Chapter 14
Land, Soils, Geology & Hydrogeology

Contents

14. Land, Soils, Geology & Hydrogeology

14.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) considers the potential impacts on land, soils, geology, and hydrogeology as a result of the Construction and Operational Phases of the Ringsend to City Centre Core Bus Corridor Scheme (hereafter referred to as the Proposed Scheme). Chapter 4 (Proposed Scheme Description) includes a full description of the Proposed Scheme.

During the Construction Phase, the potential land, soils, geology and hydrogeology impacts associated with the development of the Proposed Scheme have been assessed. This includes the potential for 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.

Potential impacts on the surface water environment are not considered in this assessment but are considered separately in Chapter 13 (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 large-scale infrastructural projects.

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

The aim of the Proposed Scheme when in operation is to provide enhanced walking, cycling and bus infrastructure on this key access corridor in the Dublin region, which will enable and deliver efficient, safe, and integrated sustainable transport movement along the corridor. The objectives of the Proposed Scheme are described in Chapter 1 (Introduction & Environmental Impact Assessment Process). The Proposed Scheme which is described in Chapter 4 (Proposed Scheme Description) has been designed to meet these objectives.

The design of the Proposed Scheme has evolved through comprehensive design iteration, with particular emphasis on minimising the potential for environmental impacts, where practicable, whilst ensuring the objectives of the Proposed Scheme are attained. In addition, feedback received from the comprehensive consultation programme undertaken throughout the option selection and design development process have been incorporated, where appropriate.

14.2 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 Scheme 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.

14.2.1 Study Area

The land, soils, geology and hydrogeology study area for the Proposed Scheme extends 250metres (m) either side of the Proposed Scheme boundary which is in accordance with the Institute of Geologists of Ireland (IGI) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (hereafter referred to as the IGI Guidelines) (IGI 2013).

The Proposed Scheme has been divided into sub-sections for ease of presentation and due to the volume of information available. The sub-sections of the Proposed Scheme are as follows:

- Talbot Memorial Bridge to Tom Clarke East Link Bridge;
- Dodder Public Transport Opening Bridge (DPTOB) (which, for the purposes of this assessment has been included within the section above); and
- Tom Clarke East Link Bridge to Sean Moore Road.

14.2.2 Relevant Guidelines, Policy and Legislation

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

- IGI Guidelines (IGI 2013); and
- National Roads Authority (NRA) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (hereafter referred to as the NRA Guidelines) (NRA 2008a).

Though the NRA is now known as Transport Infrastructure Ireland (TII), for the purpose of this Chapter the guidelines mentioned above are referred to as the NRA Guidelines.

In addition, the assessment has been prepared using the following guidelines and legislation:

- Environmental Protection Agency (EPA). Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (hereafter referred to as the EPA Guidelines) (EPA 2022);
- European Commission, Environmental Impact Assessment of Projects Guidance on the preparation of the Environmental Impact Assessment Report (2017);
- Environmental Impact Assessment of National Road Schemes – A Practical Guide (NRA, 2008b);
- Strive Report Series No. 100. Evaluating the Influence of Groundwater Pressures on Groundwater-Dependent Wetlands. Strive EPA Programme 2007 - 2013 (EPA 2011); and
- Environmental Research Centre Report Series No. 12. A Framework for the Assessment of Groundwater-Dependent Terrestrial Ecosystems under the Water Framework Directive. Strive EPA Programme 2007 – 2013 (EPA 2008).

14.2.3 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.

14.2.3.1 Publicly Available Datasets

The publicly available datasets listed in Table 14.1 have been acquired and consulted in the assessment of the baseline conditions. All datasets were accessed throughout 2020 and 2021.

Table 14.1: Publicly Available Datasets

Source	Name	Description
Ordnance Survey Ireland (OSI)	Current and historical ordnance survey maps	Current and historical survey maps produced by the OSI.
OSI	Aerial photography	Current and historical survey maps produced by the OSI.
Google Maps	Aerial photography	Current aerial imagery produced by Google
Bing Maps	Aerial photography	Current aerial imagery produced by Bing (Bing Maps 2019)
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 also available on GSI online map viewer.
	Bedrock Mapping	
	Aggregate Potential Mapping	

Source	Name	Description
	Mineral Localities	
	Geotechnical viewer	
	Groundwater Mapping	
	Groundwater Levels	
	National Landslide Database	
	Karst Database	
	Active Quarries and pits	
	County Geological Sites (CGS) and Geological Heritage Areas	
	GSI, Memoirs	
EPA	Corine Land Cover 2018	These datasets are based on interpretation of satellite imagery and national in-situ vector data.
	Designated Natural Heritage Area (NHA). Special Protections Area (SPA), Special Area of Conservation (SAC) sites.	
	River Network Map	
	EPA Hydro Net	Reports of groundwater level monitoring points.
National Parks and Wildlife Service (NPWS)	Mapping within the area of the Proposed Scheme	This dataset provides information on national parks, protected sites and nature reserves
National Monuments Service (NMS)	State Mining and Prospecting Facilities	This dataset provides all recorded archaeological monuments
Department of Communications, Energy and Natural Resources (DCENR)	Minerals Ireland	A booklet contains a list of all current and prospecting mining facilities.
	Historic Mine Sites – Inventory and Risk Classification	Department of the Environment, Climate and Communications

14.2.3.2 Ground Investigation

The details of the historical ground investigation reports located within the study area which have been used in the assessment of the baseline conditions are presented in Table 14.2. These reports are publicly available from the Geological Survey of Ireland (GSI) Spatial Resources Map Viewer 'EXT GSI Geotechnical Sites layer' (GSI 2019a).

Table 14.2: Existing Ground Investigations

GSI Report ID	Title	Year	Author	Location	Scope
R2808	River Liffey Crossing	1978	Site Investigations Ltd.	Cable across River Liffey	Three percussion boreholes (shell and auger)
R2785	Sir John Rogerson's Quay	1996	IGSL	Sir John Rogerson's Quay	Two cable percussion borehole
R810	Windmill Lane	1989	IGSL	Windmill Lane	Two cable percussion boreholes
R823	No.50 City Quay	1990	IGSL	No.50 City Quay	One cable percussion borehole
R756	City Quay Stage 2	1982	SIL	City Quay	11 cable percussion boreholes
R751	City Quay Development	1978	SIL	City Quay	11 cable percussion boreholes
R2718	Site Development	1990	IGSL	York Road, Ringsend	One percussion borehole (shell and auger)

GSI Report ID	Title	Year	Author	Location	Scope
R1467	Temporary Bridge	1996	IGSL		Two Boreholes (non-specified)
R5976	North Wall Dredging	2005	IGSL	North Wall Dredging	Four cable percussion boreholes
R5090	Scherzer Opening Bridge	2003	IGSL	Scherzer Opening Bridge at the Royal Canal	Two cable percussion boreholes
R105	Clerys Warehouse	1978	Geotechnical Consulting Ltd.	Clerys Warehouse	Six cable percussion boreholes
R755	Sean Moore Housing Development	1978	Irish Soil Laboratories Ltd	Sean Moore Road	Four Boreholes (non-specified)
R4876	Herbert Place	2002	IGSL	Herbert Place	Two cable percussion boreholes
R17	Pembroke Street	1988	IGSL	Pembroke Street	One cable percussion boreholes
R6393	Irish Town Ringsend	2005	IGSL	Irish Town Ringsend	One Borehole (non-specified)
R6740	Fitzwilliam Quay Ringsend	2006	IGSL	Fitzwilliam Quay Ringsend	Five cable percussion boreholes and six Trial Pits
R2242	Report on a site investigation at York Road	1988	IGSL	York Road, Ringsend	One percussion borehole (shell and auger)
R338	Dublin Harbour Liffey Quays	1900	Unknown	Butt Bridge	Four boreholes (non-specified)
R7674	Spencer Dock Sewage Scheme	Unknown	Unknown	Sir Rogerson Quay	Five cable percussion (shell and auger)
R7412	Dublin underground EIS	Unknown	IGSL	Dublin Co Dublin.	27 cable percussion boreholes (shell and auger), 119 rotary core drilling, five trial pits and 12 window samples
R2879	Dublin Port Boring Locations	1963	Unknown	Dublin Port	22 boreholes (non-specified)
R2160	Macken Street Bridge Dublin	1999	Exploration Associates	River Liffey, Opposite Guild Street	Seven cable percussion boreholes (shell and auger) and six rotary drilling boreholes
R399	Development	Unknown	Unknown	Sir Rogerson Quay	Five boreholes (not specified)
R560	Memorial Bridge	1970	The Cementation Co. Ltd, Ireland.	Memorial Road, by the Liffey.	10 boreholes (non-specified)
R462	Development	1933	The Irish Boring Company, Ltd.	Georges Dock Bridge.	Four boreholes (non-specified)
R310	Drill Holes on custom Quay house	Unknown	Unknown	Custom House Quay	Five boreholes (not specified)

The scheme specific ground investigations carried out to inform the Proposed Scheme and EIAR are listed in Table 14.3 and the factual reports contained in Appendix A14.2 (Ground Investigations) of Volume 4 of this EIAR. These provide useful verification for the data already compiled relating to the baseline environment.

Table 14.3: Scheme Specific Ground Investigations

Title	Contractor	Year	Location	Scope
River Dodder Ground Investigation	IGSL	2019	West of proposed Bridge at Britain Quay/ Sir John Rogerson's Quay, East of Proposed Bridge between York Road/ Thorncastle Street and the R131 East Link Road/ Tom Clark Bridge and overwater works	Over water works comprised of 11 No. Cable percussion boreholes, (No. Geobore S boreholes, 5 No. Grab samples and geophysical surveys Land works comprised of 7 No. Cable Percussive Boreholes, with 6 No Rotary Follow On, 1 No. Trial Pit, 7 No. slit trenches and geophysical and utility surveys
Ringsend Ground Investigation Draft Factual Report	GII	2021	West and east of the Scherzer Bridges at George's Dock and to the north-west and east of the Scherzer Bridges at the Royal Canal.	Four cable percussive boreholes

14.2.3.3 Design Information

The information listed in Table 14.4 is design information that has been used in the assessment of the baseline conditions.

Table 14.4: Design Information

Title	Author	Date	Description
BCID Project D Earthworks Table	ROD-TYPSA	August 2020	Earthworks Table to inform the conceptual site model
Plan and Profile Drawings	ROD-TYPSA	July 2021	Plan and Cross sections drawings

14.2.3.4 Proposed Scheme Walkover

Walkover surveys of the Proposed Scheme was carried out on the 28 February 2020, the 21 February 2022 and the 3 November 2022 to inform and verify the review of publicly available datasets.

The findings of the walkover survey of the Proposed Scheme, including photos and survey notes, are included in Appendix A14.1 (Scheme Walkover Summary) in Volume 4 of this EIAR.

14.2.4 Appraisal Method for the Assessment of Impacts

The impact assessment for this Chapter has been carried out in accordance with the NRA Guidelines (NRA 2008a) and the IGI Guidelines (IGI 2013).

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, as outlined below.

14.2.4.1 Initial Assessment

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

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 Scheme 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 Scheme 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.

