHA	001082	pNHA	Mudflats	Very High	Groundwater supports river, wetland or surface water body ecosystem protected by national legislation

17.4.3.17 Summary of features of importance

The feature importance ranking is based on the Guidelines for the Preparation of Soil, Geology and Hydrogeology Chapters of Environmental Impacts Statements (IGI, 2013) and the Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA, 2008a). Features with an importance ranking are summarised in **Table 17.31** and the potential impact of the Proposed Development are assessed in Section 17.7**.**

Table 17.31: Summary of Land, Soils, Geology and Hydrogeology features of importance

Category	Feature	Location	Description	Importance	Justification for importance rating
Topsoil	Made Ground	Associated with urban development	Northwest boundary of the Proposed Development site	Low	Poorly drained and / or low fertility soils
	AminDW	Acid Brown Earths / Brown Podzolic	Northern boundary and southern section of the Proposed Development site	High	Deep well drained mineral (mainly acidic)
	AlluvMIN	Mineral alluvium	Central section of the Proposed Development site	Medium	Moderately drained and / or moderate fertility soils
Subsoil	A	Alluvium	Underlying the mineral alluvium in the centre of the Proposed Development site.	Low	Low value on a local scale. Widespread throughout the study area.
	GDSs	Gravels derived from Devonian sandstones	Large deposit location in the southern section of the Proposed Development site, to the south of the N25 carriageway. Potential for minor deposits in the northwest of the site.	Low	Low value on a local scale. Widespread throughout the study area.
	TDSs	Till derived from Devonian sandstones	Northern edge of the Proposed Development	Low	Low value on a local scale. Widespread throughout the study area.
Bedrock	Cuskinny Member (KNcu)	North and west of the Proposed Development	Sandstone	Low	Low value on a local scale. Widespread throughout the study area.
	Gyleen (GY)	South of the Proposed Development.	Siltstone	Low	Low value on a local scale. Widespread throughout the study area.
Soft ground	Alluvial deposits	Throughout Proposed Development beneath the made ground	Recent soft ground silts and clays	Medium	Volume of soft soil underlying the Proposed Development is moderate on a local scale.
Contaminated Land	Made ground	Throughout the Proposed Development	Made ground associated with the historic development of the existing infrastructure.	Medium	Predominately non-hazardous waste. Imported inert soils and stone material to reclaim land and construct the various existing infrastructure. Degree or extent of soil contamination is moderate on a local scale
Aquifer	Locally Important Gravel Aquifer	Throughout	Gravel which is moderately productive only in local zones	Medium	Medium value on a local scale

Category	Feature	Location	Description	Importance	Justification for importance rating
	Bedrock – Locally Important Aquifer	Throughout	Bedrock which is moderately productive only in local zones	Medium	Medium value on a local scale
Environmentally sensitive sites	Cork Harbour SPA	Less than 1km to the east of the Proposed Development	Wetland	Extremely High	Groundwater supports attribute with value on international importance.
	Great Island Channel SAC and pNHA	Less than 1km to the east of the Proposed Development (SAC) and less than 500m to the east of the Proposed Development (pNHA)	Tidal Mudflats and Sandflats Atlantic Salt Meadows	Extremely High	Groundwater supports attribute with value on international importance.
	Dunkettle Shore pNHA	Between 1-2km west of the Proposed Development.	Tidal Mudflats and Sandflats Atlantic Salt Meadows	Very High	Groundwater supports attribute with value on international importance.

17.5 Conceptual Site Model

A Conceptual Site Model (CSM) has been developed for the Proposed Development based on the ground investigation data and all publicly available data. The CSM is a summary of the underlying geological conditions and considers the likely significant impacts of the Proposed Development.

The CSM can be summarised as follows:

- The Proposed Development is underlain predominantly by made ground overlying recent alluvial deposits which are underlain by Glacial Deposits including fluvioglacial sands and gravels and glacial till derived from Old Red Sandstone in a deep paleochannel running through the site. These are in turn are underlain by either the Carboniferous Cuskinny sandstone member or Devonian Gyleen siltstone formation;
- The thickness of made ground varies across the Proposed Development from 0 to 4m with the thickest depths expected on the N25 dual carriageway embankment where the ground level is higher than the original ground level by 1 to 2m;
- The cohesive alluvial deposits extend to typically 3 to 5mBGL and the glacial deposits extend to depths greater than 20mBGL. The presence of glacial till in the ground investigation suggests the extent of the gravel aquifer beneath the Proposed Development may not be as widespread as indicated in the GSI mapping;
- Bedrock was not proven at depths of 30mGL. Both bedrock types are interpreted as a Locally Important aquifer;
- The gravels underlying the site are relatively thick with a high permeability with a limited local extent. The gravels are considered to be a Locally Important Gravel Aquifer. Recharge into the gravel aquifer is from outside the study area and the gravels are within an area of groundwater discharge; and
- There is likely a groundwater connection between the gravel aquifer underlying the Proposed Development and environmentally sensitive sites, on the edges of the study area.

