Chapter 14
Land, Soils, Geology & Hydrogeology

Contents

14. Land, Soils, Geology & Hydrogeology

14.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) considers the potential impacts on land, soils, geology and hydrogeology as a result of the Construction and Operational Phases of the Bray 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 in 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, 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 sub-sections for ease of presentation and due to the volume of information available. The sub-sections of the Proposed Scheme are as follows:

- Leeson Street to Donnybrook (Anglesea Road Junction);
- Donnybrook (Anglesea Road Junction) to Loughlinstown Roundabout;
- Loughlinstown Roundabout to Bray North (Wilford Roundabout); and
- Bray North (Wilford Roundabout) to Bray South (Fran O'Toole Bridge).

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);
- Environmental Impact Assessment of Projects Guidance on the preparation of the Environmental Impact Assessment Report (European Commission 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, 2021 & 2022.

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
Teagasc	Teagasc Soils Data	Surface soils classification and description
Geological Survey Ireland (GSI)	Quaternary Mapping	Geological maps of the site area produced by the GSI and available on GSI online map viewer.
	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	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	An inventory of historic mines in Ireland that includes detailed geochemical analysis.

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
R646	Setanta Centre	Unknown	Unknown	Kildare Street, Dublin 2	Four rotary percussion and cable percussion boreholes.
R5321	New Pavilion at Leinster House	Unknown	Unknown	Kildare Street Dublin 2	Three cable percussion boreholes (shell and auger)
R7412	Dublin Dart Underground EIS	Unknown	Unknown	Dublin Co Dublin	27 cable percussion boreholes (shell and auger), 119 rotary core drilling, five trial pits and 12 window samples.
R550	Office Development on Hume Street	Unknown	Unknown	Hume Street, Dublin 2	Five boreholes, one trial pit.
R299	Donnybrook Bridge	Unknown	Unknown	Donnybrook, Dublin 4	Two boreholes (natural exposure).
R381	St. Mary's Church	Unknown	Unknown	Donnybrook, Dublin 4	Two rotary coring / cable percussion boreholes and six cable percussion boreholes (shell and auger).
R4728	Donnybrook Bus Station	Unknown	Unknown	Donnybrook, Dublin 4	One borehole (natural exposure).
R630	C.I.E Bus Garage	Unknown	Unknown	Donnybrook, Dublin 4	Six boreholes (drilling type unspecified).
R948	Apartments at Belfield Court	Unknown	Unknown	Belfield Court, Stillorgan Road, Dublin 4	Four cable percussion boreholes (shell and auger).
R4993	Residential / Commercial development	Unknown	Unknown	Booterstown, Co. Dublin	Five cable percussion boreholes (shell and auger) and two trial pits.
R4865	New Commercial Development	Unknown	Unknown	Clonkeen Road, Deansgrange Co. Dublin	Four cable percussion boreholes (shell and auger) and four trial pits.
R1064	Bank of Ireland Computer Centre	Unknown	Unknown	Cabinteely, Dublin 18	Four trial pits.
R2603	M50 South Eastern motorway	Unknown	Unknown	Ballinteer to Shankill Co. Dublin	263 cable percussion / rotary coring boreholes and 132 trial pits.
R1461	Carrickmines / Shanganagh Main Drainage Scheme	Unknown	Unknown	Dun Laoghaire, Co. Dublin	11 cable percussion and rotary coring boreholes, 59 cable percussion (shell and auger) and 24 trial pits.
R1766	M11 Motorway Bray-Shankill By-Pass	Unknown	Unknown	Co. Dublin	79 cable percussion and rotary coring boreholes.
R5260	Residential / Commercial development	Unknown	Unknown	Dublin Road, Shankill, Co. Dublin	Four cable percussions boreholes.
R5428	Shankill Caravan Park	Unknown	Unknown	Shankill, Co. Dublin	Four 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 A14.2 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 Connects Route 13 Bray to City Centre – Ground Investigation	Causeway	2020	St Laurence's Park Subway & Upper Dargle Road	3 no. Cable Percussion Boreholes, 1 no. Window Sample 6 no. Slit Trenches

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-JAC-GEO_HV-0013_ML_00-DR-CR-9001 in Volume 3 of this EIAR) have been used in the assessment.

14.2.3.4 Scheme Walkover

A scheme walkover survey was carried out on 29 January 2020, 17 August 2022 and 23 March 2023 to inform and verify the review of publicly available datasets.

The findings of the 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' (IGI 2013).

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 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 (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 2022). However, it has intermediate steps to justify using that terminology:

- Step 1: Quantify the importance of a feature for geology (Box 4.1) and hydrogeology (Box 4.3);

- Step 2: Estimate the magnitude of the impact on the feature from the Proposed Scheme (Box 5.1, Box 5.3); and
- Step 3: Determine the significance of the impact on the feature from the matrix (Box 5.4) based on the importance of the feature and the magnitude of the impact.