14.2.4.2 Direct and Indirect Site Investigation

Information gathered on the baseline environment during specific ground investigations for the Proposed Scheme 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 Scheme are gathered and assessed. Then, the preliminary CSM is refined accordingly.

14.2.4.3 Determination of Likely Significant 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 Table 14.5);
- Box 4.3: Criteria for Rating Site Attributes – Estimation of the Importance of Hydrogeology Attributes (Table 14.6);
- The magnitude of impacts should be defined in accordance with the criteria provided in the NRA Guidelines. This is outlined in Table 14.7);
- Box 5.1: Criteria for Rating Site Attributes at Environmental Impact Assessment (EIA) Stage – Estimation of Magnitude of Impact on Soil / Geology Attribute (Table 14.8);
- Box 5.3: Criteria for Rating Site Attributes at EIA Stage – Estimation of Magnitude of Impact on Hydrogeology Attributes (Table 14.9); and
- Box 5.4: Rating of Significant Environmental Impacts at EIA Stage (Table 14.10).

The NRA Guidelines criteria uses 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 Scheme (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 14.5: Criteria for rating the importance of identified soils and geological attributes (Table C2 (IGI,2013) and Box 4.1 (NRA,2008)).

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
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

Importance	Criteria	Typical Example
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 14.6: Criteria for rating the importance of identified hydrogeological features (Box 4.3 NRA,2008).

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. SAC 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

Table 14.7: Definition of Magnitude of Impact (Table 5.1 (NRA, 2008))

Magnitude of Impact	Description
Imperceptible	An impact capable of measurement but without noticeable consequences
Slight	An impact that alters the character of the environment without affecting its sensitivities
Moderate	An impact that alters the character of the environment in a manner that is consistence with existing or emerging trends
Significant	An impact which by its character, magnitude, duration, or intensity alters a sensitive aspect of the environment
Profound	An impact which obliterates all previous sensitive characteristics

Table 14.8: Criteria for rating Soils and Geology Impact Significance and Magnitude at EIA stage (Table C4 (IGI,2013) and Box 5.1 (NRA, 2008))

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

Magnitude of Impact	Criteria	Typical Example
		Requirement to excavate / remediate significant proportion of waste site Requirement to excavate and replace moderate proportion of peat, organic soils and / or soft mineral soils beneath alignment
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	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
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

Table 14.9: Criteria for rating Hydrogeological Impact Significance and Magnitude at EIA stage (Box 5.3 NRA 2008)

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 14.10: Rating of Significant Environmental Impacts at EIA Stage (NRA 2008)

		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

14.2.4.4 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. Mitigation by design measures which have been incorporated into the design for the Proposed Scheme are also considered in this Section 14.5.

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.

14.3 Baseline Environment

14.3.1 Introduction

This Section describes the existing conditions and important features in terms of the land, soils, geology and hydrogeology within the study area of the Proposed Scheme. A regional overview is followed by a description of site-specific baseline conditions and a CSM. Features are then identified, and their importance ranked in accordance with the NRA Guidelines (NRA 2008a).

14.3.2 Regional Overview

The regional geomorphology, topography, soils and subsoils, bedrock geology and hydrogeology are discussed in this Section for the majority of County Dublin, including the City Centre and extends north to Swords and to Bray in County Wicklow in the south of the region.

14.3.2.1 Regional Topography and Geomorphology

The topography of the region is dominated by the Wicklow Mountains to the south with undulating topography to the north, west and east with localised highs generally synonymous with outcropping rock or near surface bedrock. There is a gradual drop in elevation across the region from west to east approaching the coast.

The landscape of the Greater Dublin Area (GDA) principally reflects the erosional and depositional legacy of the last period of glaciation, which ended some 10,000 years ago following the Devensian geological period. Glacial erosion of pre-existing topographic features and deposition of thick glacial drift deposits, mainly till (boulder clay), resulted in a rather subdued post-glacial topography.

The post-glacial landscape also reflects the effects of fluvial (river) processes that have altered the topography, with the River Liffey and its tributaries dominating the region, since the ice sheet retreat. The topography of the area reflects the geomorphology, showing topographic lows moving eastwards to the sea near Dublin City, becoming steeper to the west, north and south towards the Dublin and Wicklow Mountains.

There are a large number of geomorphology features across the region including mega scale glacial lineation in the north of the region, streamlined bedrock, numerous meltwater channels, hummocky sands and gravel deposits, drumlins, eskers and glaciofluvial terraces throughout the region (refer to Figure 14.1 in Volume 3 of this EIAR).

The post-glacial landscape also reflects the effects of fluvial (river) processes that have altered the topography, albeit only to a small extent in the region, since the ice sheet retreat. The coastline within the region is characterised by sandy beaches and rock outcrops.

The land uses in the region are mainly comprised of urban developments including but not limited to industrial, commercial, residential, and recreational. Moving away from the City Centre there are also marine, agricultural, and forested areas in the region.

14.3.2.2 Regional Soils (Teagasc Classification)

Soils comprise the unconsolidated geological deposits which overlie the subsoil (i.e. the topsoil). The main soils within the region, as classified by Teagasc (Teagasc et al. 2017) are presented on Figure 14.2 in Volume 3 of this

EIAR and have been listed in Table 14.11. The majority of Dublin is underlain by made ground with areas of alluvial, estuarine, and marine deposits present that may be associated with recent and ancient water bodies. To the north of the region, there are soils which are deep and well drained as well as poorly drained soils derived from basic parent material. To the south of the region the soil is derived from acidic material.

Table 14.11: Summary of Soil Types Within the Region

Soil Code	Description	Location
AeoUND	Aeolian undifferentiated	Coast
AlluvMin	Alluvial (min)	Along river courses and meltwater channels
AminDW	Deep well drained mineral soil (mainly acidic)	South towards Bray
AminPD	Mineral poorly drained (mainly acidic)	South towards Bray
AminPDPT	Peaty Gleys Acidic	Near Wicklow mountains
AminSP	Surface water gleys/ Ground water gleys shallow	South towards Bray
AminSW	Shallow well drained mineral soil (mainly acidic)	South towards Bray
AminSRPT	Shallow rocky peaty, non-peaty mineral complexes (mainly acidic)	Near Wicklow mountains
BktPT	Blanket Peat	Near Wicklow mountains
BminDW	Deep well drained mineral soil (mainly basic)	North near Swords
BminPD	Mineral poorly drained (mainly basic)	North near Swords
BminPDPT	Peaty gleys basic parent materials basic	Near Wicklow mountains
BminSP	Surface water gleys/ groundwater gleys shallow	South towards Newcastle
BminSPPT	Peaty gleys shallow	Near Wicklow mountains
BminSRPT	Lithosols peats	Near Wicklow mountains
BminSW	Renzinas/Lithosols	Dublin outskirts
Cut	Raised bog cutaway/cutover	Near Wicklow mountains
FenPT	Fenpeat	Near Wicklow mountains
Lac	Lacustrine sediments	South near Wicklow mountains
Made	Made ground	Dublin City and outskirts
MarSands	Marine sands and gravels	Coast
MarSed	Marine / estuarine sediments	Coast
Scree	Scree	Near Wicklow mountains

14.3.2.3 Regional Subsoils (GSI Quaternary Classification)

Superficial deposits (subsoil) comprise the unconsolidated geological deposits which overlie the solid geology. The subsoils within the region, as classified by the GSI Quaternary mapping (GSI 2016a) are presented on Figure 14.3 in Volume 3 of this EIAR and have been listed in Table 14.12.

During the Pleistocene epoch of the Quaternary, two glaciations covered County Dublin and County Wicklow which gave rise to the deposition of glacial till. Typically, during the ice advance, boulder clays were deposited sub-glacially as lodgement till over the eroded bedrock surface, whilst moraine granular deposits were laid down at the glacier margins.

Subsequently, with the progressive retreat of the ice sheets from the region, granular fluvio-glacial deposits were laid down in places by melt waters discharging from the front of the glacier which are generally encountered as sand and gravel lenses within the glacial till deposits. The glacial deposits can exhibit significant lateral and vertical variations in grain size distributions over short distances.

This glacial till is the predominant subsoil of the region and described as till derived from limestones. The subsoils of the region may also be comprised of made ground where major development has occurred. More recent alluvial deposits (silts and clays and sands and gravels) may be present along historic and recent watercourses.

To the east of the region, along the coast the subsoils consist of estuarine silts and clays and marine beach sands. Outcropping and sub cropping rock and till derived from granites and metamorphic rock are present to the south and west of the region where the topography rises towards the Dublin Mountains and Bray.

Table 14.12: List of Subsoils (Quaternary) Within the Region

Soil Type	Description	Location
A	Alluvium	Along river channels and meltwater channels
Ag	Alluvium (gravelly)	Along river channels and meltwater channels
As,	Alluvium (sandy)	Along river channels and meltwater channels
Asi	Alluvium (silty)	Along river channels and meltwater channels
BktPt	Blanket Peat	Near Wicklow Mountains
Cut	Cut over raised peat	Near Wicklow Mountains
AcEsk	Eskers comprised of gravels of acidic reaction	Tallaght / Ballymount
GCh	Gravels derived from chert	North West Dublin
GLPSsS	Gravels derived from Lower Palaeozoic sandstones and shales	Howth
GLs	Gravels derived from limestones	Dublin City
GMp	Gravels derived from metamorphic rocks	South towards Bray
GGr	Gravels derived from granite	South Dublin
Rck	Bedrock outcrop or subcrop	Localised pockets within Dublin City / near Wicklow Mountains
Scree	Scree	Near Wicklow Mountains
L	Lacustrine sediments	South near Wicklow mountains
Mbs	Marine beach sands	Coast
Mesc	Estuarine silts and clays	Portmarnock
TdlMr	Tidal Marsh	Bull Island
IrSTCSsS	Irish Sea Till derived from Cambrian sandstones and shales	Bray South
IrSTLPSsS	Irish Sea Till derived from Lower Palaeozoic sandstones and shales	Bray South
IrSTLs	Irish Sea Till derived from limestones	South towards Bray
TCSsS	Till derived from Cambrian sandstones and shales	Bray South
TGr	Till derived from granites	South Dublin
TLPSsS	Till derived from Lower Palaeozoic sandstones and shales	South Dublin
TLs	Till derived from limestones	Dublin City
TMp	Till derived from metamorphic rocks	Near Wicklow Mountains
TQz	Till derived from quartzites	South towards Bray
Ws	Windblown sands	Coast
Wsd	Windblown sands and dunes	Coast
Dam	Dam	Tallaght
Embankment	Embankment	Sandyford
Landfill	Landfill	Near Blanchardstown
Urban	Urban (made ground)	Dublin City and outskirts

14.3.2.4 Regional Bedrock Geology

The bedrock geology of the region, as classified by the GSI 1:500,000k Bedrock Geology Map (GSI 2018) are presented on Figure 14.4 in Volume 3 of this EIAR and have been listed in Table 14.13. The region is predominantly underlain by Carboniferous Limestones. The majority of the Dublin City area was a deep marine basin known as the Dublin Basin where these sedimentary rocks were deposited.

