Chapter 14
Land, Soils, Geology & Hydrogeology

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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 Templeogue / Rathfarnham 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). 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 process 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 250m (metres) 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 four principal sections for ease of presentation and due to the volume of information available. The principal sections of the Proposed Scheme are as follows:

- Tallaght Road to Rathfarnham Road;
- Nutgrove Avenue to Terenure Road North – Grange Road, Rathfarnham Road;
- Terenure Road North to Charleville Road – Terenure Road East, Rathgar Road; and
- Charleville Road to Dame Street.

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	Aerial photography	Current aerial imagery produced by Google
Bing	Aerial photography	Current aerial imagery produced by Bing (Bing 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	
	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 existing / 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
R596	Dodder valley drainage scheme	1967	Unknown	South Dublin area	29 percussion Boreholes (shell and auger) and trial pits
R3246	M50 Tallaght By-pass	Unknown	Unknown	Tallaght, Dublin 24	Five trial pits
R3774	Our Lady's School Residential Development	Unknown	Unknown	Bushy Park	Six cable percussion boreholes (shell and auger)
R1364	Development	1986	IGSL	Butterfield Avenue	Six percussion boreholes (shell and auger)
R962	The Swan Centre	1980	Irish Soils Laboratories Ltd.	Swan Centre Rathmines.	Seven percussion boreholes (shell and auger) and seven trial pits
R469	College of Commerce	1970	The Cementation Co. Ltd, Ireland.	Rathmines.	Four boreholes (non-specified)
R650	Rathmines Shopping Centre	1973	Site Investigations Ltd.	Rathmines.	Six boreholes (bon-specified)
R3194	Apartments; Kelso Laundry Site	Unknown	Unknown	Lower Rathmines Road	Four cable percussion boreholes and one trial pit
R179	Development	1992	IGSL	Richmond Street, Rathmines.	Three percussion boreholes (shell and auger)
R3059	Proposed Development	1995	IGSL	Kellys Corner, South Circular Road.	Four percussion boreholes (shell and auger)
R367	Camden Court Hotel	1996	Unknown	Camden St. Dublin.	Eight percussion boreholes (shell and auger) and six trial pits
R6455	Kevin Street Development	Unknown	Unknown	15a Bishop Street	One cable percussion borehole
R167	Dublin Institute of Technology	1984	Unknown	Bishop Street / Peters Row	17 percussion boreholes (shell and auger), five rotary coring boreholes and nine trial pits
R572	Former Maceys Store	1972	Site Investigations Ltd.	78 - 93 South Georges Street	Six percussion boreholes (shell and auger), one rotary drilled borehole and nine trial pits.

The scheme specific ground investigations carried out to inform the Proposed Scheme and EIAR are listed in Table 14.3 and the factual reports provided in Appendix 14.2 Ground Investigation Report in 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
Bus Connect Detailed Stage 1 Lot 1 Route 12 National Transport Authority Ground Investigation Report	Ground Investigations Ireland	April 2021	Rathfarnham to City Centre	3 cable percussion boreholes with rotary follow on to a maximum depth of 15.5 mBGL.

14.2.3.3 Design Information

The design information as provided in Chapter 4 (Proposed Scheme Description) and Chapter 5 (Construction) as well as the Plan and Profile Drawings (BCIDC-ARP-GEO_HV-1012_ML_00-DR-CR-9001 in Volume 3 of this EIAR) have been used in the assessment.

14.2.3.4 Scheme Walkover

Scheme walkover survey was carried out on 27th February 2020 and 11th August 2022 and 16th January 2023 to inform and verify the review of publicly available datasets.

The findings of the Proposed Scheme walkover survey including photos and scheme walkover 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 Baseline - 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 Baseline - 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 Gradation of Impacts

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

- Box 4.1: Criteria for Rating Site Attributes – Estimation of Importance of Soil and Geology Attributes (Table 14.4);
- Box 4.3: Criteria for Rating Site Attributes – Estimation of the Importance of Hydrogeology Attributes (Table 14.5);
- The magnitude of impacts should be defined in accordance with the criteria provided in the NRA Guidelines. This is outlined in Table 14.6;
- Box 5.1: Criteria for Rating Site Attributes at Environmental Impact Assessment (EIA) Stage – Estimation of Magnitude of Impact on Soil / Geology Attribute (Table 14.7);
- Box 5.3: Criteria for Rating Site Attributes at EIA Stage – Estimation of Magnitude of Impact on Hydrogeology Attributes (Table 14.8); and
- Box 5.4: Rating of Significant Environmental Impacts at EIA Stage (Table 14.9).

The NRA Guidelines criteria uses similar significance terminology as the EPA Guidelines (EPA 2017). 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 14.4: 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
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 14.5: 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 14.6: 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 14.7: 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 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

Magnitude of Impact	Criteria	Typical Example
		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 14.8: 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 14.9: Rating of 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 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 14.10. 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 14.10: 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 14.11.

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 14.11: 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 Paleaozoic 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	Esturine 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 Paleozoic 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 Paleozoic 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 14.12. 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 14.12: 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 14.3. 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 aquifers, corresponding to whether they are major, minor or unproductive resources whereby:

- Regionally Important Aquifers are capable of supplying regionally important abstractions (e.g. large public water supplies), or excellent yields (>400 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 14.13: 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 14.14, 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 14.14: 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, both Dublin City Council (DCC) and Dun Laoghaire Rathdown Council (DLR) also maintain databases 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. Again, 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 are 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 of 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 14.15.

Table 14.15: 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

Designation Code	Designated Site
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

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 could 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 2022), Google (Google 2022), Bing (Bing 2022) and the Corine Land Cover maps (EPA 2018). The historic land use is based on the following OSI (OSI 2022) 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 Section 1; Tallaght Road to Rathfarnham Road

The Corine Land Cover 2018 classifies the land use as discontinuous urban fabric with pockets of green urban areas within Dodder Valley Park, Tymon Park and Bushy Park. Dodder Valley Park and Tymon Park are located between the M50 interchange and the R137 as far as Hillcrest. Bushy Park is located along the R137 between Bushy Park House and Olney Grove.

The historic mapping indicates that the land along the Proposed Scheme was primarily used for agricultural, parklands and residential areas.

Based on the OSI 6-inch mapping shows the area within this section of the study area was predominantly agricultural land with some local industrial activities present. A mill race intersected the Proposed Scheme near the junction of Templeogue Road and Wellington Lane and a flour mill was present at Hill Crest.

The OSI 25-inch mapping shows the predominant land use within this section of the study area was agricultural. The Dublin and Blessington steam tramway ran adjacent to the Proposed Scheme with a tram depot located adjacent to the Proposed Scheme at Templeogue Tennis Club. The 25-inch maps also show an old quarry adjacent to the Proposed Scheme near the intersection of Templeogue Road and Wellington Lane.

The Aerial photography (Geohive) for this section of the study area shows a number of residential developments between 1995 and 2005. The road has also been altered to incorporate the M50 Junction, several roundabouts and the widening of the road into a dual carriageway from Junction 11 to Cypress Road junction. A service station and garage has also been constructed by Junction 11.

No significant developments were noted on the aerial photography between 2005 and present.

14.3.3.1.2 Section 2; Nutgrove Avenue to Terenure Road North

The Corine Land Cover 2018 classifies the land use as discontinuous urban fabric with pockets of green urban areas and sport and leisure facilities. Green urban areas are associated with Bushy Park which is located adjacent the Dodder Park Road. The sport and leisure facility identified is the Castle golf course located adjacent to Nutgrove Avenue.

The historic mapping indicates that the land along the Proposed Scheme was predominantly mixed use agricultural, industrial and residential land.