17.5.1 Environment type

The environment type across the study area has been categorised in accordance with the IGI Guidelines (IGI, 2013). As the site is within a groundwater discharge area and underlain by a Locally Important Gravel aquifer gravel, the environment type within the study area is considered as:

- **Type B** – Naturally dynamic hydrogeological environments, e.g., groundwater discharge areas, areas underlain by regionally important aquifers, nearby spring rises, areas underlain by permeable subsoils.

17.6 Proposed Development

A description of the Proposed Development is provided in **Chapter 4**, *Description of the Proposed Development* and construction activities are described in **Chapter 5**, *Construction Strategy*. Refer also to the planning drawings in **Volume 3** of this EIAR for further information.

A summary of the characteristics of the Proposed Development relevant to land and soils is outlined in this section.

The Proposed Development will consist of a new pedestrian and cyclist bridge that encompasses a segregated footway and cycleway that will be 5m wide (3m two way cycleway and 2m footway), connecting the Little Island train station and the Dunkettle to Carrigtwohill pedestrian and cycle route with the Radisson Blu Hotel, Eastgate Business Park and the wider surrounds of Little Island.

The proposed crossing will be approximately 460m long and will consist of a combination of different structural forms as follows:

- Northern approach ramp: Combination of earthen embankment and elevated ramp structure;
- Irish Rail span: Concrete portal frame structures;

- N25 span: Steel network arch structure; and
- South approach ramp: Combination of elevated ramp structure, at grade sections and earthen embankment.

All structural forms will sit on reinforced concrete piled foundations. It is expected, subject to detailed design, that piles will be approximately 900mm diameter and 20-30m in length (pile lengths may vary locally to shallower or deeper depths). The piling methodology is assumed to be rotary bored and cased piles or Continuous Flight Auger (CFA) piles. All pile caps are to sit below the existing ground level by approximately 500mm.

The ramp structures will consist of a combination of elevated structures, embankments, landscaping and at grade sections. The southern ramp section between the Radisson Blu Hotel car park and the N25 bridge tie in will be an elevated structure due to the fall off in level to the north and east of the Radisson Blu Hotel car park. An earthen embankment is also proposed on the west side tie into the Radisson Blu Hotel car park due to the level difference. Ramp embankments are proposed to consist of steepened slope reinforced earth embankment with a green vegetated finish. For details of proposed makeup of approach ramps, refer to Drawing No. LIPB-ARUP-ZZ-XX-DR-CB-0004 and Drawing No. LIPB-ARUP-ZZ-XX-DR-CB-0005 in **Volume 3** of this EIAR.

Subsurface drainage will be implemented in accordance with DN-STR-03012 (TII, 2016). It is proposed that bridge run off will tie into existing drainage networks in the area. Subject to discussions with Uisce Eireann, it is proposed that the 750mm diameter asbestos water main will remain in place with suitable protection measures and easements to allow piling works and bridge assembly / protection works.

In total, it is estimated that the construction of the Proposed Development will require the excavation of approximately 5,950 tonnes (bulk weight) of material. This material will comprise made ground, topsoil and subsoil.

It is estimated that approximately 300mm will need to be excavated under the proposed embankments and tie ins at grade footways / cycleways to allow for competent formation layers to be placed. The total amount of material estimated to be generated from these works will be approximately 2,260 tonnes (bulk weight). Topsoil material which is proposed to be reused within the Proposed Development will be stored in designated areas.

In addition to excavated topsoil, pile arisings / spoil is expected to amount to 1,950 tonnes (bulk weight) in total and excavation for pile caps is expected to amount to 1,740 tonnes (bulk weight). Surplus excavation material will be removed off site by a waste collection permit holder and delivered to an authorised waste facility (i.e., a facility which holds a Certificate of Registration, Waste Facility Permit or Waste Licence).

Two construction compounds will be provided, one in the northern amenity park area / Little Island train station area and one in the Radisson Blu Hotel / Eastgate Business Park car park area. A bridge assembly area will also be provided in the northern amenity park area. Once construction works are complete, structures and facilities will be removed, with the construction compounds and bridge assembly area reinstated to their original condition.

17.7 Potential Impacts

This section presents potential impacts that may occur due to the Proposed Development, in the absence of mitigation. This informs the need for mitigation or monitoring to be proposed (refer to Section 17.8). Predicted ‘residual’ impacts considering any proposed mitigation are presented in Section 17.10.

17.7.1 Do-Nothing Scenario

In the do-nothing scenario the Proposed Development would not be implemented and there would be no resulting impacts on the land, soils, geology and hydrogeology along the route of the Proposed Development.

17.7.2 Construction Phase

The potential land, soils, geology and hydrogeology impacts during the Construction Phase for the relevant construction activities described in Section 17.6 are presented in this section, along with their impact

significance. These potential impacts also relate and interact with other environmental factors which are described within the EIAR.