To the south of the region, stretching from Dún Laoghaire on the coast in a south to south-west direction and located beneath much of the Dublin and Wicklow Mountains, are the older Caledonian granites known as the Leinster Granite. This is a large intrusion of igneous rock which occurred during the Devonian Period mountain building event known as the Caledonian Orogeny.

The oldest rocks in the region are the Cambrian and Ordovician Metasediments which extend from Loughlinstown towards Bray with the Cambrian Bray Head Formation dominating the Bray to Greystones area and synonymous with the Quartzite of the Sugar Loaf.

The structural geology within the region is highly variable and complex. A series of parallel faults running mainly in a north-west to south-east direction are indicated in the north of the region between Blanchardstown and Dublin Airport. Additional faulting in this area is indicated in a north / north-west to south / south-east direction with associated fold axes both synclinal and anticlinal running in a north-east to south-west direction. The contact between the Lucan formation and the Leinster Granite is characterised by a west-east trending fault. The south of the region is dominated by metamorphic intrusions and north-west / south-east trending faults within the Leinster Granite. The south-eastern section of the region around Bray and Shankill is heavily faulted and folded with a number of west-east thrust faults and numerous north-west / south-east synclinal fold axis.

The depth to bedrock within the region ranges from one metre below ground level (mBGL) in the south-west of the region near Tallaght and the north-west near Blanchardstown to potentially greater than 25mBGL in the Dublin City Centre area and up to 45mBGL in Dublin Port. The bedrock level ranges from 80 metres above Ordnance Datum (mOD) towards the mountainous and inland parts of the region to approximately -40mOD near Dublin Port.

Table 14.13: Rock Formation Within the Region.

Geological Period	Formation	Description	Location
Carboniferous	Visean basinal limestone “Calp”	(Calp) Dark-grey argillaceous and cherty limestone and shale	Central and north County Dublin
	Waulsortian mudbank	Pale grey massive limestone	North-west near the N2 and N3 National Roads, Malahide and Swords
	Courceyan Limestone	Argillaceous dark-grey bioclastic limestone and subsidiary shale	North-west
	Upper Devonian -Lower Carboniferous Old Red Sandstone	Sandstone, conglomerate and siltstone	North of Swords
Caledonian Orogeny (Mountain Building Era)	Caledonian Granite	Granite, granodiorite	South near Bray
Silurian	Silurian sandstone, greywacke and shale	Mudstone, greywacke and conglomerate	South-west
Ordovician	Middle to Upper Ordovician basic volcanics	Basalt-andesite, tuff, slate and mudstone	North-west
	Lower to Middle Ordovician slate	Slate, schist and minor greywacke	South-west
	Lower to Middle Ordovician acid volcanics	Rhyolite and rhyolitic tuff	South-west
	Lower to Middle Ordovician basic volcanics	Basalt- andesite, tuff and shale	South-west
Cambrian	Cambrian Greywacke	Greywacke and Shale	Bray

14.3.2.5 Regional Aquifer Type and Classification

The aquifers of the region (groundwater bearing bodies), as classified by the National Draft Bedrock Aquifer Map (GSI 2019b) are presented on Figure 14.5 in Volume 3 of this EIAR and have been listed in Table 14.14. The GSI (GSI 2019b) has devised a system for classifying the aquifers in Ireland based on the hydrogeological characteristics, size, and productivity of the groundwater resource. The aquifer classes and sub-classes are shown in the National Draft Bedrock Aquifer Map. There are three principal types of aquifer, 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 metres cubed per day (m^3/d)).
- Locally Important Aquifers are capable of supplying locally important abstractions (e.g., smaller public water supplies, group schemes), or good yields ($100m^3/d$ to $400m^3/d$); and
- Poor Aquifers are capable of supplying small abstractions (e.g., domestic supplies), or moderate to low yields ($<100m^3/d$).

The lower permeability glacial till soils which overlay the bedrock (gravelly clay / boulder clay), slow infiltration and restrict recharge to bedrock aquifers. The glacial till is not classified as an aquifer by the GSI.

Under the WFD, the regional hydrogeology has been assessed using the GSI groundwater viewer (GSI 2019b). The regional groundwater bodies (GWB) in the area are (refer to Figure 14.5 in Volume 3 of this EIAR):

- Dublin GWB;
- Swords GWB;
- Kilcullen GWB; and
- Wicklow GWB.

Table 14.14: Aquifer Types Within the Region

Aquifer Type	Location	Description	Code
Locally Important	North and centre of the region	Bedrock which is moderately productive only in local zones	(Ll)
	Bray (south-eastern extent of the region	Gravel	(Lg)
Poor Aquifer	Most of southern extent of the region	Bedrock which is generally unproductive except for local zones	(Pl)

14.3.2.6 Regional Aquifer Vulnerability

Aquifer vulnerability of a groundwater body is the term used to describe the intrinsic geological and hydrogeological characteristics which determine 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. The groundwater vulnerability is determined mainly by the permeability and thickness of the subsoils that underlay the topsoil. For example, bedrock with a thick, low permeability overburden is less vulnerable than bedrock with a thin high permeability, gravel overburden.

The GSI aquifer vulnerability classification guidelines (GSI 2019b), which are outlined in Table 14.15, demonstrate that the aquifers are most at risk in areas where subsoils are thin or absent and where karst features such as swallow holes are present. This is due to the ability of potential contaminants to reach the aquifer in a relatively short period and with little or no contaminant attenuation due to the thin or absent overburden. The regional groundwater vulnerability varies significantly across the region, ranging from Rock at Surface (X) to Low (L) vulnerability.

Table 14.15: Aquifer Vulnerability

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)
Rock at or close to surface (X)	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Extreme (E)	0m – 3.0m	0m – 3.0m	0m – 3.0m	0m – 3.0m	Not applicable
High (H)	>3.0m	3.0m – 10.0m	3.0m – 5.0m	>3.0m	Not applicable
Moderate (M)	Not applicable	>10.0m	5.0m – 10.0m	Not applicable	Not applicable
Low (L)	Not applicable	Not applicable	>10.0m	Not applicable	Not applicable

14.3.2.7 Regional Recharge

Recharge is the amount of rainfall that replenishes the aquifer. It is a function of the effective rainfall, the permeability and thickness of the subsoil and the aquifer characteristics. The GSI Groundwater Recharge mapping for the region indicates annual groundwater recharge across the region ranges from approximately 1mm/yr (millimetre per year) to 600mm/yr as shown on Figure 14.6 in Volume 3 of this EIAR.

14.3.2.8 Regional Groundwater Abstractions

Groundwater resources describe any large spring, well or boreholes which are used as a groundwater abstraction source by domestic, agricultural, commercial, industrial, local authority or group water scheme users.

The GSI keeps a record of groundwater wells drilled (GSI 2019b). However, the record does not state which wells are currently used for abstraction.

In addition to these abstractions, Dublin City Council (DCC) also maintains a database of groundwater and surface water abstractions. However, this data is not available to the public. The EPA have also launched a register of water abstractions, whereby people who abstract 25m^3 (cubic metres) of water or more per day are required to register their water abstraction. However, this data is not available to the public.

Source Protection Zones (SPZ) reports have been produced by the GSI (GSI 2019b) in conjunction with 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 with regard to any sites within the study area.

Groundwater is not used extensively for residential or industrial purposes in the area. The majority of potable water used within the region is abstracted elsewhere and piped to the region, and therefore groundwater abstraction is not considered further in this Chapter.

14.3.2.9 Groundwater Quality and Levels

Based on professional experience and previous ground investigations in the area, groundwater levels are generally within 5m of the surface in Dublin City and are closer to the surface near rivers and streams. Historical groundwater monitoring is available from a monitoring borehole at the GSI Beggar's Bush Office, Dublin 4 (monitored from 1990 to 2000). Groundwater level monitoring has commenced at Beggar's Bush since August 2018 with the data available online (GSI 2019e). Beggar's Bush lies approximately 2 kilometres (km) south-east of the City Centre. There is an inactive EPA monitoring borehole located in Goatstown, Dublin 14 which is approximately 6km south of the City Centre (monitored from 1997 to 2006). The results from both monitoring points show that the groundwater levels have a seasonal range over their entire monitoring record of 0.55m and 0.27m respectively.

The hydro-chemical analyses of groundwater within the Dublin GWB is available at the EPA Ryewater monitoring stations at Carton House, near Maynooth, County Kildare. The limestone groundwater quality is very hard water (350 milligrams per litre (mg/l) to 480mg/l of Calcium carbonate ($CaCO_3$)), with a high alkalinity (300mg/l to 350mg/l ($CaCO_3$)) and conductivities (550 micro siemens per centimetre (µS/cm) to 900µS/cm). The pH is relatively neutral ranging from 6.5 to 7.5.

Further to the south where the region is underlain by granites or the Maulin Formation, the groundwater is softer and less mineralised with hardness values of 100mg/l ($CaCO_3$) to 150mg/l ($CaCO_3$), alkalinity of <50mg/l ($CaCO_3$) and conductivity values of 300µS/cm to 500µS/cm and a lower pH range of 6 to 7.

14.3.2.10 Regional Hydro-Ecology Designated Sites

Designated protected sites within Ireland compiled by the National Parks and Wildlife Service (NPWS) such as Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) could be groundwater dependent habitats and therefore an impact on the hydrogeology could be an impact on a designated site. Further information regarding the designated sites within the region are provided in Chapter 12 (Biodiversity). Only the hydrogeology related impacts on groundwater dependant designated sites are assessed within this Chapter.

14.3.2.11 Regional Geological Heritage

The basic designation for wildlife is the Natural Heritage Area (NHA). This is an area considered important for the habitats present or which holds species of plants and animals whose habitat needs protection. The GSI is compiling a list of geological / geomorphological sites in need of protection through NHA designation (not available

at the time of writing). However, these sites will be compiled from the existing database of County Geological Sites (CGS) (GSI 2019c), as listed in Table 14.16.

Table 14.16: Designated Sites Within the Region.

Designation Code	Designated Site
CGS, SPA	North Bull Island
CGS	Glasnevin Cemetery
CGS	Phoenix Park
CGS	River Poddle
CGS	Greenhills Esker
CGS	Dodder Terraces
CGS	Belgard Quarry
CGS	Killiney Bay
CGS	Enniskerry Delta
CGS	GPO (General Post Office)
CGS	Museum Building, Trinity College Dublin
CGS	Oscar Wilde Statue
CGS	51 St. Stephens Green
CGS	Dublin City Walls
CGS	Temple Bar Street Well
CGS	Guinness Wells
CGS	Kippure
CGS	Lucan Esker
CGS	Liffey Valley Centre road sections
CGS	N4 Lucan cutting
CGS	Ballinascorney Quarry
CGS	Newcastle Buried channel
CGS	Carrickgollogan
CGS	Ballycorus
CGS	Killiney Hill
CGS	White Rock, Killiney
CGS	Ballybetagh Bog
CGS	Dalkey Island
CGS	Killiney Bay
CGS	The Scalp
CGS	Three Rock Mountain
CGS	Blackrock Breccia
CGS	Dalkey Hill
CGS	Murphystone Quarry
CGS	Enniskerry Delta
CGS	Glencullen River
CGS, pNHA	River Dargle Valley
CGS, SAC	Bray Head

14.3.3 Site Specific Environment

The following Section discusses the site-specific conditions (refer to Figure 14.7 to Figure 14.15 in Volume 3 of this EIAR) within the study area for the Proposed Scheme as defined in Section 14.2.1. Where applicable the importance of the attributes for which the impact of the Proposed Scheme is to be assessed are reported in this Section.