Based on the OSI 6-inch mapping, an old mill was located adjacent Nutgrove Avenue and an old pond and creek (possibly mill race) intersected the Proposed Scheme at Butterfield Avenue and Rathfarnham Road. An old mill pond was located adjacent to Springfield Avenue and an old cloth factory was located at the intersection of the Rathfarnham Road and Springfield Avenue.

The OSI 25-inch mapping show further residential developments locally within this section of the study area.

The Aerial photography (Geohive) for this section of the study area shows a number of residential developments between 1995 and 2005. The road at Nutgrove Avenue has been realigned and junctions have been added at Butterfield Avenue and Springfield Avenue.

No significant developments were noted on the aerial photography between 2005 and present.

14.3.3.1.3 Section 3; Terenure Road North to Charleville Road

The Corine Land Cover 2018 classifies the land use as discontinuous urban fabric along the Proposed Scheme.

The historic mapping indicates that the land along the Proposed Scheme was predominantly mixed use industrial and residential land.

The OSI 6-inch mapping shows an old quarry was located adjacent the within this section of the study area at Brighton Green and at Rathgar Park.

The OSI 25-inch mapping show further residential developments locally within this section of the study area. An old tram depot was located at the junction of Terenure Road North and Terenure Road East. The quarry at Brighton Green was developed into an engineering works building and the quarry at Rathgar Park seen further development and expansion at this time.

The Aerial photography (Geohive) for this section of the study area shows a number of residential developments between 1995 and 2005.

The 2000 OSI aerial photography shows a small increase in development compared to the 1995 OSI aerial photography.

Similarly, the 2005 OSI aerial photography and 2019 Google Maps aerial imagery shows no significant development of the land within the study area.

14.3.3.1.4 Section 4; Charleville Road to Dame Street

The Corine Land Cover 2018 classifies the land use as discontinuous urban fabric south of the Grand Canal and as continuous Urban fabric north of the Grand Canal.

The historical mapping indicates that the land along the Proposed Scheme was predominantly residential land and green areas.

The OSI 6-inch mapping shows this section of the study area was mainly residential and green areas. The OSI 25-inch mapping show a tramway from Charleville Road to Dame Street.

It should be noted that the 1995 OSI aerial photography is in black and white and of poor resolution. The area is predominantly mixed residential and urban with localised developments.

The 2000 OSI aerial photography shows a small increase in development compared to the 1995 OSI aerial photography.

Similarly, the 2005 OSI aerial photography and 2019 Google Maps aerial imagery shows no significant development of the land within the study area.

14.3.3.2 Geomorphology and Topography

The geomorphology and topography is 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 Section 1; Tallaght Road, Templeogue Road to Rathfarnham Road

The Templeogue Section of the Proposed Scheme will begin at Tallaght Road which according to the OSI 10m contours, is at an elevation between 70mOD and 80mOD and gradually falls to between 40mOD and 50mOD at the Rathfarnham Road. The Proposed Scheme will run parallel to the River Dodder.

The geomorphology within this section of the study area shows a deposit of Hummocky Sand and Gravel associated with the Greenhills Esker identified at the M50 interchange and glacial meltwater channels associated with the River Dodder.

14.3.3.2.2 Section 2; Nutgrove Avenue to Terenure Road North – Grange Road, Rathfarnham Road

The Rathfarnham Section of the Proposed Scheme will lie at approximately 50mOD at Nutgrove Avenue before gradually falling towards Terenure Road North to 40mOD. The Proposed Scheme will cross the River Dodder in Rathfarnham.

The geomorphology within this section of the study area is characterised by Hummocky Sand and Gravel which is identified along Nutgrove Avenue as far as Willbrook Road and a glacial meltwater channel associated with the River Dodder and Owendoher River.

14.3.3.2.3 Section 3; Terenure Road North to Charleville Road – Terenure Road East, Rathgar Road

The Proposed Scheme will remain at a consistent level ranging from 40mOD to 50mOD before gradually falling to between 20mOD and 30mOD between Terenure Road North and Harold’s Cross and between 20mOD to 30mOD between Terenure Road North to Charleville Road.

No notable geomorphology was identified within this section of the study area.

14.3.3.2.4 Section 4; Charleville Road to Dame Street

The Proposed Scheme will generally lie between 20mOD and 30mOD along Charleville Road to between 0mOD to 10mOD at Dame Street. The Proposed Scheme will crosse over the Grand Canal at the junction of the Rathmines Road Lower and Richmond Street South.

Hummocky Sand and Gravel deposits are identified along King Street South and at Saint Patricks Close.

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 14.16 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 Section 1 Tallaght Road to Rathfarnham Road

The underlying soils within the study area for this section of the Proposed Scheme are predominately made ground. Localised pockets of topsoil (Amin SW, BminDW, BminSW and BminPD) are identified near the from the junction of the M50 interchange to the junction at Cheeverstown along the Templeogue Road. Alluvium (AlluvMin) deposits are identified along the banks of the River Dodder.

14.3.3.3.2 Section 2: Nutgrove Avenue to Terenure Road North – Grange Road, Rathfarnham Road

The soils within the study area for this section of the Proposed Scheme are predominately made ground. Localised pockets of topsoil (BminDW, BminSW and BminPD) are identified within Rathfarnham Castle. Alluvium (AlluvMin) deposits are identified along the banks of the River Dodder.

14.3.3.3.3 Section 3; Terenure Road North to Charleville Road – Terenure Road East, Rathgar Road

The soils within the study area for this section of the Proposed Scheme are predominately made ground. Localised pockets of topsoil (BminSW) are identified around Brighton Square.

14.3.3.3.4 Section 4: Charleville Road to Dame Street

The soils within the study area for this section of the Proposed Scheme from Charleville Road to Dame Street is underlain by made ground.

Localised pockets of topsoil (BminSW) are identified around Rathgar Park.

Table 14.16: 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 - BminPD	Poorly drained (mainly basic)	M50 Interchange to Cheeverstown, Rathfarnham Castle	Low	Poorly drained and / or low fertility soils
Alluvium - AlluvMIN	Typically found along current and historic watercourses	Banks of River Dodder	Medium	Moderately drained and / or moderate fertility soils
Topsoil - BminSW	Shallow well drained (mainly basic)	M50 Interchange to Cheeverstown, Rathfarnham Castle, Brighton Square, Rathgar Park	High	Well drained and / or high fertility soils
Topsoil - BminDW	Deep well drained (mainly basic)	M50 Interchange to Cheeverstown, Rathfarnham Castle,	High	Well drained and / or high fertility soils
Topsoil - AminSW	Shallow well drained (mainly acidic	M50 Interchange to Cheeverstown	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 14.17, 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 within the study area are predominately glacial tills derived from limestones. Additionally, there are areas of made ground (Urban), alluvium, gravelly alluvium (coarse-grained) and silty alluvium (fine-grained), bedrock outcrops and subcrops and tills derived from gravels.

14.3.3.4.1 Section 1 Tallaght Road to Rathfarnham Road

The subsoils encountered within the study area for this section of the Proposed Scheme are predominately glacial tills derived from limestone.

Both fine and coarse-grained alluvial deposits are associated with the River Dodder and gravels derived from limestones are located at the M50 interchange. Bedrock outcrops are identified along Springfield Avenue at Springfield Park and along the banks of the River Dodder.

14.3.3.4.2 Section 2 Nutgrove Avenue to Terenure Road North - Grange Road, Rathfarnham Road

The subsoils encountered within the study area for this section of the Proposed Scheme are predominately glacial tills derived from limestone. Localised pockets of gravels derived from limestones, alluvium and alluvium gravelly deposits are also identified.