The Proposed Development could have the following potential impacts on the land, soils, geology and hydrogeology as discussed below and summarised in Section 17.7.2.8.

Though the magnitude of the impact may vary depending on the scale of activities and location of the Proposed Development relative to the impacted important feature, in order to ensure a robust assessment, only the maximum magnitude or "worst case" of the impact of the Proposed Development is considered.

17.7.2.1 Loss of topsoil

The quantity of topsoil estimated to be excavated is approximately 740m^3. Where practicable, this material will be reused for landscape fill and topsoil within the Proposed Development. However, it is expected that where this is not achievable, topsoil and overburden will be appropriately transported off site for reuse, recovery or disposal at an appropriate licenced facility.

Topsoil is a non-renewable source which if removed or damaged can result in a permanent irreversible negative impact. There are a number of ways this could happen:

- Potential for materials on site to be spilled resulting in the pollution of the topsoil;
- Excavated topsoil will be stockpiled using appropriate methods to minimise the impacts of weathering. Materials that are stockpiled incorrectly can be exposed to erosion and weathering which reduces the quality of the resource;
- Excavations in areas of contaminated ground for the construction works may mobilise pollution contained in the soils into the nearby topsoil; and
- Permanent damage of topsoil through waterlogging and erosion due to the trafficking of plant, regrading of slopes and storage of materials in areas not intended to be paved as part of the Proposed Development.

Chapter 5, *Construction Strategy* highlights that excavations will be required in places to construct the foundations and divert services. Where practicable, this material will be reused for landscape fill and topsoil within the Proposed Development. However, it is expected that where this is not achievable, topsoil and overburden will be appropriately transported off site for reuse, recovery or disposal at an appropriate licenced facility. The reuse of soil and stone is addressed in detail in **Chapter 15**, *Resources and Waste.*

Where it is not practicable to reuse the material on site, the topsoil may be reused on another site. Where it is proposed to use an Article 27 EPA notification in relation to excavation material from the Proposed Development, the appointed contractor will be responsible for ensuring compliance with Regulation 27 of the European Union (Waste Directive) Regulations 2011-2020, including notification to the EPA, seeking a determination from the EPA on the matter and compliance with all relevant Agency guidance on the matter.

Where topsoil and subsoil are stripped to accommodate the works outlined above, all the above impacts have the potential to occur at these locations. The magnitude of this potential impact is **moderate adverse**, and the highest significance of this potential impact is **significant / moderate** for topsoil of high importance.

17.7.2.2 Loss of solid geology

It is estimated that no bedrock will be encountered or excavated as part of the Construction Phase.

The magnitude of this potential impact is **negligible**. The significance of the potential impact is **imperceptible** and will not be considered further.

17.7.2.3 Earthwork activities

Earthworks haulage

During construction, large plant and equipment will be used throughout the Proposed Development causing noise, ground vibrations, soil compaction and disturbance of natural ground.

This will also result in increased traffic on the roads to and from the Proposed Development. Internal haul roads (access tracks) within the site would be used where possible during the Construction Phase. Increased noise, dust and vibration will also be generated.

These works are expected to have a limited impact given the volume of the material for removal. The magnitude of this potential impact is **small adverse**. The highest significance of the potential impact is **moderate / slight** for topsoil of high importance.

Chapter 10, *Noise and Vibration* and **Chapter 11**, *Air Quality* provide more information on noise, dust and vibration. **Chapter 7**, *Traffic and Transport* provides more information on earthworks haulage within the Proposed Development.

Impact on the surrounding ground

Soil excavation during the Construction Phase has the potential to induce movement and settlement of surrounding ground. Due to the shallow depth of excavations, the nature of the subsoil and the gentle slopes, the magnitude of the impact of this activity would be **small adverse**. The highest significance of the potential impact is **moderate / slight** for topsoil of high importance.

17.7.2.4 Excavation of potentially contaminated land

The excavation of made ground will result in the production of excess material that requires placement elsewhere in the Proposed Development or removal off site, and / or the mobilisation of possible contaminants. Made ground will be encountered within the entirety of the Proposed Development site, as discussed in Section 17.4.3.

Exposure of locations of contamination and excavation of contaminated soil may potentially lead to a risk to the surrounding environment or underlying soil, if not dealt with in an appropriate manner, in accordance with EPA Guidance on Land Contamination (EPA, 2013). The underlying soil could be impacted from the exposure of previous buried hazardous material, e.g., in an unlicensed dumping site.

The magnitude of this impact is **small adverse** as it results in the excavation of a small proportion contaminated land. As the potential contaminated ground is of **medium importance**, the resulting significance of the permanent **small adverse impact** is **slight.**

17.7.2.5 Mobilisation of contamination into aquifers

The underlying bedrock is classified as a Locally Important Aquifer where bedrock is moderately productive only in local zones (LI). The underlying gravel aquifer is classified as a Locally Important Gravel Aquifer which is also moderately productive only in local zones (Lg). The mobilisation of contaminants into the aquifer either through accidental spillage or disturbance of contaminated ground during excavation will reduce the quality of the groundwater within the aquifer.