14.3.3.1 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 2019), Google Maps (Google 2019), Bing Maps (Bing 2019) and the Corine Land Cover maps (EPA 2018). The historic land use is based on the following OSI (OSI 2019) 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 1995 aerial photography;
- OSI 2000 aerial photography; and
- OSI 2005 aerial photography.

14.3.3.1.1 Talbot Memorial Bridge to Tom Clarke East Link Bridge

This section of the Proposed Scheme forms part of the industrial docklands, which was developed following a land reclamation scheme initiated in the late 17th century, with the construction of warehouses and stores beginning in earnest following the building of the Custom House a century later. Until the large-scale reclamation projects of the 17th and 18th centuries, this area formed part of the slob lands of the broad River Liffey estuary. Historically this section of the study area was renowned for its industrial heritage, with several heavy industries established in the area such as goods stations, ship yards, iron works and timber yards.

The study area has undergone several phases of development and the current land use within the study area is a combination of mixed residential, office and commercial developments.

The Corine Land Cover 2018 classifies the land use on the northern and southern side of the River Liffey, particularly along Custom House Quay, North Wall Quay and Sir John Rogerson's Quay, as industrial, commercial and transport units. Areas along City Quay are detailed as continuous urban fabric.

14.3.3.1.2 Tom Clarke East Link Bridge to Sean Moore Road

This section of the Proposed Scheme developed as a result of reclamation projects around the historic settlements of Ringsend and Irishtown. The area initially developed as a fishing village and later was renowned for its industrial heritage, with several industries established in the area such as glass works, dock yards and lime and salt works. The study area has undergone several phases of development and the current land use within the study area is a combination of mixed residential, office and commercial developments.

The Corine Land Cover 2018 classifies the land use on the eastern side of the proposed DPTOB, particularly the area around York Road, Pigeon House Road and Thorncastle Street as far as Sean Moore Road, as discontinuous urban fabric. The area of land further east along the Poolbeg peninsula is detailed as industrial, commercial and transport units.

14.3.3.2 Geomorphology and Topography

The geomorphology and topography are discussed in order to give context to any potential changes to land, soils, geology, and hydrogeology 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 14.7 in Volume 3 of this EIAR.

14.3.3.2.1 Talbot Memorial Bridge to Tom Clark East Link Bridge

The geomorphology and topography of this section of the Proposed Scheme is dominated by the River Liffey which is associated with a glacial meltwater channel and glacio-fluvial terraces that have been identified to the north of the River Liffey near Custom House Quay and the 3Arena. According to the OSI 10m contours this section is at an elevation of approximately 0mOD.

14.3.3.2.2 Tom Clarke East Link Bridge to Sean Moore Road

The geomorphology and topography of this section of the Proposed Scheme is dominated by the River Liffey which is associated with a glacial meltwater channel as referred to in Section 14.3.3.2.1.

14.3.3.3 Soils (Teagasc Soil Classification)

The majority of the soils expected to be encountered within the study area are made ground comprising varying forms of hard standing materials including road pavements and footpaths. However, there are topsoil and other soils present within the study area for which there are a number of classifications on the Teagasc Soil Map (Teagasc et al. 2017). The main soils within the study area, as classified by Teagasc (Teagasc et al. 2017) are presented on Figure 14.8 in Volume 3 of this EIAR and are listed in Table 14.17 along with their importance with respect to drainage and fertility, as determined by Box 4.1 in the NRA Guidelines (NRA 2008a). Where these soils are important features with respect to possible soft soils or contamination their importance is detailed in Section 14.3.3.8 and Section 14.3.3.9.

14.3.3.3.1 Talbot Memorial Bridge to Tom Clark East Link Bridge

Due to the predominantly urban nature of much of the Proposed Scheme, the majority of this section of the study area is expected to be mainly made ground comprising varying forms of hardstanding materials including road pavements and footpaths. Topsoils are encountered in green areas such as Ringsend Park and grass verges along the Proposed Scheme.

14.3.3.3.2 Tom Clarke East Link Bridge to Sean Moore Road

The underlying soils within this section of the Proposed Scheme are the same as those outlined in Section 14.3.3.3.1.

Table 14.17: Soils within the Study Area

Soil Type	Notes / Description	Location	Importance	Justification for Importance Rating
Made Ground - Made	Associated with urban development	Widespread	Low	Poorly drained and / or low fertility soils
Topsoil	Grassland adjacent to Tom Clarke East Link Bridge and St Patrick's Rowing Club (SPRC) as well as within Ringsend Park and surrounding areas along the Proposed Scheme	Widespread	High	Well drained and / or high fertility soils

14.3.3.4 Subsoil Deposits (GSI Quaternary Classification)

Superficial deposits (subsoil) comprise the unconsolidated geological deposits which overlie the solid geology. The subsoils within the study area, as classified by the GSI Quaternary mapping (GSI 2016a) are presented on Figure 14.9 in Volume 3 of this EIAR and are listed in Table 14.18 along with their importance with respect to feature quality and significance as determined by Box 4.1 of the NRA Guidelines (NRA 2008a). Where these subsoils are important features with respect to possible soft soils or contamination, their importance is detailed in Section 14.3.3.8 and Section 14.3.3.9.

The main subsoils encountered across the Proposed Scheme include made ground, with localised pockets of alluvium, marine beach sands, till derived from limestones, and gravels derived from limestones.

14.3.3.4.1 Talbot Memorial Bridge to Tom Clark East Link Bridge

Made ground deposits are encountered throughout the study area, while gravels derived from limestones are encountered near Custom House Quay and the 3Arena. Till derived from limestones and alluvial deposits are also encountered near Custom House Quay.

14.3.3.4.2 Tom Clarke East Link Bridge to Sean Moore Road

The subsoils encountered within the study area for this section of the Proposed Scheme are made ground deposits, with localised pockets of marine beach sands being identified around Irishtown.

Table 14.18: Subsoils Within the Study Area

Subsoil Type	Description	Location	Importance	Justification for Importance Rating
Made Ground - Urban	Associated with urban development	Widespread	Low	Low value on a local scale
Marine sands - Mbs	Marine beach sands	Irishtown	Medium	Medium value on a local scale
Glacial gravels - GLs	Gravels derived from limestones	Custom House Quay and the 3 Arena	Low	Low value on a local scale
Glacial till - TLs	Till derived from limestones	Custom House Quay	Low	Low value on a local scale

14.3.3.5 Bedrock Geology

The bedrock geology of the study area, as classified by the GSI 1:100,000k Bedrock Geology Map (GSI 2018) are presented on Figure 14.10 in Volume 3 of this EIAR and have been listed in Table 14.19 along with their importance with respect to feature quality and significance as determined by Box 4.1 in the NRA Guidelines (NRA 2008a). Where the bedrock is an important feature with respect to economic geology its importance is detailed in Section 14.3.3.10.

The underlying bedrock of the study area is predominantly comprised of the Lucan Formation. A summary of the bedrock geology along the Proposed Scheme is presented in Table 14.19.

14.3.3.5.1 Talbot Memorial Bridge to Tom Clark East Link Bridge

The bedrock encountered in the study area is the Lucan Formation, a dark Carboniferous limestone and shale. The formation comprises dark-grey to black, fine-grained, occasionally cherty, micritic limestones that weather paler, usually to pale grey.

No structural bedrock features were identified within the study area.

14.3.3.5.2 Tom Clarke East Link Bridge to Sean Moore Road

The underlying bedrock within this section of the Proposed Scheme is the same as those outlined in Section 14.3.3.5.1.

Table 14.19: Rock Formations Within the Study Area

Formation	Description	Location	Importance	Justification for Importance Rating
Lucan	(Calp) Dark Limestone and shale - Carboniferous	Widespread	Low	Low value on a local scale

14.3.3.6 Ground Investigation

A summary of the ground conditions encountered by historical ground investigations adjacent to the Proposed Scheme and the scheme specific ground investigations (listed in Section 14.2.3.2) are presented in Table 14.20 to Table 14.22.

The data presented in the tables below are indicative and strata depth and presence will vary by location. The historical ground investigation data outlined below was undertaken for purposes and projects other than the Proposed Scheme. Therefore, although the historical ground investigation data provides a useful indication of ground conditions, the quality of the data cannot be verified.

The factual scheme specific ground investigation reports are included in Appendix A14.2 (Ground Investigations) in Volume 4 of this EIAR.

Table 14.20: Summary of Ground Conditions Expected to be Encountered by the Proposed Scheme between Talbot Memorial Bridge to Tom Clark East Link Bridge

Strata	General Extent / Location	Top of Strata (mBGL)	Thickness Range (m)
Made Ground	Widespread	0	1 to 6.4
Alluvial Deposits	Widespread	1.6 to 5.0	3.4 to 3.7
Sands & Gravels	Widespread	0.6 to 6.5	5.5 to 8.5
Glacial Till (Brown and Black Boulder Clay with lenses of fluvioglacial sands and gravels)	Widespread	0.3 to 10.9	2.8 to 7.9
Bedrock	Widespread	17 – 17.5	N/A

Table 14.21: Summary of Ground Conditions Expected to be Encountered by the Proposed Scheme over the River Dodder

Strata	General Extent / Location	Top of Strata (mBGL)	Thickness Range (m)
Made Ground	Widespread	0	0.7 to 9.0
Fluvial Sands & Gravels	Widespread	4.2 to 13.5	1.1 to 6.0
Glacial Till	Widespread	5.3 to 19.5	1.5 to 11.78
Bedrock	Widespread	16.0 - 21.5	N/A

Table 14.22: Summary of Ground Conditions Expected to be Encountered by the Proposed Scheme between Tom Clark East Link Bridge to Sean Moore Road

Strata	General Extent/Location	Top of Strata (mBGL)	Thickness Range (m)
Made Ground	Widespread	0	1.2 to 8.0
Alluvial Deposits	Widespread	1.2 to 4.5	7.2 to 9.6
Sands & Gravels	Widespread	0.8 to 4.0	6.8 to 10.4
Marine Beach sands and gravels	Ringsend	1.3 – 2.5	0.6 - 1.7
Glacial Till (Brown and Black Boulder Clay with lenses of fluvioglacial sands and gravels)	Widespread	7.8 to 13.1	N/A
Bedrock	Widespread	N/A	N/A

14.3.3.7 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 (GSI 2019b). Consequently, the risk of karst is deemed negligible due to the geology of the region not being known to contain karst features and will not be further assessed.

14.3.3.8 Soft and / or Unstable Ground

Soft soils consist of peat, fine grained alluvium, or very soft cohesive material. Their presence within the study area could result in an impact if they require excavation and are therefore considered important features. Various sources of information were consulted in establishing these areas within the study area namely:

- Teagasc soil map (Teagasc et. al 2017);
- GSI Quaternary Map (GSI 2016a);
- Ground investigation data;
- Scheme walkover survey; and
- GSI Landslide Events (GSI 2017)

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.