Both fine and coarse-grained alluvial deposits are associated with the River Dodder along Springfield Avenue, Rathfarnham Castle and gravels derived from limestones are located along Nutgrove Avenue and Grange Road.

14.3.3.4.3 Section 3 Terenure Road North to Charleville Road – Terenure Road East, Rathgar Road

The subsoils encountered within the study area for this section of the Proposed Scheme are predominately glacial tills derived from limestone. Localised pockets of bedrock outcrop are also noted within the area around Rathgar Park.

14.3.3.4.4 Section 4 Charleville Road to Dame Street

The subsoils encountered within the study area for this section of the Proposed Scheme are predominately glacial tills derived from limestone and Made Ground (Urban) deposits. Localised pockets of alluvium deposits and gravels derived from limestones are also identified within the study area.

Made Ground (Urban) deposits are identified from Rathmines Road Lower to Richmond Street South and from Camden Row to Dame Street. Alluvium deposits are identified at Saint Patrick's Close, Eustace Street and Anglesea Street and gravels derived from limestones are identified at Saint Patrick's close and King Street South.

Table 14.17: 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
Alluvium - A	Typically found along current and historic watercourses	River Dodder along Springfield Avenue and Rathfarnham Castle, Saint Patrick's Close & Eustace Street	Low	Low value on a local scale
Glacial gravels - GLs	Gravels derived from limestones	Nutgrove Avenue and Grange Road, Saint Patrick's Close and King Street South	Low	Low value on a local scale
Glacial till - TLs	Till derived from limestones	Terenure Road to Charleville Road	Low	Low value on a local scale
Rock - Rck	Bedrock outcrop or subcrop	Rathgar Park	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 14.18 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 bedrock encountered within the study area for the Proposed Scheme comprises the Lucan Formation (locally known as Calp Limestone).

No major structural bedrock features were identified within the study area.

Table 14.18: 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 14.19 to Table 14.22.

The data presented in the tables are indicative and strata depth and presence will vary by location. The historical ground investigation data was carried out for purposes and projects other than this EIAR. Therefore, although the historical ground investigation data provides useful indication of ground conditions, the quality of the data cannot be verified.

Table 14.19: Summary of Ground Conditions Expected to be Encountered by the Proposed Scheme Along the Tallaght Road, Templeogue Road to Rathfarnham Road Section

Strata	General Extent / Location	Top of Strata (mBGL)	Thickness of Strata (m)
Made Ground	Widespread along the Proposed Scheme	0	1.5 – 2.0
Glacial Till	Widespread along the Proposed Scheme	0.3 – 1.5	Not proven

Table 14.20: Summary of Ground Conditions Expected to be Encountered by the Proposed Scheme Along the Nutgrove Avenue to Terenure Road North – Grange Road, Rathfarnham Road Section

Strata	General Extent/Location	Depth Range (mBGL)	Thickness Range (m)
Topsoil	Green areas – including parks, large estates	0	0.4 - 0.8
Made Ground	Widespread along the Proposed Scheme	0 – 0.8	1.5 – 4.9
Glacial Till	Widespread along the Proposed Scheme	0.1 – 0.40	3.9 – 4.6
Limestone Bedrock	Widespread along the Proposed Scheme	4.2 – 5.5	Not proven

Table 14.21: Summary of Ground Conditions Expected to be Encountered by the Proposed Scheme Along the Terenure Road North to Charleville Road – Terenure Road East, Rathgar Road Section

Strata	General Extent/Location	Depth Range (mBGL)	Thickness Range (m)
Topsoil	Throughout	0	0.2
Made Ground	Widespread along the Proposed Scheme	0 – 0.2	0.3 – 1.2
Glacial Till	Widespread along the Proposed Scheme	0.3 – 0.6	5.3 – 7.5

Strata	General Extent/Location	Depth Range (mBGL)	Thickness Range (m)
Limestone Bedrock	Widespread along the Proposed Scheme	5.6 – 8.1	Not proven

Table 14.22: Summary of Ground Conditions Expected to be Encountered by the Proposed Scheme Along the Charleville Road to Dame Street Section

Strata	General Extent/Location	Depth Range (mBGL)	Thickness Range (m)
Made Ground	Widespread along the Proposed Scheme	0	0.4 – 4.0
Glacial Till	Widespread along the Proposed Scheme	0.4 – 4.0	2.9 – 4.1
Limestone Bedrock	Widespread along the Proposed Scheme	5.4 – 7	Not Proven

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)	Typically found along current and historic watercourses	River Dodder, Owendoher River	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 are likely to 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 information provided by the design team as listed in Section 14.2.3.3.
- 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 scheme specific ground investigations at depths ranging from 0.5 to 3.5m BGL.

The main findings of the soil analysis carried out along the Proposed Scheme are as follows (and summarised in Table 14.25):

- Asbestos was not detected in any of the recorded results during the scheme specific GI carried out by GII.

- Seven samples were classified as inert.

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

Feature	Description	Location	Importance	Justification for Importance Rating
Old Paper Mill	Industrial (OSI 6 Inch Mapping)	M50 Interchange	Medium	Degree or extent of soil contamination is moderate on a local scale
Old Mill Race	Industrial (OSI 6 Inch Mapping)	Tallaght Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Old Ford Site	Industrial (OSI 6 Inch Mapping)	Spawell roundabout	Medium	Degree or extent of soil contamination is moderate on a local scale
Dublin and Blessington Steam Tramway	Tramway (OSI 25 Inch Mapping)	Tallaght Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Tram Depot	Tramway Depot (OSI 25 Inch Mapping)	Templeogue Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Old Quarry	Quarry (OSI 6 Inch Mapping)	Springfield Avenue	Medium	Degree or extent of soil contamination is moderate on a local scale
Service stations	Service Station (OSI Aerial Photography)	M50 Interchange	Medium	Degree or extent of soil contamination is moderate on a local scale
Fish Pond	Industrial (OSI 6 Inch Mapping)	Rathfarnham Castle	Medium	Degree or extent of soil contamination is moderate on a local scale
Creek (Possible Mill Race)	Industrial (OSI 6 Inch Mapping)	Rathfarnham	Medium	Degree or extent of soil contamination is moderate on a local scale
Old Mill	Industrial (OSI 6 Inch Mapping)	Rathfarnham Mill	Medium	Degree or extent of soil contamination is moderate on a local scale
Old Cloth Factory	Industrial (OSI 6 Inch Mapping)	Dodder Park Road / Rathfarnham Road Junction	Medium	Degree or extent of soil contamination is moderate on a local scale
Old Mill Pond	Industrial (OSI 6 Inch Mapping)	River Dodder adjacent to the R112 Dodder View Road	Medium	Degree or extent of soil contamination is moderate on a local scale

Feature	Description	Location	Importance	Justification for Importance Rating
Service Station	Service Station (OSI Aerial Photography)	Rathfarnham Road / Crannagh Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Old Quarry	Quarry (OSI 6 Inch Mapping)	Brighton Green	Medium	Degree or extent of soil contamination is moderate on a local scale
Old Quarry	Quarry (OSI 6 Inch Mapping)	Rathgar Park	Medium	Degree or extent of soil contamination is moderate on a local scale
Old Tram depot	Tramway Depot (OSI 25 Inch Mapping)	Terenure	Medium	Degree or extent of soil contamination is moderate on a local scale
Old Engineering Works	Engineering Works (OSI 25 Inch Mapping)	Brighton Green	Medium	Degree or extent of soil contamination is moderate on a local scale
Service Station	Service Station (OSI Aerial Photography)	Rathgar Road / Grosvenor Road	Medium	Degree or extent of soil contamination is moderate on a local scale

There are no licensed facilities within the study area that are either currently licensed or previously licensed with the EPA for waste, industrial emissions and integrated pollution control.