The construction of pile foundations either using drilling rotary bored and cased piles or Continuous Flight Auger (CFA) piles will involve the injection of concrete. Potential pollutants associated with construction activities (i.e., fuel and lubricants etc.) will be stored at the temporary construction compounds. During the Construction Phase there is a risk of pollution to the groundwater in the Locally Important Aquifer by the spillage of fuels or chemicals used by the plant operated on site.

The magnitude of this potential impact on the Locally Important aquifers could potentially be **moderate adverse** leading to a significance rating of **moderate**.

17.7.2.6 Mobilisation of contamination into environmentally sensitive sites

The environmentally sensitive sites may receive groundwater flow from the gravel aquifer underlying the site. There is a risk of pollution to the groundwater as a result of the spillage of fuels or chemicals associated with construction activities used within the Proposed Development. The gravel aquifer may act as a pathway for these contaminants to enter the environmentally sensitive sites.

The risks from hazardous substances are similar to those highlighted above for the mobilization of contamination into the aquifers. However, due to the distance from the site to the environmentally sensitive areas and the potential for dilution / attenuation of contamination, the significance of this adverse impact on

the environmentally sensitive sites is deemed to be **small adverse**. The highest significance rating of the impact on the environmentally sensitive sites is considered to be **significant**.

17.7.2.7 Dewatering

Localised pumping of excavations may be required during the Construction Phase to allow works to be carried out in dry excavations. This could lead to a temporary reversible small change in the groundwater levels and flow within the locally important aquifer underlying the Proposed Development.

Since the pumping is expected to be limited, localised and temporary, the magnitude of this impact is considered to be **negligible**. As the importance of the Locally Important Aquifers is **medium**, the resulting significance is **imperceptible.**

17.7.2.8 Summary of potential impacts during the Construction Phase

The potential impacts on the land, soils, geology and hydrogeology during the Construction Phase of the Proposed Development are summarised as follows and in **Table 17.32**.

- Loss of topsoil;
- Loss of solid geology;
- Earthworks haulage;
- Impact on the surrounding ground;
- Excavation of potentially contaminated land;
- Contamination by Radon gas;
- Mobilisation of contamination into aquifers;
- Mobilisation of contamination into environmentally sensitive sites; and
- Dewatering.

Table 17.32: Summary of potential Land, Soils, Geology and Hydrogeology impacts during the Construction Phase

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Loss or damage of topsoil									
Topsoil	AlluvMIN	Northwest boundary of the Proposed Development site	Medium	Loss or damage of topsoil	Negative	Permanent	Local	Moderate adverse	Moderate
	AminDW	Northern boundary and southern section of the Proposed Development site	High	Loss or damage of topsoil	Negative	Permanent	Local	Moderate adverse	Significant / Moderate
	BminSW	Central section of the Proposed Development site	Medium	Loss or damage of topsoil	Negative	Permanent	Local	Moderate adverse	Moderate
Loss of solid geology									
Bedrock	Cuskinny Member (KNcu)	North and west of the Proposed Development	Low	Loss of solid geology	Negative	Permanent	Local	Negligible	Imperceptible
	Gyleen (GY)	South of the Proposed Development.	Low	Loss of solid geology	Negative	Permanent	Local	Negligible	Imperceptible
Earthworks haulage									
Topsoil	Made ground	Site construction areas	Low	Loss or damage of topsoil	Negative	Temporary	Local	Small adverse	Imperceptible
	AminDW	Site construction areas	High	Loss or damage of topsoil	Negative	Temporary	Local	Small adverse	Moderate / Slight
	AlluvMIN	Site construction areas	Medium	Loss or damage of topsoil	Negative	Temporary	Local	Small adverse	Slight
Impact on the surrounding ground									
Topsoil	Made ground	Site construction areas	Low	Soil movement or settlement	Negative	Temporary	Local	Small adverse	Slight
	AminDW	Site construction areas	High	Soil movement or settlement	Negative	Temporary	Local	Small adverse	Moderate / Slight