The soft soils identified within the study area are detailed in Table 14.23 along with their importance as determined by 'Box 4.1' of the NRA Guidelines (NRA 2008a).

Table 14.23: Soft Soils Within the Study Area

Feature	Description	Location	Importance	Justification for Importance Rating
Alluvium - AlluvMIN (soils) / A (subsoils)	Alluvial Material	Areas around the Rivers	Low	Volume of soft soil underlying the study area is small and of a local scale.

14.3.3.9 Contaminated Land

Considering the location of the Proposed Scheme in the urban environment, there will likely be some sources of contamination within the made ground throughout the study area. Therefore, the assessment of contaminated land is focused on the footprint and directly on either side of the Proposed Scheme unless there is likely to be a pathway connecting the possible source of contamination to the footprint of the Proposed Scheme.

Various sources of information were consulted in assessing the Proposed Scheme for locations of potential contaminated land:

- CORINE land cover mapping (EPA 2018);
- Teagasc soil map (Teagasc et al. 2017);
- EPA (EPA 2019);
- OSI mapping (OSI 2019);
- The design information as listed in Table 14.4;
- The scheme-specific ground investigations carried out to inform the Proposed Scheme and this EIAR as listed in Table 14.3. These provide useful verification for the data already compiled relating to the baseline environment; and
- Local authority archives and databases as listed in Table 14.1.

The known potential sources of contamination relevant to the Proposed Scheme identified within the study area are detailed in Table 14.24 along with their importance as determined by Box 4.1 of the NRA Guidelines (NRA 2008a).

Soil analysis was carried out on samples retrieved during the ground investigations at depths ranging from 0.5mBGL to 5.0mBGL.

The main findings of the soils analysis carried out along the proposed scheme are as follows:

- 19 no. samples were recovered during the GII Ground Investigation (June 2021) contained in Appendix 14.2 (Ground Investigation Reports) in Volume 4 of this EIAR;
    - 16 no. samples of made ground were recovered, of which:
        - 7 no. were classed as suitable for disposal to an inert licensed landfill;

- 5 no. were classed as requiring disposal to a non-hazardous licensed landfill due to the presence of elevated Poly Aromatic Hydrocarbons (PAHs), chlorides and sulfates;
- 4 no. were classed as requiring disposal to a hazardous licensed landfill due to the samples holding a List of Waste Code 17 05 03*. This is due to the presence of detectable asbestos in one sample and elevated pH in the remaining three samples (>11.5).

o 3 no. samples of natural ground which would be suitable for deposition in a Soil Recovery Facility located in Domain 2 as per the EPA guidance document 'Guidance on waste acceptance criteria at authorised soil recovery facilities', EPA 2020.

Table 14.24: Summary of Potential Sources of Contaminated Land Adjacent to the Proposed Scheme

Feature	Description	Importance	Justification for Importance rating
Industrial (6-inch mapping)	Sugar Store at Custom House Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (6-inch mapping)	Tobacco Store at Custom House Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (6-inch mapping)	Timber Yard at Custom House Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (6-inch mapping)	Vitriol Works at North Wall Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (6-inch mapping)	Gas Works at Sir Rogerson's Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (6-inch mapping)	Timber Yard at Sir Rogerson's Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (6-inch mapping)	Reclaimed land south of the North Wall Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (6-inch mapping)	Lime and Salt Works at Ringsend	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (6-inch mapping)	Glass Works at Ringsend	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (6-inch mapping)	Reclaimed Land at Ringsend and Irishtown to Sean Moore Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (25-inch Mapping)	Railway at Custom House Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (25-inch Mapping)	Goods shed at Custom House Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (25-inch Mapping)	Coal Yard at North Wall Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (25-inch Mapping)	Goods Shed at North Wall Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (25-inch Mapping)	Iron Works at North Wall Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (25-inch Mapping)	Saw Mill/ Timber at North Wall Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (25-inch Mapping)	Slate Tile Yard at North Wall Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (25-inch Mapping)	Coal Depot at Sir Rogerson's Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (25-inch Mapping)	Chemical Works at Sir Rogerson's Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (25-inch Mapping)	Chemical Manure and Oilcake Mill at Sir Rogerson's Quay	Medium	Degree or extent of soil contamination is moderate on a local scale

Feature	Description	Importance	Justification for Importance rating
Industrial (25-inch Mapping)	Granaries at Sir Rogerson's Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (25-inch Mapping)	Coal Yard at York road	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (25-inch Mapping)	Timber Yard at Ringsend	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (25-inch Mapping)	Lead Works at Ringsend	Medium	Degree or extent of soil contamination is moderate on a local scale
Industrial (Cassini)	Chemical Manure Works at Sir Rogerson's Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Various Petrol Stations	Petrol stations along the route	Medium	Degree or extent of soil contamination is moderate on a local scale
Ground conditions from Dodder Public Transport Opening Bridge Ground Investigation	Asbestos found in one sample classified as non-hazardous. 44 No. soil samples classed as non-hazardous due to the saline nature of the estuary. 1 No. sample classified as hazardous for Arsenic and Hydrocarbons. Riverbed grab samples were classified as non-hazardous	Medium	Degree or extent of soil contamination is moderate on a local scale
Ground Conditions from the R16 Ground Investigation	Chrysotile asbestos and exceedances of chloride was found in CP03 above the inert waste limit. Exceedances of Polyaromatic Hydrocarbons (PAH) above the inert waste limits were found in CP02. Sulphates, Chlorides and Total dissolved solids were found in CP04 which also exceed inert waste limits.	Medium	Degree or extent of soil contamination is moderate on a local scale

A summary of the facilities within the study area along with their importance as determined by the NRA Guidelines Box 4.1 (NRA 2008a) is presented in Table 14.25.

Table 14.25: List of EPA Licensed Facilities Within the Study Area

Name	Description	Importance	Justification for Importance Rating
Everlac Paints Limited	Licensed IPC: Hanover Quay (P0468-01)	Medium	Light industrial usage
Brooks Thomas Limited	Licensed IPPC & IPC: Upper Mayor Street (P0345-01)	Medium	Light industrial usage
Swalcliffe Limited	Licensed: Sheriff Street Upper	Medium	Light industrial usage
Sita Environmental Ltd.	Licensed: Sheriff Street Upper	Medium	Light industrial usage
Dean Waste Company Ltd.	Licensed: Sheriff Street Upper	Medium	Light industrial usage
Sir John Rogerson's Quay Gasworks	Licensed (Surrendered): Sir John Rogerson's Quay	Medium	Light industrial usage
Former Hammond Lane Metal Co/Molly and Sherry Site	Licensed (Surrendered): Sir John Rogerson's Quay to the North, Britain Quay to the East, Green Street East to the South, and Benson Street to the West	Medium	Light industrial usage

Name	Description	Importance	Justification for Importance Rating
Site contained by the street frontages	Licensed (Surrendered): 28 and 29 Sir John Rogerson's Quay, Nos. 10, 11, 12 and 13 Cardiff Lane, Site east of No. 10 Hanover Street East	Medium	Light industrial usage

14.3.3.10 Mineral / Aggregate Resources

Considering the location of the Proposed Scheme in the urban environment, there are unlikely to be many opportunities to extract mineral or aggregate resources, however the following datasets were consulted in order to assess the impact of the Proposed Scheme on the economic geology of the study area:

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

No active pits, mines or quarries were identified within the study area. There are no non-metallic mineral locations within the study area.

14.3.3.10.1 Talbot Memorial Bridge to Tom Clark East Link Bridge

The GSI aggregate potential mapping shows the crushed rock aggregate potential along this subsection is mainly low with a moderate crushed rock aggregate potential at Tara Street.

The GSI granular aggregate potential mapping generally shows no granular aggregate potential; however, a small area of high granular aggregate potential is present around Custom House Quay and the 3Arena.

14.3.3.10.2 Tom Clarke East Link Bridge to Sean Moore Road

The GSI aggregate potential mapping shows the crushed rock aggregate potential along this subsection is low.

The GSI granular aggregate potential mapping generally shows no granular aggregate potential; however, a small area of moderate to high granular aggregate potential is present around Irishtown.

A summary of the aggregate resources identified in the study area (refer to Figure 14.11 and Figure 14.12 in Volume 3 of this EIAR) are outlined in Table 14.26 along with their importance as determined by the Box 4.1 of the NRA Guidelines (NRA 2008a).

Table 14.26: GSI Aggregate Potential for the Study Area

GSI Aggregate Potential Type	Potential	Location	Importance	Justification for Importance Rating
Crushed rock aggregate potential	Low potential	Widespread	Low	Uneconomically extractable mineral resource
Crushed rock aggregate potential	Moderate potential	Tara Street	Medium	Sub-economic extractable mineral resource
Granular aggregate potential	Moderate potential	Irishtown	Medium	Sub-economic extractable mineral resource
Granular aggregate potential	High potential	Custom House Quay ,the 3 Arena, Irishtown	Medium	Extractable mineral resource

14.3.3.11 Geological Heritage Areas

There are no Geological Heritage Areas (2019c) within the study area.

14.3.3.12 Aquifer Type and Classification

The GSI Bedrock Aquifer mapping (GSI 2019b) for the study area (refer to Figure 14.13 in Volume 3 of this EIAR) indicates that there is one aquifer type within the study area as summarised in Table 14.27 along with their importance as determined by 'Box 4.3' of the NRA Guidelines (NRA 2008a).

The GSI Gravel Aquifer mapping (GSI 2019b) show there are no gravel aquifers within the study area.

Table 14.27: Summary of Aquifer Types Within the Study Area

Aquifer Type	Description	Location	Importance	Justification for Importance Rating
Locally Important Aquifer. (Ll)	Bedrock which is moderately productive only in local zones	Widespread	Medium	Locally important aquifer which supplies the local area

14.3.3.13 Groundwater Vulnerability

Groundwater vulnerability (GSI 2019b) within the study area is 'low' according to the GSI with s small section of moderate groundwater vulnerability located near Tara Street, as shown on Figure 14.14 in Volume 3 of this EIAR.

14.3.3.14 Groundwater Recharge

The rate of groundwater recharge corresponds to the soil type as shown in Figure 14.8 and Figure 14.15 in Volume 3 of this EIAR. The study area predominately has an annual recharge range of 51-100mm (millimeters).

14.3.3.15 Hydro-ecology

Two pNHAs are identified within study area namely, the Royal Canal and the Grand Canal pNHAs respectively. The canals are protected from groundwater ingress or leakage by a liner and therefore are not considered to be in hydraulic connectivity with the surrounding groundwater. As such these are not considered a groundwater dependent habitat and are not considered further as part of this assessment.

14.3.4 Summary of Features of Importance

The importance ranking of the features, based on Box 4.1 of the NRA Guidelines (NRA 2008a), established for the baseline conditions is summarised below.

Features with an importance ranking of low are not considered further as they will not result in a significant impact according to Box 5.4 of the NRA Guidelines (NRA 2008a) and are summarised in Table 14.28 for completeness. Features with an importance ranking of medium or higher are summarised in Table 14.29 and the impact of the Proposed Scheme on these features will be assessed in Section 14.4.