Based on the samples recovered during the scheme specific ground investigation, there was no evidence of elevated contaminants within the shallow sediments.

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 two mineral localities within the study area, a limestone mineral locality associated with a limestone quarry which was active in the 1830's in Rathgar and a metallic mineral locality in the vicinity of Rathfarnham village along the River Dodder.

The crushed rock aggregate potential is predominately low to moderate potential with the exception of shallow rocks associated with the River Dodder. The granular aggregate potential is highly variable as discussed below.

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 14.25 along with their importance as determined by the Box 4.1 of the NRA Guidelines (NRA 2008a).

14.3.3.10.1 Tallaght Road to Rathfarnham Road

The GSI aggregate potential mapping shows that the crushed rock aggregate potential along this section of the study area is generally low. Areas of moderate to very high crushed rock aggregate potential are identified around Templeogue and Terenure and are generally associated with the River Dodder.

The GSI aggregate potential mapping shows the granular aggregate potential ranges from very low to very high along the banks of the River Dodder.

14.3.3.10.2 Nutgrove Avenue to Terenure Road North – Grange Road, Rathfarnham Road

The GSI aggregate potential mapping shows that the crushed rock aggregate potential along this section of the study area is generally low. Areas of moderate to high crushed rock aggregate potential are identified in Rathfarnham Village and is generally associated with the River Dodder

The GSI aggregate potential mapping shows the granular aggregate potential ranges from very low to high along the banks of the River Dodder and Owendoher River.

14.3.3.10.3 Terenure Road North to Charleville Road – Terenure Road East, Rathgar Road

The GSI aggregate potential mapping shows that the crushed rock aggregate potential along this section of the study area ranges from low to very high. Terenure village generally has low crushed rock aggregate potential, and it increases from moderate to very high crushed rock aggregate along Terenure Road north to Brighton Square and reduces to moderate crushed rock potential approaching Harold's Cross. The crushed rock aggregate potential from Terenure Road east to Orwell Road ranges from moderate to very high. The crushed rock aggregate potential is moderate along Rathgar Road as far as Charleville Road. The higher crushed rock aggregate potential is associated with historic quarries within the study area.

The GSI aggregate potential mapping shows no granular aggregate potential was identified along this section of the Proposed Scheme.

14.3.3.10.4 Charleville Road to Dame Street

The GSI aggregate potential mapping shows that the crushed rock aggregate potential is generally moderate. A localised pocket of high to very high crushed rock aggregate potential is identified adjacent to South Great Georges Street.

The GSI aggregate potential mapping shows the granular aggregate potential is very low to moderate adjacent to South Great Georges Street.

Table 14.25: 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	Rathfarnham Village, Terenure Road North to Brighton Square, Charleville Road to Dam Street	Medium	Sub-economic extractable mineral resource
Crushed rock aggregate potential	High potential	Terenure Road North to Brighton Square, South Great Georges Street	Medium	Extractable mineral resource
Crushed rock aggregate potential	Very high potential	Terenure Road North to Brighton Square, South Great Georges Street	High	Marginally extractable mineral resource
Granular aggregate potential	Very low potential	Banks of River Dodder and Owendoher River	Low	Uneconomically extractable mineral resource
Granular aggregate potential	Low potential	South Great Georges Street	Low	Uneconomically extractable mineral resource
Granular aggregate potential	Moderate potential	South Great Georges Street	Medium	Sub-economic extractable mineral resource
Granular aggregate potential	High potential	Banks of River Dodder and Owendoher River	Medium	Extractable mineral resource
Granular aggregate potential	Very high potential	Banks of River Dodder	High	Marginally extractable mineral resource

14.3.3.11 Geological Heritage Areas

The Geological Heritage Areas (GSI 2019c) within the study area are presented on Figure 14.10 in Volume 3 of this EIAR and detailed in Table 14.26 along with their importance as determined by the NRA Guidelines Box 4.1 (NRA 2008a).

Table 14.26: Geological Heritage Areas

Name (Code)	Description	Location	Importance	Justification for Importance rating
Greenhills Esker (SD005)	The Greenhills esker includes a large accumulation of sands and gravels	North of M50 / N81 Interchange	High	Geological feature of high value on a local scale (CGS)

Name (Code)	Description	Location	Importance	Justification for Importance rating
Dodder Terraces	The dodder terraces comprise a series of flat-topped, elevated terraces much higher than the current River Dodder.	South / South West of M50 / N81 interchange	High	Geological feature of high value on a local scale (CGS)
River Poddle (DC011)	A river which flows northwards through Dublin city. Most of its course is diverted underground	Harold's Cross Road	High	Geological feature of high value on a local scale (CGS)

14.3.3.12 Aquifer Type and Classification

The GSI Bedrock Aquifer mapping (GSI 2019b) for the study area (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: Aquifer Types Within the Study Area

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

14.3.3.13 Groundwater Vulnerability

Groundwater vulnerability (GSI 2019b) within the study area ranges from 'Extreme' where bedrock is close to or at the surface to 'Low' vulnerability in areas where thick subsoil deposit is present as shown on Figure 14.14 in Volume 3 of this EIAR.

14.3.3.13.1 Section 1 Tallaght Road, Templeogue Road to Rathfarnham Road

The GSI groundwater vulnerability mapping shows the groundwater vulnerability potential along this section of the study area is generally low. Areas of moderate to extreme rock at / close to surface potential were identified around Templeogue, Hyde Park and Springfield Road and is generally associated with the River Dodder.

14.3.3.13.1 Section 2 Nutgrove Avenue to Terenure Road North – Grange Road, Rathfarnham Road

The GSI groundwater vulnerability mapping shows the groundwater vulnerability along this section of the study area ranges from low to extreme.

The GSI groundwater vulnerability mapping shows the groundwater vulnerability along this section of the study area is generally low. Areas of moderate to extreme groundwater vulnerability were identified in Rathfarnham Village and is generally associated with the River Dodder and Owendoher River.

14.3.3.13.2 Section 3 Terenure Road North to Charleville Road – Terenure Road East, Rathgar Road

The GSI groundwater vulnerability mapping shows the groundwater vulnerability along this section of the study area ranges from low to extreme rock at or near the surface.

Terenure village is generally low groundwater vulnerability, and it increases from moderate to extreme rock at or near the surface groundwater vulnerability along Terenure Road north to Brighton square and again from Terenure Road east to Rathgar Road. The higher groundwater vulnerability is associated with historic quarries within the study area.

14.3.3.13.3 Section 4 Charleville Road to Dame Street

The GSI groundwater vulnerability mapping shows the groundwater vulnerability along this section of the study is generally moderate. Localised pockets of high to extreme groundwater vulnerability are identified adjacent to the Proposed Scheme at South Great Georges Street and the Bank of Ireland at Westmoreland Street.

14.3.3.14 Groundwater Recharge

The rate of groundwater recharge corresponds to the soil type as shown in Figure 14.6 and Figure 14.15 in Volume 3 of this EIAR. The study area predominately has an annual recharge range of 51mm (millimetres) to 100mm in urban areas. Where there is topsoil or alluvium present instead of made ground the annual recharge is typically 1mm to 50mm.

14.3.3.15 Hydro-Ecology

There are no groundwater dependent habitats within the study area that have the status of SPA, SAC, NHA or pNHA (NPWS 2020).