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
	AlluvMIN	Site construction areas	Medium	Soil movement or settlement	Negative	Temporary	Local	Small adverse	Slight
Subsoil	A	Site construction areas	Low	Soil movement or settlement	Negative	Temporary	Local	Small adverse	Imperceptible
	GDSs	Site construction areas	Low	Soil movement or settlement	Negative	Temporary	Local	Small adverse	Imperceptible
	TDSs	Site construction areas	Low	Soil movement or settlement	Negative	Temporary	Local	Small adverse	Imperceptible
Excavation of potentially contaminated land									
Contaminated Ground	Made ground	Throughout the Proposed Development	Medium	Soil contamination	Negative	Permanent	Local	Small adverse	Slight
Mobilisation of contamination into aquifers									
Aquifer	Locally Important Gravel Aquifer	Throughout	Medium	Contamination of the aquifer	Negative	Temporary	Local	Moderate adverse	Moderate
	Bedrock – Locally Important Aquifer	Throughout	Medium	Contamination of the aquifer	Negative	Temporary	Local	Moderate adverse	Moderate
Mobilisation of contamination into environmentally sensitive sites									
Environmentally sensitive sites	Cork Harbour SPA	Less than 1km to the east of the Proposed Development	Extremely High	Contamination of the site	Negative	Temporary	Local	Small adverse	Significant
	Great Island Channel SAC and pNHA	Less than 1km to the east of the Proposed Development (SAC) and less than 500m to the east of the Proposed Development (pNHA)	Extremely High	Contamination of the site	Negative	Temporary	Local	Small adverse	Significant
	Dunkettle Shore pNHA	Between 1-2km west of the Proposed Development.	Very High	Contamination of the site	Negative	Temporary	Local	Small adverse	Significant / Moderate
Dewatering									
Aquifer	Locally Important Gravel Aquifer	Throughout	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
	Bedrock – Locally Important Aquifer	Throughout	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible

17.7.3 Operational Phase

17.7.3.1 Contamination

The Operational Phase has the potential to lead to occasional accidental leakage of oil, petrol or diesel, resulting in contamination of the surrounding environment. While the likelihood of an accidental spillage may increase in comparison to the Do Nothing scenario, the magnitude of the impact is **negligible**.

Therefore, the significance of the impact is **imperceptible** on any of the land, soils, geology and hydrogeology.

17.7.3.2 Reduction in recharge to the locally important aquifers

Recharge to the Locally Important aquifers is from outside the Proposed Development area. Therefore, the magnitude of the reduction in recharge as a result of the Proposed Development is anticipated to be **negligible** and the significance will be **imperceptible.**

17.7.3.3 Summary of potential impacts during the Operational Phase

The potential impacts on the land, soils, geology and hydrogeology during the Operational Phase of the Proposed Development are summarised as follows and in **Table 17.33**.

- Contamination; and
- Reduction in recharge of locally important aquifer.

Table 17.33: Summary of potential Land, Soils, Geology and Hydrogeology impacts during the Operational Phase

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Mobilisation of contamination into aquifers									
Aquifer	Locally Important Gravel Aquifer	Throughout	Medium	Contamination of the aquifer	Negative	Temporary	Local	Negligible	Imperceptible
	Bedrock – Locally Important Aquifer	Throughout	Medium	Contamination of the aquifer	Negative	Temporary	Local	Negligible	Imperceptible
Mobilisation of contamination into environmentally sensitive sites									
Environmentally sensitive sites	Cork Harbour SPA	Less than 1km to the east of the Proposed Development	Extremely High	Contamination of the site	Negative	Temporary	Local	Negligible	Imperceptible
	Great Island Channel SAC and pNHA	Less than 1km to the east of the Proposed Development (SAC) and less than 500m to the east of the Proposed Development (pNHA)	Extremely High	Contamination of the site	Negative	Temporary	Local	Negligible	Imperceptible
	Dunkettle Shore pNHA	Between 1-2km west of the Proposed Development.	Extremely High	Contamination of the site	Negative	Temporary	Local	Negligible	Imperceptible
Loss of recharge to aquifer									
Aquifer	Locally Important Gravel Aquifer	Throughout	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible
	Bedrock – Locally Important Aquifer	Throughout	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible

17.7.4 Decommissioning

If decommissioning activities occur, the proposed works will be undertaken in a safe manner by minimising interaction with the soils and underlying aquifers.

The Decommissioning Phase has the potential to result in accidental leakage of oil, petrol or diesel, resulting in contamination of the surrounding environment. While the likelihood of an accidental spillage may increase in comparison to the Do Nothing scenario, the magnitude of the impact is **negligible**.

Therefore, the significance of the impact is **imperceptible** on any of the land, soils, geology and hydrogeology.

17.8 Mitigation and Monitoring

The following sections outline the mitigation and monitoring measures associated with the potential impacts identified in Section 17.7 for the Construction, Operational and Decommissioning Phases of the Proposed Development.

17.8.1 Construction Phase

The mitigation strategy outlined in this section will be implemented during the Construction Phase of the Proposed Development. The strategy will be incorporated into the Construction Environmental Management Plan (CEMP – refer to **Appendix 5.1** in **Volume 4** of this EIAR) and the Construction Resource and Waste Management Plan (CRWMP – refer to **Appendix 15.3** in **Volume 4** of this EIAR).

Construction techniques that comply with the requirements of statutory bodies (Cork County Council and the EPA) in terms of noise, vibration, soil and groundwater contamination, and the disposal of possible contaminated material will be adopted.

The Proposed Development will be constructed in accordance with the relevant design standards by means of good practice measures under appropriate engineering supervision.

17.8.1.1 Earthworks management

These mitigation measures relate to the following potential impacts:

- Loss of topsoil;
- Loss of solid geology;
- Earthworks haulage; and
- Impact on the surrounding ground.