Table 14.28: Summary of Land, Soils, Geology and Hydrogeology Features with Low Importance Within the Study Area

Category	Feature	Description	Location	Importance	Justification
Soil Fertility	Made Ground - Made	Associated with urban development	Widespread	Low	Poorly drained and / or low fertility soils
Subsoils quality and significance	Made Ground - Urban	Associated with urban development	Widespread	Low	Low value on a local scale
Subsoils quality and significance	Glacial gravels - GLs	Gravels derived from limestones	Custom House Quay and the 3 Arena	Low	Low value on a local scale
Subsoils quality and significance	Glacial till - TLs	Till derived from limestones	Custom House Quay	Low	Low value on a local scale
Bedrock quality and significance	Lucan	(Calp) Dark Limestone and shale - Carboniferous	Widespread	Low	Low value on a local scale
Economic Geology	Crushed rock aggregate potential	Low potential	Widespread	Low	Uneconomically extractable mineral resource

Table 14.29: Summary of Land, Soils, Geology and Hydrogeology Features with Medium to Extremely High Importance Within the Study Area

Category	Feature	Description	Location	Importance	Justification
Subsoils quality and significance	Marine sands - Mbs	Marine beach sands	Irishtown	Medium	Medium value on a local scale
Soil Fertility	Topsoil	Dodder Public Transport Opening Bridge as well as within Ringsend Park and surrounding areas where the existing shared user path is to be extended as far as Sean Moore Road.	Widespread	High	Well drained and / or high fertility soils
Potential source of contamination	Industrial (6-inch mapping)	Sugar Store	Custom House Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (6-inch mapping)	Tobacco Store	Custom House Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (6-inch mapping)	Timber Yard	Custom House Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (6-inch mapping)	Vitriol Works	North Wall Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (6-inch mapping)	Gas Works	Sir Rogerson's Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (6-inch mapping)	Timber Yard	Sir Rogerson's Quay	Medium	Degree or extent of soil contamination is moderate on a local scale

Category	Feature	Description	Location	Importance	Justification
Potential source of contamination	Industrial (6-inch mapping)	Reclaimed land	south of the North Wall Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (6-inch mapping)	Lime and Salt Works	Ringsend	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (6-inch mapping)	Glass Works	Ringsend	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (6-inch mapping)	Reclaimed Land	Ringsend and Irishtown to Sean Moore Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (25-inch Mapping)	Railway	Custom House Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (25-inch Mapping)	Goods shed	Custom House Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (25-inch Mapping)	Coal Yard	North Wall Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (25-inch Mapping)	Goods Shed	North Wall Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (25-inch Mapping)	Iron Works	North Wall Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (25-inch Mapping)	Saw Mill/ Timber	North Wall Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (25-inch Mapping)	Slate Tile Yard	North Wall Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (25-inch Mapping)	Coal Depot	Sir Rogerson's Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (25-inch Mapping)	Chemical Works at Sir Rogerson's Quay	Sir Rogerson's Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (25-inch Mapping)	Chemical Manure and Oilcake Mill at Sir Rogerson's Quay	Sir Rogerson's Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (25-inch Mapping)	Granaries at Sir Rogerson's Quay	Sir Rogerson's Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (25-inch Mapping)	Coal Yard at York road	York road	Medium	Degree or extent of soil contamination is moderate on a local scale

Category	Feature	Description	Location	Importance	Justification
Potential source of contamination	Industrial (25-inch Mapping)	Timber Yard at Ringsend	Ringsend	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (25-inch Mapping)	Lead Works at Ringsend	Ringsend	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Industrial (Cassini)	Chemical Manure Works at Sir Rogerson's Quay	Sir Rogerson's Quay	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Various Petrol Stations	Petrol stations along the route	Grand Canal and Ringsend	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Ground conditions from Ground Investigation	Asbestos found in one sample classified as non-hazardous. 44 No. soil samples classed as non-hazardous due to the saline nature of the estuary. 1 No. sample classified as hazardous for Arsenic and Hydrocarbons. Riverbed grab samples were classified as non-hazardous	Dodder Public Transport Opening Bridge	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential source of contamination	Ground Conditions from the R16 Ground Investigation	Chrysotile asbestos found in CP03, which also showed exceedances in chloride above the inert waste limit, along with PAH in CP02. Sulphates, Chlorides and Total dissolved solids found in CP04 also exceed inert waste limits	4 Cable Percussive holes near the two Scherzer Bridges	Medium	Degree or extent of soil contamination is moderate on a local scale
Licenced Facility	Everlac Paints Limited	Licensed: Hanover Quay	Hanover Quay	Medium	Light industrial usage
Licenced Facility	Brooks Thomas Limited	Licensed: Upper Mayor Street	Upper Mayor Street	Medium	Light industrial usage
Licenced Facility	Swalcliffe Limited	Licensed: Sheriff Street Upper	Sheriff Street Upper	Medium	Light industrial usage
Licenced Facility	Sita Environmental Ltd.	Licensed: Sheriff Street Upper	Sheriff Street Upper	Medium	Light industrial usage
Licenced Facility	Dean Waste Company Ltd.	Licensed: Sheriff Street Upper	Sheriff Street Upper	Medium	Light industrial usage
Licenced Facility	Sir John Rogerson's Quay Gasworks	Licensed (Surrendered): Sir John Rogerson's Quay	Sir John Rogerson's Quay	Medium	Light industrial usage
Licenced Facility	Former Hammond Lane Metal Co/Molly and Sherry Site	Licensed (Surrendered): Sir John Rogerson's Quay to the North, Britain Quay to the East, Green Street East to the South, and Benson Street to the West	Sir John Rogerson's Quay to the North, Britain Quay to the East, Green Street East to the South, and Benson Street to the West	Medium	Light industrial usage

Category	Feature	Description	Location	Importance	Justification
Licenced Facility	Site contained by the street frontages	Licensed (Surrendered): 28 and 29 Sir John Rogerson's Quay, Nos. 10, 11, 12 and 13 Cardiff Lane, Site east of No. 10 Hanover Street East	28 and 29 Sir John Rogerson's Quay, Nos. 10, 11, 12 and 13 Cardiff Lane, Site east of No. 10 Hanover Street East	Medium	Light industrial usage
Economic Geology	Crushed rock aggregate potential	Moderate potential	Tara Street	Medium	Sub-economic extractable mineral resource
Economic Geology	Granular aggregate potential	Moderate potential	Irishtown	Medium	Sub-economic extractable mineral resource
Economic Geology	Granular aggregate potential	High Potential	Custom House Quay, the 3 Arena, Irishtown	Medium	economic extractable mineral resource
Aquifer	Locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Widespread	Medium	Locally important aquifer which supplies the local area

14.3.5 Conceptual Site Model

A tabulated Conceptual Site Model (CSM) was developed based on all publicly available data, along with the project specific data that was provided.

The Proposed Scheme is predominantly underlain by made ground over alluvial / estuarine sediments over glacial till over limestone bedrock. The relevant subsections of the Proposed Scheme are presented in Table 14.30 along with the fill height (average and maximum) cut height (average and maximum) and the soils and geology at each earthwork areas.

Table 14.30: Conceptual Site Model – Talbot Memorial Bridge to Tom Clarke East Link Bridge

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)
			Max	Avg	Max	Avg		
North Wall Quay	1,560	At Grade	0	0	0	0	Made ground overlying alluvium, sands and gravels overlying glacial till and bedrock	5m
Georges Dock Scherzer Bridges (and Replacement Carriageway Bridge)	Approximately 17	Structure	No Cut / Fill due to existence of structure				Made ground overlying glacial till and bedrock	5.8m
Royal Canal Scherzer Bridges (and Replacement Carriageway Bridges)	Approximately 13.5	Structure	No Cut / Fill due to existence of structure				Made ground overlying marine sands and gravels overlying glacial till and bedrock	4.5m
Pedestrian Boardwalk at Excise Walk / North Wall Quay	Approximately 58	Structure	No Cut / Fill due to existence of structure				Made ground overlying alluvium, sands and gravels overlying glacial till and bedrock	5m
Pedestrian Boardwalk at Custom House Quay	Approximately 58	Structure	No Cut / Fill due to existence of structure				Made ground overlying alluvium, sands and gravels overlying glacial till and bedrock	5m
South Quays: City Quay / Sir John Rogerson's Quay	1,460	At Grade	0.5	0.5	0	0	Made ground overlying alluvium, sands and gravels overlying glacial till and bedrock	5m
Dodder Public Transport Opening Bridge (DPTOB)	Approximately 140	Structure	No Cut / Fill due to existence of structure				Made Ground overlying Fluvial and gravel deposits overlying Glacial till and Bedrock	9m

Table 14.31: Conceptual Site Model – Tom Clark East Link Bridge to Sean Moore Road

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)
			Max	Avg	Max	Avg		
Ringsend cycle route	1,100	At Grade	0.2	0.2	0	0	Road pavement and foundation or landscaped parkland on silt / sand	5m

14.3.5.1 Environment Type

The environment across the study area has been categorized in accordance with the IGI Guidelines. It has been classified as:

- Type A environment which corresponds to a passive geological / hydrogeological environment – examples include areas of thick low permeability subsoils, areas underlain by poor aquifers, recharge areas, historically stable geological environments.

14.4 Potential Impacts

This section presents potential impacts that may occur due to the Proposed Scheme, in the absence of mitigation. This informs the need for mitigation or monitoring to be proposed (refer to Section 14.5). Predicted 'residual' impacts taking into account any proposed mitigation is presented in Section 14.6.

14.4.1 Characteristics of the Proposed Scheme

A detailed description of the Proposed Scheme and construction activities are provided in Chapter 4 (Proposed Scheme Description) and Chapter 5 (Construction).

This Section outlines the key design features, characteristics and construction activities of the Proposed Scheme of relevance to land, soils, geology and hydrogeology.

A Construction Environmental Management Plan (CEMP) is provided in Appendix A5.1 in Volume 4 of this EIAR.