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	Location	Description	Importance	Justification
Soil fertility	Made Ground - Made	Widespread	Associated with urban development	Low	Poorly drained and / or low fertility soils
Soil fertility	Topsoil - BminPD	M50 Interchange to Cheeverstown, Rathfarnham Castle	Poorly drained (mainly basic)	Low	Poorly drained and / or low fertility soils
Subsoils quality and significance	Made Ground - Urban	Widespread	Associated with urban development	Low	Low value on a local scale
Subsoils quality and significance	Alluvium - A	River Dodder along Springfield Avenue and Rathfarnham Castle, Saint Patrick's Close & Eustace Street	Typically found along current and historic watercourses	Low	Low value on a local scale
Subsoils quality and significance	Glacial gravels - GLs	Nutgrove Avenue and Grange Road, Saint Patrick's Close and King Street South	Gravels derived from limestones	Low	Low value on a local scale
Subsoils quality and significance	Glacial till - TLs	Terenure Road to Charleville Road	Till derived from limestones	Low	Low value on a local scale
Subsoils quality and significance	Rock - Rck	Rathgar Park	Bedrock outcrop or subcrop	Low	Low value on a local scale
Bedrock quality and significance	Lucan	Widespread	(Calp) Dark Limestone and shale -Carboniferous	Low	Low value on a local scale
Soft Soils	Alluvium - AlluvMIN (soils) / A (subsoils)	River Dodder, Owendoher River	Typically found along current and historic watercourses	Low	Volume of soft soil underlying the route is small and of a local scale.
Economic geology	Crushed rock aggregate potential	Widespread	Low potential	Low	Uneconomically extractable mineral resource
Economic geology	Granular aggregate potential	Banks of River Dodder and Owendoher River	Very low potential	Low	Uneconomically extractable mineral resource
Economic geology	Granular aggregate potential	South Great Georges Street	Low potential	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	Location	Description	Importance	Justification
Soil fertility	Alluvium - AlluvMIN	Banks of River Dodder	Typically found along current and historic watercourses	Medium	Moderately drained and/or moderate fertility soils
Soil fertility	Topsoil - BminSW	M50 Interchange to Cheeverstown, Rathfarnham Castle, Brighton Square, Rathgar Park	Shallow well drained (mainly basic)	High	Well drained and / or high fertility soils
Soil fertility	Topsoil - BminDW	M50 Interchange to Cheeverstown, Rathfarnham Castle,	Deep well drained (mainly basic)	High	Well drained and / or high fertility soils

Category	Feature	Location	Description	Importance	Justification
Soil fertility	Topsoil - AminSW	M50 Interchange to Cheeverstown	Shallow well drained (mainly acidic)	High	Well drained and / or high fertility soils
Potential sources of contamination	Old Paper Mill	M50 Interchange	Industrial (OSI 6 Inch Mapping) -	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential sources of contamination	Old Mill Race	Tallaght Road	Industrial (OSI 6 Inch Mapping)	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential sources of contamination	Old Ford Site	Spawell roundabout	Industrial (OSI 6 Inch Mapping)	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential sources of contamination	Dublin and Blessington Steam Tramway	Tallaght Road	Tramway (OSI 25 Inch Mapping)	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential sources of contamination	Tram Depot	Templeogue Road	Tramway Depot (OSI 25 Inch Mapping)	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential sources of contamination	Old Quarry	Springfield Avenue	Quarry (OSI 6 Inch Mapping)	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential sources of contamination	Service stations	M50 Interchange	Service Station (OSI Aerial Photography)	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential sources of contamination	Fish Pond	Rathfarnham Castle	Industrial (OSI 6 Inch Mapping)	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential sources of contamination	Creek (Possible Mill Race)	Rathfarnham	Industrial (OSI 6 Inch Mapping)	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential sources of contamination	Old Mill	Rathfarnham Mill	Industrial (OSI 6 Inch Mapping)	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential sources of contamination	Old Cloth Factory	Dodder Park Road / Rathfarnham Road Junction	Industrial (OSI 6 Inch Mapping)	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential sources of contamination	Old Mill Pond	River Dodder adjacent to the R112 Dodder View Road	Industrial (OSI 6 Inch Mapping)	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential sources of contamination	Service Station	Rathfarnham Road / Crannagh Road	Service Station (OSI Aerial Photography)	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential sources of contamination	Old Quarry	Brighton Green	Quarry (OSI 6 Inch Mapping)	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential sources of contamination	Old Quarry	Rathgar Park	Quarry (OSI 6 Inch Mapping)	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential sources of contamination	Old Tram depot	Terenure	Tramway Depot (OSI 25 Inch Mapping)	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential sources of contamination	Old Engineering Works	Brighton Green	Engineering Works (OSI 25 Inch Mapping)	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential sources of contamination	Service Station	Rathgar Road / Grosvenor Road	Service Station (OSI Aerial Photography)	Medium	Degree or extent of soil contamination is moderate on a local scale
Economic geology	Crushed rock aggregate potential	Rathfarnham Village, Terenure Road North to Brighton Square, Charleville Road to Dam Street	Moderate potential	Medium	Sub-economic extractable mineral resource

Category	Feature	Location	Description	Importance	Justification
Economic geology	Crushed rock aggregate potential	Terenure Road North to Brighton Square, South Great Georges Street	High potential	Medium	Extractable mineral resource
Economic geology	Crushed rock aggregate potential	Terenure Road North to Brighton Square, South Great Georges Street	Very high potential	High	Marginally extractable mineral resource
Economic geology	Granular aggregate potential	South Great Georges Street	Moderate potential	Medium	Sub-economic extractable mineral resource
Economic geology	Granular aggregate potential	Banks of River Dodder and Owendoher River	High potential	Medium	Extractable mineral resource
Economic geology	Granular aggregate potential	Banks of River Dodder	Very high potential	High	Marginally extractable mineral resource
Aquifer	Locally Important Aquifer (LI)	Widespread	Bedrock which is moderately productive only in local zones	Medium	Locally important aquifer which supplies the local area
County geological site	Greenhills Esker (SD005)	North of M50/ N81 Interchange	The Greenhills esker includes a large accumulation of sands and gravels	High	Geological feature of high value on a local scale (CGS)
County geological site	Dodder Terraces	South/South West of M50/N81 interchange	The dodder terraces comprise a series of flat-topped, elevated terraces much higher than the current River Dodder.	High	Geological feature of high value on a local scale (CGS)
County geological site	River Poddle (DC011)	Harold's Cross Road	A river which flows northwards through Dublin city; most of its course is diverted underground	High	Geological feature of high value on a local scale (CGS)

14.3.5 Conceptual Site Model

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

The Proposed Scheme is predominantly underlain by made ground over alluvium (associated with water bodies) over glacial till over limestone bedrock. The relevant subsections of the Proposed Scheme are presented in Table 14.30 to Table 14.33 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 - Tallaght Road, to Rathfarnham Road

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)	Additional Notes
			Max	Avg	Max	Avg			
Section 1a - M50 off Ramp to Spawell Roundabout	480	Cut	-0.4	-0.1	0.3	0	No GI carried out. Based on the desk study the section is underlain by Till derived from Limestone (Dublin Boulder Clay) over Limestone. Inferred Road pavement and foundation on possible reworked boulder clay/ natural boulder clay.	0.5	Desk study presents possible sources of contamination along this section
Section 1b: Spawell Roundabout	200	Cut	0	0	0	0	No GI carried out. Based on the desk study the section is underlain by Till derived from Limestone (Dublin Boulder Clay) over Limestone. Inferred Road pavement and foundation on possible reworked boulder clay/ natural boulder clay.	0.5	n/a
Section 1c - Spawell Roundabout to Cypress Grove Junction	680	Cut	-0.5	0.0	0.4	0	No GI carried out. Desk study shows that the section is underlain by Till derived from Limestone (Dublin Boulder Clay) over Limestone. Desk study also shows Alluvium close to the proposed alignment. Alluvium, if encountered during construction works, would have been excavated and removed. Inferred Road pavement and foundation on possible reworked boulder clay/ natural boulder clay.	0.5	Desk study shows possible sources of contamination along this section
Section 1d - Cypress Grove Junction to Templeville Road	735	Fill	-0.1	0	0.2	0	No GI carried out. According to the desk study the section is underlain by Till derived from Limestone (Dublin Boulder Clay) over Limestone. Desk study also shows Alluvium close to the proposed alignment. Alluvium, if encountered during construction works, would have been excavated and removed. Inferred Road pavement and foundation on possible reworked boulder clay/ natural boulder clay.	0.5	Desk study shows possible sources of contamination at the middle part of this section.