Excavated topsoil will be stockpiled using appropriate methods to minimise the effects of weathering. Care will be taken in reworking this material to minimise dust generation, groundwater infiltration and generation of runoff. Any surplus suitable material excavated that is not required elsewhere for the Proposed Development will be reused for other projects where possible, subject to appropriate approvals / notifications or removed off site to a suitable licensed facility.

In order to reduce the compaction and erosion of topsoil outside the areas of direct construction, haul routes will be along predetermined routes within the Proposed Development and deliveries will be along predetermined routes outside the Proposed Development. Where compaction occurs due to truck movements and other construction activities on unfinished surfaces, remediation works will be undertaken to reinstate the ground to its original condition. Where practical, compaction of any soil or subsoil which is not part of the works or to remain *in situ* within the Proposed Development will be avoided.

The contractor will ensure that any topsoil or subsoil is assessed for re-use within the Proposed Development, ensuring the appropriate handling, processing and segregation of the material. Where practical the removal of soil from the Proposed Development will be avoided. All earthworks will be undertaken in accordance with TII Specification for Road Works (SPW) Series 600 Earthworks (TII, 2013) and project specific earthworks specifications ensuring that all excavated material and imported material is classified using the same methodology so as to allow maximum opportunity for the reuse of materials on site.

17.8.1.2 Contaminated land management

These mitigation measures relate to the following potential impacts:

- Excavation of potentially contaminated land;
- Mobilisation of contamination into aquifers; and
- Mobilisation of contamination into environmentally sensitive sites.

Excavations in made ground will be monitored by an appropriately qualified person to ensure that any potential hotspots of encountered contamination are properly identified, segregated and disposed of appropriately. Any identified hotspots will be segregated and stored in an area where there is no possibility of runoff generation or infiltration to ground or surface water drainage. Care will be taken to ensure that the hotspot does not cross contaminate clean soils elsewhere throughout the site.

In areas with the potential to encounter asbestos containing materials the following measures will apply:

- During construction, the potential risk to site users and member of the public from contaminated dust will be managed using standard health and safety measures as outlined in the Health and Safety Authority (HSA) guidance document, Asbestos-containing Materials (ACMs) in Workplaces: Practical Guidelines on ACM Management and Abatement (HSA, 2013). This document states that *"Removal of asbestos from contaminated soil will require a specialist asbestos contractor for any friable asbestos to be removed"* and *"A risk assessment by an independent competent person should determine the most appropriate control measures and remediation strategies."*;
- Control measures for the Construction Phase will be devised based on a risk assessment carried out by the contractor prior to the commencement of the construction works and will be specific to the construction methods. Such methods could include the prompt removal of excavated soils to avoid stockpiling on site of material or dampening down of soil to prevent dust generation. In the rare instances where stockpiles are required, they will not be allowed in the areas which are identified as public interfaces; and
- Only suitably experienced contractors shall be used to carry out the excavation work. During construction, they shall employ standard practices to manage risk from contaminated soils. These will be designed by the contractor dependent on his construction practices and are likely to include the use of gloves, dust masks and potentially disposable overalls. These and other appropriate measures will minimise the exposure of the site workers and member of the public.

If a potential soil and water pollution are identified, this will be minimised by the implementation of good construction practices. Such practices will include adequate bunding for oil containers, wheel wash and dust suppression on site roads, and regular plant maintenance. The Construction Industry Research and Information Association (CIRIA) provides guidance on the control and management of water pollution from construction sites in their publication Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors (Masters-Williams *et al.*, 2001) and this will be reflected in the CEMP (refer to **Appendix 5.1** in **Volume 4** of this EIAR).

Any dewatering in areas of contaminated ground will be designed to minimise the mobilisation of contaminants into the surrounding environment. Where dewatering in such areas is unavoidable, the water will be adequately treated prior to discharge. Good construction management practices will be employed to minimise the risk of transmission of hazardous materials as well as pollution of adjacent watercourses and groundwater.

17.8.1.3 Spills from temporary storage of hazardous substances

These mitigation measures relate to the following potential impacts:

- Loss of topsoil;
- Excavation of potentially contaminated land;
- Mobilisation of contamination into aquifers; and

- Mobilisation of contamination into environmentally sensitive sites.

Good construction management practices, as outlined in the CIRIA guidance Control of Water Pollution from Construction Sites – Guidance for consultants and contractors (Masters-Williams *et al.*, 2001) will be employed by the appointed contractor to minimise the risk of transmission of hazardous materials as well as pollution of adjacent watercourses and groundwater. The construction management of the site will take account of these recommendations to minimise as far as possible the risk of soil, groundwater and surface water contamination.