14.4.1.1 Talbot Memorial Bridge to Tom Clark East Link Bridge

The primary construction activities to be carried out within this section of the Proposed Scheme comprise of the following:

- Reconstruction of road carriageway along this section of the Proposed Scheme including realignment and reconstruction of the road carriageway, cycle paths, and bus lanes;
- Diversion of services and utilities where required;
- The existing Scherzer Bridges and adjacent steel and wooden pedestrian bridges at George's Dock and the Royal Canal will be deconstructed. The Scherzer Bridges will be relocated just north and south of the existing carriageway. Groundworks including piling will be required at both locations;
- A new fixed concrete bridge will be provided across Georges Dock entry channel and Royal Canal entry channel;
- Two separate new pedestrian boardwalks will be installed. The first pedestrian boardwalk will be installed on Custom House Quay. The boardwalk will be installed in part on 3 no. hollow steel piles which will be driven from a landside or barged mounted vibratory piling rig and the second boardwalk will be constructed at the Excise Walk / North Wall Quay junction, ground anchors will be installed from the barge side through core holes in the quay wall;
- The DPTOB will be constructed over the confluence of the River Dodder and River Liffey, from Sir John Rogerson's Quay to York Road / south side of the Tom Clarke (East Link) Bridge, comprising of the following:
    - Construction of a new control building for operating the bridge and relocation of existing marina and rowing club facilities onto the reclaimed land to the west of the existing Tom Clarke East Link Bridge;
    - The bridge works will require quay wall realignment and infilling along the eastern approach;
    - Bored piles are to be carried out behind the quay wall along Sir John Rogerson's Quay with the construction of pile caps and an abutment wall;
    - On the eastern side of the proposed bridge, there will be construction of permanent and temporary sheet pile walls, reclamation of land from the River Liffey, excavation for the bridge east abutment. Bored piles are to be carried out along with the construction of pile cap and abutment wall; and

- Temporary works will be required within the River Dodder for the bridge piers. These works include braced sheet pile cofferdams from a jack-up barge or temporary access bridge to allow for the construction of the two piers. Installation of pier steeled cased reinforced concrete bored piles within the confines of the cofferdams, dewatering of the cofferdams and excavation to the underside pier pile caps as well as the construction of temporary working platforms to allow pile cap construction. Cutting down of steel casings and concrete piles to the underside of each pile cap level will be carried out along with the construction of in situ pile caps and pier walls.

- Erection of Construction Compound R1, R2, and R3A/R3B which will be located on the north side of Custom House Quay at George's Dock; on the north side of North Wall Quay at Royal Canal; and on the eastern end of Sir John Rogerson's Quay respectively (see Chapter 5 (Construction) for further details).

14.4.1.2 Tom Clarke East Link Bridge to Sean Moore Road

The primary construction activities to be carried out within this section of the Proposed Scheme comprise of the following:

- The existing paths within Ringsend Park (and along adjoining routes at its southern fringes) will be widened and upgraded to provide an adjacent cycleway, with footpath pavement improvements where required; and
- Construction Compound R4 will be located southwest of the existing Tom Clarke East Link Bridge.

14.4.1.3 Operational Phase

The impact assessment for the Operational Phase has been outlined in terms of impact analysis of the Proposed Scheme on the local environment from a land, soils, geology, and hydrogeology perspective. This is outlined in the following sections.

14.4.2 'Do Nothing' Scenario

In the 'Do Nothing' scenario the Proposed Scheme would not be implemented and there would be no resulting impacts on the land, soils, geology and hydrogeology along the route of the Proposed Scheme. The impact would therefore be neutral.

14.4.3 Construction Phase

The potential land, soils, geology and hydrogeology impacts during the construction phase for the relevant construction activities described in Section 14.4.1 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. Specific interactions are outlined in Section 14.1.

The Proposed Scheme will have the following potential impacts on land, soils, geology, and hydrogeology as discussed below and summarised in Table 14.32.

- Loss or damage of topsoil;
- Excavation of potentially contaminated ground;
- Loss of future quarry or pit reserve;
- Loss or damage of proportion of aquifer; and
- Change to groundwater regime

Though the magnitude of the impact may vary depending on the scale of activities and location of the Proposed Scheme 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 Scheme is considered.

14.4.3.1 Loss and damage of topsoil

Topsoil is a non-renewable resource which if removed or damaged can result in a permanent irreversible negative impact. The potential ways in which this can occur as a result of the Proposed Scheme are as follows:

- There is the potential for materials on site to be spilled resulting in the pollution of the topsoil. For example, raw or uncured concrete and grouts, washed down water from exposed aggregate surfaces, cast-in-place concrete from concrete trucks, fuels, lubricants and hydraulic fluids for equipment used on site, bitumen and sealants used for waterproofing concrete surfaces can all potentially impact on soils and groundwater during the Construction Phase;
- These excavated soil materials 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 during construction works may mobilise pollution contained in the soils into the nearby topsoil;
- Permanent damage of topsoil through waterlogging, sealing, washout of fines and erosion. This would be due to the trafficking of plant, regrading of slopes, laying of hardstanding surfaces and storage of materials in areas not intended to be paved as part of the Proposed Scheme; and
- Excavation and disposal of topsoil instead of its reuse or reinstatement.

Topsoil is encountered in only a few locations across the Proposed Scheme as discussed in Section 14.3.3.3. Where topsoil is stripped to accommodate construction activities, all of the above impacts are likely to occur at these locations. Such impacts on topsoil are particularly likely in the area around the proposed DPTOB as well as within Ringsend Park (and its surrounds) where the existing shared user path is to be extended as far as Sean Moore Road.

The magnitude of these impacts on topsoil in proximity to the Proposed Scheme is considered small adverse as it results in a permanent irreversible loss of only a very small proportion of locally high fertility topsoil within the study area. As the topsoil is of high importance with respect to drainage and fertility, the resulting significance of this permanent small adverse impact is slight.

The impact of the Proposed Scheme on the marine sands is negligible. As these soils are of medium importance the resulting significance of this negligible impact is imperceptible.

14.4.3.2 Excavation of Potentially Contaminated Land

The excavation of made ground results in the production of excess material that requires placement elsewhere in the Proposed Scheme, removal off-site, and / or the mobilisation of possible contaminants. The entirety of the Proposed Scheme will encounter made ground as discussed in Section 14.3.3.1 and Section 14.3.3.3.

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 the EPA guidance on Land Contamination (EPA 2013). The underlying soil could be impacted from the exposure of previously buried hazardous material, in an unlicensed dumping site for example.

Potential sources of contamination relevant to the Proposed Scheme identified within the study area are detailed in Table 14.24 and include reclaimed land, petrol stations and historic industries. It is expected that some contaminated land in the area has been remediated through construction activities over the years.

The magnitude of this impact is small adverse as it results in the excavation of a small proportion of contaminated land where the proposed DPTOB is to be located, along with the works associated with the Scherzer Bridges.

As the potential contaminated ground is of medium importance the resulting significance of the permanent small adverse impact is slight.

14.4.3.3 Loss of Future Quarry or Pit Reserve

The excavation of soil and rock during construction can diminish future quarry and pit reserves. This can result in a permanent irreversible loss of the in-situ characteristics of the land, soils and geology area. There are no notable existing or historic quarries within the study area of the Proposed Scheme.

The magnitude of this impact is negligible as it results in an insufficient permanent irreversible change on a local scale to affect the integrity of the land and soils above the Do Nothing scenario. As the aggregate potential is of medium importance the resulting significance of this negligible impact will be imperceptible and will not be considered further.

14.4.3.4 Loss or damage of proportion of aquifer

The removal of a proportion of an aquifer can reduce its ability to provide baseflow to groundwater dependant habitats and / or water supplies, and results in an irreversible loss of the in-situ characteristics of the land, soils, geology and hydrogeology. Likewise, 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 underlying limestone bedrock is defined as a locally important aquifer, where there is anticipated to be minimal excavation into the limestone rock as part of the Proposed Scheme. The magnitude of this impact is negligible as it results in no measurable change which may affect the integrity of the underlying aquifer. As the aquifer is a locally important aquifer of medium importance, the resulting significance of this negligible impact is imperceptible and will not be considered further.

In addition to the above impact, potential pollutants from routine run-off during construction or mobilisation of pollution from the disturbance of contaminated ground during construction activities (particularly excavations) have the potential to alter the groundwater quality temporarily in the study area. The magnitude of this impact is moderate adverse as it results in a temporary potential medium risk of pollution to groundwater. As the aquifer is a locally important aquifer of medium importance the resulting significant of this temporary moderate adverse impact is moderate.

14.4.3.5 Change to groundwater regime

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

Since the pumping is expected to be limited, localised and temporary, the magnitude of this impact is considered negligible. As the importance of the locally important aquifer is medium, the resulting significance is imperceptible and therefore will not be considered further.

Table 14.32 Summary of Predicted Construction Phase Impacts

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Loss of damage of Topsoil									
Topsoil	Dodder Public Transport Opening Bridge as well as within Ringsend Park and surrounding areas where the existing shared user path is to be extended as far as Sean Moore Road.	Dodder Public Transport Opening Bridge as well as within Ringsend Park and surrounding areas where the existing shared user path is to be extended as far as Sean Moore Road.	High	Well drained and / or high fertility soils	Negative	Permanent	Local	Small adverse	Slight
Excavation of potentially contaminated ground									
Potential Sources of Contamination	Sugar Store at Custom House Quay- Industrial (6-inch mapping)	Custom House Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Tobacco Store at Custom House Quay- Industrial (6-inch mapping)	Custom House Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Timber Yard at Custom House Quay- Industrial (6-inch mapping)	Custom House Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Vitriol Works at North Wall Quay- Industrial (6-inch mapping)	North Wall Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Gas Works at Sir Rogerson's Quay- Industrial (6-inch mapping)	Sir Rogerson's Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Timber Yard at Sir Rogerson's Quay- Industrial (6-inch mapping)	Sir Rogerson's Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Reclaimed land south of the North Wall Quay- Industrial (6-inch mapping)	south of the North Wall Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Lime and Salt Works at Ringsend- Industrial (6-inch mapping)	Ringsend	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Glass Works at Ringsend - Industrial (6-inch mapping)	Ringsend	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Potential Sources of Contamination	Reclaimed Land at Ringsend and Irishtown to Sean Moore Road- Industrial (6-inch mapping)	Ringsend and Irishtown to Sean Moore Road	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Railway at Custom House Quay- Industrial (25-inch Mapping)	Custom House Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Goods shed at Custom House Quay- Industrial (25-inch Mapping)	Custom House Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Coal Yard at North Wall Quay- Industrial (25-inch Mapping)	North Wall Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Goods Shed at North Wall Quay- Industrial (25-inch Mapping)	North Wall Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Iron Works at North Wall Quay- Industrial (25-inch Mapping)	North Wall Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Saw Mill/ Timber at North Wall Quay- Industrial (25-inch Mapping)	North Wall Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Slate Tile Yard at North Wall Quay- Industrial (25-inch Mapping)	North Wall Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Coal Depot at Sir Rogerson's Quay- Industrial (25-inch Mapping)	Sir Rogerson's Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Chemical Works at Sir Rogerson's Quay- Industrial (25-inch Mapping)	Sir Rogerson's Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Chemical Manure and Oilcake Mill at Sir Rogerson's Quay- Industrial (25-inch Mapping)	Sir Rogerson's Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Granaries at Sir Rogerson's Quay- Industrial (25-inch Mapping)	Sir Rogerson's Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Potential Sources of Contamination	Coal Yard at York road- Industrial (25-inch Mapping)	York road	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Timber Yard at Ringsend- Industrial (25-inch Mapping)	Ringsend	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Lead Works at Ringsend- Industrial (25-inch Mapping)	Ringsend	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Chemical Manure Works at Sir Rogerson's Quay- Industrial (Cassini)	Sir Rogerson's Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Petrol stations along the route	Grand Canal and Ringsend	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential sources of contamination	Ground conditions from Ground Investigation. Asbestos found in one sample classified as non-hazardous. 44 No. soil samples classed as non-hazardous due to the saline nature of the estuary. 1 No. sample classified as hazardous for Arsenic and Hydrocarbons. Riverbed grab samples were classified as non-hazardous	Dodder Public Transport Opening Bridge	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential sources of contamination	Ground Conditions from the R16 Ground Investigation. Chrysotile asbestos found in CP03, which also showed exceedances in chloride above the inert waste limit, along with PAH in CP02. Sulphates, Chlorides and Total dissolved solids found in CP04 also exceed inert waste limits	4 Cable Percussive holes near the two Scherzer Bridges	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Licenced Facilities	Swalcliffe Limited - Waste Licensed: Sheriff Street Upper	Hanover Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Licenced Facilities	Sita Environmental Ltd.- Waste Licensed: Sheriff Street Upper	Upper Mayor Street	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Licenced Facilities	Dean Waste Company Ltd.- Waste Licensed: Sheriff Street Upper	Sheriff Street Upper	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Licenced Facilities	Sir John Rogerson's Quay Gasworks - Waste Licensed (Surrendered): Sir John Rogerson's Quay	Sheriff Street Upper	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Licenced Facilities	Former Hammond Lane Metal Co/Molly and Sherry Site - Waste Licensed (Surrendered): Sir John Rogerson's Quay to the North, Britain Quay to the East, Green Street East to the South, and Benson Street to the West	Sheriff Street Upper	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Licenced Facilities	Site contained by the street frontages - Waste Licensed (Surrendered): 28 and 29 Sir John Rogerson's Quay, Nos. 10, 11, 12 and 13 Cardiff Lane, Site east of No. 10 Hanover Street East	Sir John Rogerson's Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Loss of Future Quarry or Pit reserves									
Crushed rock aggregate potential	Moderate potential	Tara Street	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Granular aggregate potential	Moderate to high potential	Custom House Quay, the 3 Arena, Irishtown	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Loss or damage of proportion of Aquifer									
Locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Widespread	Medium	Loss or damage of proportion of aquifer through excavation	Negative	Permanent	Local	Negligible	Imperceptible
Locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Widespread	Medium	Loss or damage of proportion of aquifer through pollution.	Negative	Temporary	Local	Moderate Adverse	Moderate
Change to groundwater regime									
Locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Widespread	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible

14.4.4 Operational Phase

14.4.4.1 Contamination

The Operational Phase has the potential to lead to occasional accidental leakage of oil, petrol or diesel, allowing 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.

14.5 Mitigation and Monitoring Measures

The following Sections outline the mitigation and monitoring measures associated with the impacts identified in Section 14.4 for both the Construction and the Operational phases of the Proposed Scheme. A summary of the pre-mitigation and post-mitigation impacts is contained in Table 14.33.

14.5.1 Construction Phase

14.5.1.1 Loss or damage of topsoil

Excavated topsoil will be stockpiled by the appointed contractor using appropriate methods to minimise the effects of weathering. Care will be taken in reworking this material to minimise dust generation, groundwater infiltration and the generation of runoff.

All topsoil or subsoil shall be assessed for re-use within the Proposed Scheme by the appointed contractor ensuring the appropriate handling, processing and segregation of the material. Where practical the removal of soil from the Proposed Scheme 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.

The impact of the production of excess material for removal off site is discussed in Chapter 18 (Waste & Resources).

14.5.1.2 Excavation of Potentially Contaminated Land

The appointed contractor will ensure that excavations shall be kept to a minimum, using shoring or trench boxes where appropriate. For more extensive excavations, a temporary works designer shall be appointed by the appointed contractor to design excavation support measures in accordance with all relevant guidelines that minimises the excavation of contaminated ground.

The appointed contractor will be responsible for regular testing of excavated soils to monitor the suitability of the soil for reuse.

Samples of ground suspected of contamination will be tested for contamination during the detailed ground investigation and ground excavated from these areas will be disposed of to a suitably licensed or permitted sites in accordance with the current Irish waste management legislation.

Any dewatering in areas of contaminated ground shall be designed by the appointed contractor to minimise the mobilisation of contaminants into the surrounding environment.

14.5.1.3 Pollution of soil and groundwater

Good construction management practices as outlined in the CIRA guidance Control of Water Pollution from Construction Sites – Guidance for consultants and contractors (Master-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 by the appointed contractor 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 in 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 Compound. These are to be designed in accordance with relevant guidelines and codes of best practice at the time of construction 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 measures 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 Environmental 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 shall 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 Appendix A5.1 CEMP in Volume 4 of this EIAR.

Sediment control methods are outlined in the Surface Water Management Plan in Appendix A5.1 (CEMP) 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.

14.5.2 Operational Phase

With the implementation of the proposed design, no additional mitigation measures for land, soils, geology and hydrogeology are considered necessary for the operation of the Proposed Scheme.

In the Operational Phase the infrastructure will be maintained by the local authority and will be subject to their management procedures to ensure that the correct measures to be taken in the event of any accidental spillages and this will reduce the potential for any impact.

14.6 Residual Impacts

14.6.1 Construction Phase

With the efficacious implementation of the above mitigation measures, there will be no significant residual adverse impacts on land, soil, geology or hydrogeology as a result of the construction of the Proposed Scheme.

Table 14.33 Summary of Predicted Construction Phase Impacts Following the Implementation of Mitigation and Monitoring Measures

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Loss of damage of Topsoil											
Topsoil	Dodder Public Transport Opening Bridge as well as within Ringsend Park and surrounding areas where the existing shared user path is to be extended as far as Sean Moore Road.	Dodder Public Transport Opening Bridge as well as within Ringsend Park and surrounding areas where the existing shared user path is to be extended as far as Sean Moore Road.	High	Well drained and / or high fertility soils	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Excavation of potentially contaminated ground											
Potential Sources of Contamination	Sugar Store at Custom House Quay- Industrial (6-inch mapping)	Custom House Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Tobacco Store at Custom House Quay- Industrial (6-inch mapping)	Custom House Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Timber Yard at Custom House Quay- Industrial (6-inch mapping)	Custom House Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Vitriol Works at North Wall Quay- Industrial (6-inch mapping)	North Wall Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Gas Works at Sir Rogerson's Quay- Industrial (6-inch mapping)	Sir Rogerson's Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Timber Yard at Sir Rogerson's Quay- Industrial (6-inch mapping)	Sir Rogerson's Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Reclaimed land south of the North Wall Quay- Industrial (6-inch mapping)	south of the North Wall Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Potential Sources of Contamination	Lime and Salt Works at Ringsend- Industrial (6-inch mapping)	Ringsend	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Glass Works at Ringsend - Industrial (6-inch mapping)	Ringsend	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Reclaimed Land at Ringsend and Irishtown to Sean Moore Road- Industrial (6-inch mapping)	Ringsend and Irishtown to Sean Moore Road	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Railway at Custom House Quay- Industrial (25-inch Mapping)	Custom House Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Goods shed at Custom House Quay- Industrial (25-inch Mapping)	Custom House Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Coal Yard at North Wall Quay- Industrial (25-inch Mapping)	North Wall Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Goods Shed at North Wall Quay- Industrial (25-inch Mapping)	North Wall Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Iron Works at North Wall Quay- Industrial (25-inch Mapping)	North Wall Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Saw Mill/ Timber at North Wall Quay- Industrial (25-inch Mapping)	North Wall Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Slate Tile Yard at North Wall Quay- Industrial (25-inch Mapping)	North Wall Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Coal Depot at Sir Rogerson's Quay- Industrial (25-inch Mapping)	Sir Rogerson's Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Chemical Works at Sir Rogerson's Quay- Industrial (25-inch Mapping)	Sir Rogerson's Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Potential Sources of Contamination	Chemical Manure and Oilcake Mill at Sir Rogerson's Quay- Industrial (25-inch Mapping)	Sir Rogerson's Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Granaries at Sir Rogerson's Quay- Industrial (25-inch Mapping)	Sir Rogerson's Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Coal Yard at York road- Industrial (25-inch Mapping)	York road	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Timber Yard at Ringsend- Industrial (25-inch Mapping)	Ringsend	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Lead Works at Ringsend- Industrial (25-inch Mapping)	Ringsend	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Chemical Manure Works at Sir Rogerson's Quay- Industrial (Cassini)	Sir Rogerson's Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Petrol stations along the route	Grand Canal and Ringsend	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential source of contamination	Ground conditions from Ground Investigation. Asbestos found in one sample classified as non-hazardous. 44 No. soil samples classed as non-hazardous due to the saline nature of the estuary. 1 No. sample classified as hazardous for Arsenic and Hydrocarbons. Riverbed grab samples were classified as non-hazardous	Dodder Public Transport Opening Bridge	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Potential source of contamination	Ground Conditions from the R16 Ground Investigation. Chrysotile asbestos found in CP03, which also showed exceedances in chloride above the inert waste limit, along with PAH in CP02. Sulphates, Chlorides and Total dissolved solids found in CP04 also exceed inert waste limits	4 Cable Percussive holes near the two Scherzer Bridges	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Licenced Facilities	Swalcliffe Limited - Waste Licensed: Sheriff Street Upper	Hanover Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Licenced Facilities	Sita Environmental Ltd.- Waste Licensed: Sheriff Street Upper	Upper Mayor Street	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Licenced Facilities	Dean Waste Company Ltd.- Waste Licensed: Sheriff Street Upper	Sheriff Street Upper	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Licenced Facilities	Sir John Rogerson's Quay Gasworks - Waste Licensed (Surrendered): Sir John Rogerson's Quay	Sheriff Street Upper	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Licenced Facilities	Former Hammond Lane Metal Co/Molly and Sherry Site - Waste Licensed (Surrendered): Sir John Rogerson's Quay to the North, Britain Quay to the East, Green Street East to the South, and Benson Street to the West	Sheriff Street Upper	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Licenced Facilities	Site contained by the street frontages - Waste Licensed (Surrendered): 28 and 29 Sir John Rogerson's Quay, Nos. 10, 11, 12 and 13 Cardiff Lane, Site east of No. 10 Hanover Street East	Sir John Rogerson's Quay	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Potential source of contamination	Ground conditions from Ground Investigation. Asbestos found in one sample classified as non-hazardous. 44 No. soil samples classed as non-hazardous due to the saline nature of the estuary. 1 No. sample classified as hazardous for Arsenic and Hydrocarbons. Riverbed grab samples were classified as non-hazardous		Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Loss of Future Quarry or Pit reserves											
Crushed rock aggregate potential	Moderate potential	Tara Street	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Granular aggregate potential	Moderate potential	Custom House Quay, the 3 Arena, Irishtown	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Loss or damage of proportion of Aquifer											
Locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Widespread	Medium	Loss or damage of proportion of aquifer through excavation	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Widespread	Medium	Loss or damage of proportion of aquifer through pollution.	Negative	Temporary	Local	Moderate Adverse	Moderate	Small adverse	Slight
Change to groundwater regime											
Locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Widespread	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible	Negligible	Imperceptible

14.6.2 Operational Phase

There will be no significant residual impacts on land, soil, geology, or hydrogeology as a result of the Operational Phase of the Proposed Scheme.

No significant residual adverse impacts have been identified either in the Construction or Operational Phases of the Proposed Scheme, whilst meeting the scheme objectives set out in Chapter 1 (Introduction & Environmental Impact Assessment Process).

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