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)	Additional Notes
			Max	Avg	Max	Avg			
Section 1e - Templeville Road to Rathdown Avenue	635	Fill	-0.1	0.0	0.16	0.002	No GI carried out. Based on the desk study the section is underlain by Till derived from Limestone (Dublin Boulder Clay) over Limestone. Inferred Road pavement and foundation on possible reworked boulder clay/ natural boulder clay.	0.5	n/a
Section 1f – Rathdown Avenue to Terenure Road North	915	Fill	-0.078	0.0	0.09	0.087	No GI carried out. According to the desk study the section is underlain by Till derived from Limestone (Dublin Boulder Clay) over Limestone. Inferred Road pavement and foundation on possible reworked boulder clay/ natural boulder clay.	0.5	Desk study presents possible sources of contamination towards the northern part of this section.
Section 1g: Rathdown Crescent, Rathdown Park, Bushy Park Road, Wasdale Park, Wasdale Road, Wasdale Grove, Victoria Road, Zion Road and Orwell Road	1,490	Fill	0	0	0	0	No GI carried out. According to the desk study the section is underlain by Till derived from Limestone (Dublin Boulder Clay) over Limestone. Inferred Road pavement and foundation on possible reworked boulder clay/ natural boulder clay.	0.5	n/a

Table 14.31: Conceptual Site Model - Nutgrove Avenue to Terenure Road North – Grange Road, Rathfarnham Road

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)	Additional Notes
			Max	Avg	Max	Avg			
Section 2a – Grange Road Junction to Main Street Junction	850	Fill	0	0	0.4	0.2	No GI carried out. Based on the desk study the section is underlain by Glacial Gravel and/or Till derived from Limestone (Dublin Boulder Clay) over Limestone. Desk study also shows Alluvium close to the proposed alignment. Alluvium, if encountered during construction works, would have been excavated and removed. Inferred Road pavement and foundation on possible reworked boulder clay/ natural boulder clay or Glacial Gravel.	0.5	Desk study presents possible sources of contamination along this section.
Section 2b – Main Street Junction to Dodder Park Road	460	Fill	0	0	0.2	0.1	Three boreholes were drilled as part of the GI towards the northern part of this section. The BHs recorded MG up to approximately 1.5m BGL. Desk study shows that the section is underlain by Till derived from Limestone (Dublin Boulder Clay) over Limestone. Desk study also shows Alluvium at part of the proposed alignment. Alluvium, if encountered during construction works, would have been excavated and removed. Inferred Road pavement and foundation on possible reworked boulder clay/ natural boulder clay	1.5	Desk study shows possible sources of contamination along this section.

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)	Additional Notes
			Max	Avg	Max	Avg			
Section 2c – Dodder Park Road to Terenure Junction	620	Fill	0	0	0.2	0.1	Three boreholes were drilled as part of the GI towards the northern part of this section. According to the desk study the section is underlain by Till derived from Limestone (Dublin Boulder Clay) over Limestone. Inferred Road pavement and foundation on possible reworked boulder clay/ natural boulder clay	1.5	Desk study presents possible sources of contamination along this section.
Section 2d – Rathfarnham Junction to Mount Tallant Avenue	720	Fill	-0	0	0.1	0.0	No GI carried out. According to the desk study the section is underlain by Till derived from Limestone (Dublin Boulder Clay) over Limestone. Inferred Road pavement and foundation on possible reworked boulder clay/ natural boulder clay	0.5	A historic quarry is noted close to the proposed alignment. Desk study shows possible sources of contamination along this section.
Section 2e – Mount Tallant Avenue to Harold's Cross	830	Fill	0	0	0.1	0.1	No GI carried out. Desk study shows that the section is underlain by Till derived from Limestone (Dublin Boulder Clay) over Limestone. Inferred Road pavement and foundation on possible reworked boulder clay/ natural boulder clay	0.5	Desk study presents possible sources of contamination along this section.

Table 14.32: Conceptual Site Model - Terenure Road North To Charleville Road – Terenure Road East, Rathgar Road

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)	Additional Notes
			Max	Avg	Max	Avg			
Section 3a - Terenure Place to Rathgar Avenue	630	Fill	0	0	0.2	0.1	No GI carried out. Based on the desk study the section is underlain by Till derived from Limestone (Dublin Boulder Clay) over Limestone. Desk study also shows Alluvium at part of the proposed alignment. Alluvium, if encountered during construction works, would have been excavated and removed. Inferred Road pavement and foundation on possible reworked boulder clay/ natural boulder clay	0.5	A historic quarry is noted close to the proposed alignment. Desk study shows possible sources of contamination along this section.
Section 3b: Rathgar Avenue to Rathmines Road	1,275	Fill	-0.1	0	0	0	No GI carried out. According to the desk study the section is underlain by Till derived from Limestone (Dublin Boulder Clay) over Limestone. Inferred Road pavement and foundation on possible reworked boulder clay/ natural boulder clay	0.5	Desk study presents possible sources of contamination along this section.

Table 14.33: Conceptual Site Model - Charleville Road to Dame Street

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)	Additional Notes
			Max	Avg	Max	Avg			
Section 4a – Rathgar Road to Grove Road	920	Fill	0	0	0.1	0	No GI carried out. According to the desk study the section is underlain by Till derived from Limestone (Dublin Boulder Clay) over Limestone. Inferred Road pavement and foundation on possible reworked boulder clay/ natural boulder clay	0.5	n/a

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)	Additional Notes
			Max	Avg	Max	Avg			
Section 4b – Grove Road to Cuffe Street	880	Fill	0	0	0.2	0.1	No GI carried out. Based on the desk study the section is underlain by Urban (Made Ground) and/or Till derived from Limestone (Dublin Boulder Clay) over Limestone. Inferred Road pavement and foundation on possible reworked boulder clay/ natural boulder clay	0.5	n/a
Section 4c – Cuffe Street to Dame Street	748	Fill	-0.1	0	0.2	0.1	No GI carried out. Desk study shows that the section is underlain by Urban (Made Ground) and/or Till derived from Limestone (Dublin Boulder Clay) over Limestone. Inferred Road pavement and foundation on possible reworked boulder clay/ natural boulder clay	0.5	n/a
Section 4d – Offline Sections	400	n/a	n/a	n/a	n/a	n/a	No GI carried out. Desk study shows that the section is underlain by Urban (Made Ground) and/or Till derived from Limestone (Dublin Boulder Clay) over Limestone. Inferred Road pavement and foundation on possible reworked boulder clay/ natural boulder clay	0.5	n/a

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 in Appendix A5.1 in Volume 4 of this EIAR.