Measures to be implemented to minimise the risk of spills and contamination of soils and waters include:

- Employing only a competent and experienced workforce, and site-specific training of site managers, foremen and workforce, including all subcontractors, in pollution risks and preventative measures;
- Ensure that all areas where liquids (including fuel) are stored, or cleaning is carried out, are designated impermeable areas that are isolated from the surrounding area and within a secondary containment system, e.g., by a roll-over bund, raised kerb, ramps or stepped access;
- The location of any fuel storage facilities shall be considered in the design of the construction compounds and bridge assembly area. These are to be designed in accordance with relevant guidelines and codes of best practice and will be fully bunded;
- Good housekeeping at the site (daily site clean-ups, use of disposal bins, etc.) during the entire Construction Phase;
- All concrete mixing and batching activities will be located in areas away from watercourses and drains;
- Potential pollutants to be adequately secured against vandalism;
- Provision of proper containment of potential pollutants according to codes of best practice.
- Thorough control during the entire Construction Phase to ensure that any spillage is identified at early stage and subsequently effectively contained and managed; and
- Spill kit to be provided and to be kept close to the storage area. Staff to be trained on how to use spill kits correctly.

An Emergency Incident Response Plan will be implemented by the appointed contractor, which will identify the actions to be taken in the event of a pollution incident. It will address such aspects as containment measures, emergency discharge routes, a list of appropriate equipment and clean-up materials and notification procedures to inform the relevant environmental protection authority. Refer to the CEMP included as **Appendix 5.1** in **Volume 4** of this EIAR.

Sediment control methods will be outlined in the Surface Water Management Plan to be prepared by the contractor and included in the CEMP (refer to **Appendix 5.1** in **Volume 4** of this EIAR), and these will be implemented by the appointed contractor.

The CEMP also addresses good construction management practices that will be employed to prevent the risk of pollution of the existing land, soils, geology and hydrogeology during construction.

17.8.1.4 Management of concrete during piling

These mitigation measures relate to the following potential impacts:

- Loss of topsoil;
- Impact on the surrounding ground;
- Mobilisation of contamination into aquifers; and
- Mobilisation of contamination into environmentally sensitive sites.

During the Construction Phase, concrete levels and volumes used will be monitored and compared against theoretical estimates to understand potential losses.

Before and during piling, it is proposed to monitor groundwater pH at the available groundwater monitoring points (trial wells and boreholes with standpipe installations). This will highlight any potential impacts on groundwater and surface water quality during piling. Where a change from baseline pH is identified, appropriate measures can then be adopted which may include an alternative grout / cement mix to limit migration or the use of temporary casing. The groundwater monitoring will utilise monitoring locations installed during the project specific ground investigation that are located outside the footprint of the Proposed Development. These monitoring locations will be maintained during the Construction Phase of the Proposed Development.

Where ground bearing foundations are being constructed, the formation will be inspected for potential features that may result in concrete losses. Appropriate earthwork details, developed during detailed design phases, will be applied to limit losses.

17.8.1.5 Monitoring

Soil, groundwater and surface water verification testing shall be carried out by the contractor during the Construction Phase to confirm the findings of the risk assessment.

17.8.2 Operational Phase

No significant impacts were highlighted. Therefore, no mitigation is proposed.

17.8.2.1 Monitoring

No monitoring is proposed for the Operational Phase.

17.8.3 Decommissioning Phase

Mitigation measures will be limited to ensuring that no temporary works occur that would damage the topsoil or aquifer permanently during the Decommissioning Phase.

17.9 Cumulative Impacts

A review of Cork County Council, An Bord Pleanála (ABP) and Department of Housing, Local Government and Heritage (DHLGH) online planning records has indicated that other projects have been permitted or proposed within the surrounding area that may give rise to cumulative impacts in combination with the impacts of the Proposed Development. The list of projects is included in **Chapter 20,** *Cumulative and Interactive Impacts*.

This section considers the potential for cumulative effects arising from the Proposed Development in association with these projects. Specifically, it considers a worst case scenario, where both the Proposed Development and the other projects are under construction at the same time.

The nature and scale of the projects listed in **Chapter 20,** *Cumulative and Interactive Impacts* are such that the development of these projects in combination with the Proposed Development would not give rise to significant impacts on land, soils, geology and hydrogeology.

17.10 Residual Impacts

17.10.1 Construction Phase

With the effective implementation of the above mitigation measures, there will be no significant residual impacts on land, soils, geology and hydrogeology as a result of the construction of the Proposed Development. Refer to **Table 17.34**.

17.10.2 Operational Phase

Based on the assessment in Section 17.7.3, it is expected that there will be no significant residual impacts on land, soils, geology and hydrogeology as a result of the operation of the Proposed Development. Refer to **Table 17.35**. Please note that as the potential impacts during the Operational Phase were all imperceptible in significance there is no change in the regards to the post mitigation significance between **Table 17.33** and **Table 17.35**.

17.10.3 Decommissioning Phase

It is not anticipated there will be any significant residual impacts on land, soils, geology and hydrogeology arising from the Decommissioning Phase of the Proposed Development.