14.4.1.1 Tallaght Road to Rathfarnham Road

- The main construction activities at this Section will include reconstitution, widening and resurfacing of roads, cycle paths and footpaths, wall removal, new kerbs, new road marking, relocation of and new bus stops and landscaping works. Boundary walls, fences and gates will be constructed where required.
- Utility (telecommunications infrastructure) diversions and / or protections will be required.
- The Spawell roundabout will be upgraded to a four arm traffic signalised junction.
- The existing vegetation within the central island of the Spawell Roundabout will be removed however new trees will be provided as part of the works.
- Construction Compound TR1 will be located south of the Spawell roundabout, at the Tallaght Road / Spawell Link Road junction.
- Construction Compound TR6 will be located on Spawell Link Road, between Spawell Roundabout and Firhouse.
- A short section of hedgerow in the existing central reserve and some trees in the verge area on the northern side of Templeogue Road will be removed, however new trees will be provided as part of the works.
- A minor retaining wall approximately 15m in length and maximum 1.2m in retained height will be constructed along the south side of Templeogue Road adjacent to the Spawell Roundabout to Cypress Grove Junction (Structure Reference: RW01).
- A gap in the existing wall to the south of Templeogue Road will be closed and infilled with a stone clad wall and railing detail, similar to the existing boundary. Further to the east, a short section of the existing wall and railing will be realigned to provide space for a bus stop and shelter. An existing informal path within the green area adjacent Rathdown Drive will be formalised as a footpath.

14.4.1.2 Nutgrove Avenue to Terenure Road North – Grange Road, Rathfarnham Road

- The main construction activities at this Section will include reconstitution, widening and resurfacing of roads, cycle paths and footpaths, wall removal, new kerbs, new road marking, relocation of and new bus stops and landscaping works. Boundary walls, fences and gates will be constructed where required.
- Sections of the existing boundary walls along the eastern side of Grange Road and Rathfarnham Road, adjacent to Rathfarnham Castle Park, will be realigned and reconstructed due to the proposed widening of the carriageway. The low height wall at the junction with Rathfarnham Wood will also be realigned and reconstructed to accommodate the upgrade of the traffic signalised junction.
- Various utility diversions and / or protections will be required; including electricity overhead lines and underground cables, gas mains and telecommunications infrastructure.
- Sections of the existing boundary walls along the western side of Rathfarnham Road, will be realigned and reconstructed due to the proposed widening of the carriageway.

- Construction Compound TR3 will be located along Dodder View Road, across the road from Bushy Park, in the greenfield area between Dodder View Road, Woodview Cottages and Church Lane.
- Sections of the existing boundary walls along the eastern and western sides of Rathfarnham Road, will be realigned and reconstructed due to the proposed widening of the carriageway. A number of driveways will also be regraded to tie in with the proposed road levels following road widening.
- Construction Compound TR2 will be located north-west of Terenure Road North, between Eaton Road and Eagle Hill Avenue.

14.4.1.3 Terenure Road North to Charleville Road – Terenure Road East, Rathgar Road

- The main construction activities at this Section will include reconstitution, widening and resurfacing of roads, cycle paths and footpaths, wall removal, new kerbs, new road marking, relocation of and new bus stops and landscaping works. Boundary walls, fences and gates will be constructed where required.
- Sections of the existing boundary walls, fencing and hedges along the northern and southern sides of Terenure Road East, will be realigned and reconstructed due to the proposed widening of the carriageway.
- New cycle tracks will also be constructed along Orwell Road, between the Zion Road junction and the Terenure Road East junction. A new pedestrian crossing will be constructed west of Brighton Road.
- Various utility diversions and / or protections will be required; including electricity underground cables, water distribution, gas mains and telecommunications infrastructure.

14.4.1.4 Charleville Road to Dame Street

- No carriageway widening works or new boundary treatment is expected within this section.
- Construction Compound TR4 will be located on Military Road, perpendicular to Rathmines Road Lower, south of St Marys College.
- Various utility diversions and / or protections will be required; including water distribution and gas mains.
- Construction Compound TR5 will be located on Richmond Street South, on the slip road between Richmond Street South and Harcourt Road.

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 14.3.5 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 the land soils geology and hydrogeology as discussed below and summarised in Table 14.35.

- Loss and damage of topsoil
- Excavation of potentially contaminated ground;
- Loss of future quarry or pit reserve;
- Loss or damage of proportion of Geological Heritage Area;
- 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. There are a number of ways this could happen:

- 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 the development site, bitumen and sealants used for waterproofing concrete surfaces can all potentially impact on soils and groundwater during construction stage.
- 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 the 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.
- Excavation and disposal of topsoil instead of its reuse or reinstatement.

Topsoil will be encountered in numerous areas across the proposed scheme as discussed in Section 14.3.3.3. Where topsoil is stripped to accommodate the works outlined above, all of the above impacts are likely to occur at these locations.

Topsoil will be encountered from the M50 interchange to the junction at Cheeverstown along Templeogue Road. Topsoil will also be encountered along the banks of the River Dodder, at Rathfarnham Castle, Brighton Square and Rathgar Park.

The magnitude of these impacts of the Proposed Scheme on the topsoil is small adverse as it results in a permanent irreversible loss of a small proportion of locally high fertility topsoil and / or a high proportion of locally low fertility topsoil within the study area. As the topsoil is of medium to high importance the resulting significance of this permanent small adverse impact is slight.

14.4.3.2 Excavation of Potentially Contaminated Land

The excavation of made ground will result in the production of excess material requires placement elsewhere in the Proposed Scheme or 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 previous 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 service stations, historic tram depots and tramways, old quarries, old paper mills, old mill races and old cloth factories.

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

14.4.3.3 Loss of Future Quarry or Pit Reserve

The sterilisation of land through development or the excavation of soil and rock during construction can diminish future quarry and pit reserves which have been shown to have been utilised in the past in the area such as the old limestone quarry in Rathgar. This can result in a permanent irreversible loss of the in-situ characteristics of the land, soils and geology area.

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 to high importance the resulting significance of this negligible impact is imperceptible and will not be considered further.

14.4.3.4 Loss or Damage of Proportion of Geological Heritage Area

The sealing, contamination or excavation of soil and rock during construction can diminish the value of geological heritage areas. This can result in a permanent irreversible loss of the in-situ characteristics of the land, soils, geology and hydrogeology of the area.

While there will be construction of new pavements and structures in the vicinity of the Greenhills Esker, Dodder Terraces and River Poddle county geological sites, 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 county geological site.

While the Greenhills Esker, Dodder Terraces and River Poddle county geological sites is of high importance the resulting significance of this negligible impact is imperceptible and therefore will not be will not be considered further.

14.4.3.5 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 and though close to surface in areas, there will be minimal excavation into the limestone rock as part 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 underlying aquifer. As the aquifer is a locally important aquifer of medium importance the resulting significance of this negligible impact is imperceptible.

In addition, potential pollutants would 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 from routine run-off during construction. As the aquifer is a locally important aquifer of medium importance the resulting significant of this temporary moderate adverse impact is moderate.