Table 17.34: Summary of residual Land, Soils, Geology and Hydrogeology impacts during the Construction Phase

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Post mitigation residual significance
Loss or damage of topsoil									
Topsoil	AlluvMIN	Northwest boundary of the Proposed Development site	Medium	Loss or damage of topsoil	Negative	Permanent	Local	Negligible	Imperceptible
	AminDW	Northern boundary and southern section of the Proposed Development site	High	Loss or damage of topsoil	Negative	Permanent	Local	Negligible	Imperceptible
	BminSW	Central section of the Proposed Development site	Medium	Loss or damage of topsoil	Negative	Permanent	Local	Negligible	Imperceptible
Loss of solid geology									
Bedrock	Cuskinny Member (KNcu)	North and west of the Proposed Development	Low	Loss of solid geology	Negative	Permanent	Local	Negligible	Imperceptible
	Gyleen (GY)	South of the Proposed Development	Low	Loss of solid geology	Negative	Permanent	Local	Negligible	Imperceptible
Earthworks haulage									
Topsoil	Made ground	Site construction areas	Low	Loss or damage of topsoil	Negative	Temporary	Local	Negligible	Imperceptible
	AminDW	Site construction areas	High	Loss or damage of topsoil	Negative	Temporary	Local	Negligible	Imperceptible
	AlluvMIN	Site construction areas	Medium	Loss or damage of topsoil	Negative	Temporary	Local	Negligible	Imperceptible
Impact on the surrounding ground									
Topsoil	Made ground	Site construction areas	Low	Soil movement or settlement	Negative	Temporary	Local	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Post mitigation residual significance
	AminDW	Site construction areas	High	Soil movement or settlement	Negative	Temporary	Local	Negligible	Imperceptible
	AlluvMIN	Site construction areas	Medium	Soil movement or settlement	Negative	Temporary	Local	Negligible	Imperceptible
Subsoil	A	Site construction areas	Low	Soil movement or settlement	Negative	Temporary	Local	Negligible	Imperceptible
	GDSs	Site construction areas	Low	Soil movement or settlement	Negative	Temporary	Local	Negligible	Imperceptible
	TDSs	Site construction areas	Low	Soil movement or settlement	Negative	Temporary	Local	Negligible	Imperceptible
Excavation of potentially contaminated land									
Contaminated Ground	Made Ground	Throughout the Proposed Development	Medium	Soil contamination	Negative	Permanent	Local	Small adverse	Slight
Mobilisation of contamination into aquifers									
Aquifer	Locally Important Gravel Aquifer	Throughout	Medium	Contamination of the aquifer	Negative	Temporary	Local	Small adverse	Slight
	Bedrock – Locally Important Aquifer	Throughout	Medium	Contamination of the aquifer	Negative	Temporary	Local	Small adverse	Slight
Mobilisation of contamination into environmentally sensitive sites									
Environmentally sensitive sites	Cork Harbour SPA	Less than 1km to the east of the Proposed Development	Extremely High	Contamination of the site	Negative	Temporary	Local	Negligible	Imperceptible
	Great Island Channel SAC and pNHA	Less than 1km to the east of the Proposed Development (SAC) and less than 500m to the east of the Proposed Development (pNHA)	Extremely High	Contamination of the site	Negative	Temporary	Local	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Post mitigation residual significance
	Dunkettle Shore pNHA	Between 1-2km west of the Proposed Development.	Very High	Contamination of the site	Negative	Temporary	Local	Negligible	Imperceptible
Dewatering									
Aquifer	Locally Important Gravel Aquifer	Throughout	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible
	Bedrock – Locally Important Aquifer	Throughout	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible

Table 17.35: Summary of residual Land, Soils, Geology and Hydrogeology impacts during the Operational Phase

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Post mitigation residual significance
Mobilisation of contamination into aquifers									
Aquifer	Locally Important Gravel Aquifer	Throughout	Medium	Contamination of the aquifer	Negative	Temporary	Local	Negligible	Imperceptible
	Bedrock – Locally Important Aquifer	Throughout	Medium	Contamination of the aquifer	Negative	Temporary	Local	Negligible	Imperceptible
Mobilisation of contamination into environmentally sensitive sites									
Environmentally sensitive sites	Cork Harbour SPA	Less than 1km to the east of the Proposed Development	Extremely High	Contamination of the site	Negative	Temporary	Local	Negligible	Imperceptible
	Great Island Channel SAC and pNHA	Less than 1km to the east of the Proposed Development (SAC) and less than 500m to the east of the Proposed Development (pNHA)	Extremely High	Contamination of the site	Negative	Temporary	Local	Negligible	Imperceptible
	Dunkettle Shore pNHA	Between 1-2km west of the Proposed Development	Extremely High	Contamination of the site	Negative	Temporary	Local	Negligible	Imperceptible
Loss of recharge to aquifer									
Aquifer	Locally Important Gravel Aquifer	Throughout	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible
	Bedrock – Locally Important Aquifer	Throughout	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible

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