14.4.3.6 Change to Groundwater Regime

Localised pumping of excavations is expected to be required as part of the Construction Phase at deep trenches 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 and 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 14.34: Summary of Predicted Construction Phase Impacts

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Loss or Damage of Topsoil									
Soil Fertility	Alluvium - AlluvMIN	Banks of River Dodder	Medium	Loss or damage of topsoil	Negative	Permanent	Local	Negligible	Imperceptible
Soil Fertility	Topsoil - BminSW	M50 Interchange to Cheeverstown, Rathfarnham Castle, Brighton Square, Rathgar Park	High	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Slight
Soil Fertility	Topsoil - BminDW	M50 Interchange to Cheeverstown, Rathfarnham Castle,	High	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Slight
Soil Fertility	Topsoil - AminSW	M50 Interchange to Cheeverstown	High	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Slight
Excavation of Potentially Contaminated Ground									
Potential Sources of Contamination	Old Paper Mill	M50 Interchange	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Old Mill Race	Tallaght Road	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Old Ford Site	Spawell roundabout	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Dublin and Blessington Steam Tramway	Tallaght Road	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Tram Depot	Templeogue Road	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Potential Sources of Contamination	Old Quarry	Springfield Avenue	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Service stations	M50 Interchange	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Fish Pond	Rathfarnham Castle	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Creek (Possible Mill Race)	Rathfarnham	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Old Mill	Rathfarnham Mill	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Old Cloth Factory	Dodder Park Road / Rathfarnham Road Junction	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Old Mill Pond	River Dodder adjacent to the R112 Dodder View Road	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Service Station	Rathfarnham Road / Crannagh Road	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Old Quarry	Brighton Green	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Old Quarry	Rathgar Park	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Old Tram depot	Terenure	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Sources of Contamination	Old Engineering Works	Brighton Green	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Potential Sources of Contamination	Service Station	Rathgar Road / Grosvenor Road	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Loss of Future Quarry Reserve									
Economic Geology	Crushed rock aggregate potential	Rathfarnham Village, Terenure Road North to Brighton Square, Charleville Road to Dam Street	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Economic Geology	Crushed rock aggregate potential	Terenure Road North to Brighton Square, South Great Georges Street	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Economic Geology	Crushed rock aggregate potential	Terenure Road North to Brighton Square, South Great Georges Street	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Economic Geology	Granular aggregate potential	South Great Georges Street	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Economic Geology	Granular aggregate potential	Banks of River Dodder and Owendoher River	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Economic Geology	Granular aggregate potential	Banks of River Dodder	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Loss or Damage of Proportion of Aquifer Through Excavation									
Aquifer	Locally Important Aquifer (LI)	Widespread	Medium	Loss or damage of proportion of aquifer through excavation	Negative	Permanent	Local	Negligible	Imperceptible
Loss or Damage of Proportion of Aquifer Through Pollution									
Aquifer	Locally Important Aquifer (LI)	Widespread	Medium	Loss or damage of proportion of aquifer through pollution	Negative	Temporary	Local	Moderate adverse	Moderate

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Change to groundwater Regime									
Aquifer	Locally Important Aquifer (LI)	Widespread	Medium	Change to groundwater regime	Negative	Permanent	Local	Negligible	Imperceptible
Loss or Damage of Proportion of Geological Heritage Area									
County geological site	Greenhills Esker (SD005)	North of M50 Interchange	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible
County geological site	Dodder Terraces	South/South West of M50 interchange	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible
County geological site	River Poddle (DC011)	Harold's Cross Road	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	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 important features such the topsoil and underlying aquifer as well as the Dodder Valley pNHA.

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 14.35.

14.5.1 Construction Phase

14.5.1.1 Loss or Damage of Topsoil

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

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 topsoil 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 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 Ground

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

Measures to be implemented 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 will be considered in the design of the Construction Compound. These are to be designed in accordance with relevant guidelines and codes of best practice and will be fully bunded;
- Good housekeeping at the site (daily site clean-ups, use of disposal bins, etc.) during the entire Construction Phase;
- Potential pollutants to be adequately secured against vandalism;
- Provision of proper containment of potential pollutants according to codes of best practice;
- Thorough control during the entire Construction Phase to ensure that any spillage is identified at early stage and subsequently effectively contained and managed; and
- Spill kits will be provided and 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 will address such aspects as containment measures, emergency discharge routes, a list of appropriate equipment and clean up materials and notification procedures to inform the relevant environmental protection authority. Refer to 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 impacts on land, soils, geology or hydrogeology as a result of the construction of the Proposed Scheme.

Table 14.35: 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 or damage of Topsoil											
Soil Fertility	Alluvium - AlluvMIN	Banks of River Dodder	Medium	Loss or damage of topsoil	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Soil Fertility	Topsoil - BminSW	M50 Interchange to Cheeverstown, Rathfarnham Castle, Brighton Square, Rathgar Park	High	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Soil Fertility	Topsoil - BminDW	M50 Interchange to Cheeverstown, Rathfarnham Castle,	High	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Soil Fertility	Topsoil - AminSW	M50 Interchange to Cheeverstown	High	Loss or damage of topsoil	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
Excavation of potentially contaminated land											
Potential Sources of Contamination	Old Paper Mill	M50 Interchange	Medium	Excavation of Potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Old Mill Race	Tallaght Road	Medium	Excavation of Potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Old Ford Site	Spawell roundabout	Medium	Excavation of Potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Dublin and Blessington Steam Tramway	Tallaght Road	Medium	Excavation of Potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Tram Depot	Templeogue Road	Medium	Excavation of Potentially 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	Old Quarry	Springfield Avenue	Medium	Excavation of Potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Service stations	M50 Interchange	Medium	Excavation of Potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Fish Pond	Rathfarnham Castle	Medium	Excavation of Potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Creek (Possible Mill Race)	Rathfarnham	Medium	Excavation of Potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Old Mill	Rathfarnham Mill	Medium	Excavation of Potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Old Cloth Factory	Dodder Park Road /	Medium	Excavation of Potentially	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
		Rathfarnham Road Junction		contaminated ground							
Potential Sources of Contamination	Old Mill Pond	River Dodder adjacent to the R112 Dodder View Road	Medium	Excavation of Potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Service Station	Rathfarnham Road / Crannagh Road	Medium	Excavation of Potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Old Quarry	Brighton Green	Medium	Excavation of Potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Old Quarry	Rathgar Park	Medium	Excavation of Potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Old Tram depot	Terenure	Medium	Excavation of Potentially 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	Old Engineering Works	Brighton Green	Medium	Excavation of Potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Service Station	Rathgar Road / Grosvenor Road	Medium	Excavation of Potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Loss of future quarry or pit reserve											
Economic Geology	Crushed rock aggregate potential	Rathfarnham Village, Terenure Road North to Brighton Square, Charleville Road to Dam Street	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Economic Geology	Crushed rock aggregate potential	Terenure Road North to Brighton Square, South Great Georges Street	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Economic Geology	Crushed rock aggregate potential	Terenure Road North to Brighton Square, South Great Georges Street	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Economic Geology	Granular aggregate potential	South Great Georges Street	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Economic Geology	Granular aggregate potential	Banks of River Dodder and Owendoher River	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Economic Geology	Granular aggregate potential	Banks of River Dodder	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Loss or damage of proportion of aquifer											
Aquifer	Locally Important Aquifer (LI)	Widespread	Medium	Loss or damage of proportion of aquifer through excavation	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Aquifer	Locally Important Aquifer (LI)	Widespread	Medium	Loss or damage of proportion of aquifer through pollution	Negative	Temporary	Local	Moderate adverse	Moderate	Negligible	Imperceptible
Change to groundwater regime											
Aquifer	Locally Important Aquifer (LI)	Widespread	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible	Negligible	Imperceptible
Loss or damage of proportion of Geological Heritage Area											
County geological site	Greenhills Esker (SD005)	North of M50 Interchange	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
County geological site	Dodder Terraces	South / South West of M50 interchange	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
County geological site	River Poddle (DC011)	Harold's Cross Road	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible

14.6.2 Operational Phase

No significant residual impacts on land, soils, geology and hydrogeology as a result of the operation of the Proposed Scheme.

No significant residual 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).

14.7 References

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