Table 14.4: Criteria for Rating the Importance of Identified Soils and Geological Attributes (Table C2 (IGI 2013) and Box 4.1 (NRA 2008a))

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and / or soft organic soil underlying route is significant on a national or regional scale.	Geological feature rare on a regional or national scale (NHA) Large existing quarry or pit Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and / or soft organic soil underlying route is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site) Well drained and / or highly fertility soils Moderately sized existing quarry or pit Marginally economic extractable mineral resource
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 Attributes (Box 4.3 (NRA 2008a)).

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

Table 14.6: Definition of Magnitude of Impact (Table 5.1 (NRA 2008a))

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 Soil and Geology Impact Significance and Magnitude at EIS stage (Table C4 (IGI 2013) and Box 5.1 (NRA 2008a))

Magnitude of Impact	Criteria	Typical Example
Large Adverse	Results in loss of attribute	Loss of high proportion of future quarry or pit reserves Irreversible loss of high proportion of local high fertility soils Removal of entirety of geological heritage feature Requirement to excavate / remediate entire waste site Requirement to excavate and replace high proportion of peat, organic soils and / or soft mineral soils beneath alignment
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Loss of moderate proportion of future quarry or pit reserves Removal of part of geological heritage feature Irreversible loss of moderate proportion of local high fertility soils Requirement to excavate / remediate significant proportion of waste site Requirement to excavate and replace moderate proportion of peat, organic soils and / or soft mineral soils beneath alignment
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Loss of small proportion of future quarry or pit reserves Removal of small part of geological heritage feature Irreversible loss of small proportion of local high fertility soils and / or high proportion of local low fertility soils Requirement to excavate / remediate small proportion of waste site Requirement to excavate and replace small proportion of peat, organic soils and/or soft mineral soils beneath alignment
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	No measurable changes in attributes
Minor Beneficial	Results in minor improvement of attribute quality	Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality	Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

Table 14.8: Criteria for Rating Hydrogeological Impact Significance and Magnitude at EIA stage (Box 5.1 (NRA 2008a))

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

Table 14.9: Rating of Significant Environmental Impacts at EIA Stage (Table C6 (IGI 2013) and Box 5.4 (NRA 2008a)).

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

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 remaining residual impacts taking these measures into account. 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 region 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. The coastline within the region is characterised by sandy beaches and rock outcrops.

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 land uses in the region mainly comprise 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	Rendzinas / 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 comprise 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 / Wicklow 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 Palaeozoic sandstones and shales	Howth
GLs	Gravels derived from limestones	Dublin City
GMp	Gravels derived from metamorphic rocks	South towards Bray
GGr	Gravels derived from granite	South Dublin
Rck	Bedrock outcrop or subcrop	Localised pockets within Dublin City / near Wicklow Mountains
Scree	Scree	Near Wicklow Mountains
L	Lacustrine sediments	South near Wicklow mountains
Mbs	Marine beach sands	Coast
Mesc	Estuarine silts and clays	Portmarnock
TdlMr	Tidal Marsh	Bull Island
IrSTCSsS	Irish Sea Till derived from Cambrian sandstones and shales	Bray South
IrSTLPSsS	Irish Sea Till derived from Lower Palaeozoic sandstones and shales	Bray South
IrSTLs	Irish Sea Till derived from limestones	South towards Bray
TCSsS	Till derived from Cambrian sandstones and shales	Bray South
TGr	Till derived from granites	South Dublin
TLPSsS	Till derived from Lower Palaeozoic sandstones and shales	South Dublin
TLs	Till derived from limestones	Dublin City
TMp	Till derived from metamorphic rocks	Near Wicklow Mountains
TQz	Till derived from quartzites	South towards Bray
Ws	Windblown sands	Coast
Wsd	Windblown sands and dunes	Coast
Dam	Dam	Tallaght
Embankment	Embankment	Sandyford
Landfill	Landfill	Near Blanchardstown
Urban	Urban (made ground)	Dublin City and outskirts

14.3.2.4 Regional Bedrock Geology

The bedrock geology of the region, as classified by the GSI 1:500,000 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 orientation 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 axes.

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)	Type 2p microcline porphyritic	Granite with microcline phenocrysts	South near Bray
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 14.13. The GSI (GSI 2019b) has devised a system for classifying the aquifers in Ireland based on the hydrogeological characteristics, size and productivity of the groundwater resource. The aquifer classes and sub-classes are shown in the National Draft Bedrock Aquifer Map. There are three principal types of aquifer, corresponding to whether they are major, minor or unproductive resources, whereby:

- Regionally Important Aquifers are capable of supplying regionally important abstractions (e.g. large public water supplies), or excellent yields (>400 metres cubed per day (m^3/d)).
- Locally Important Aquifers are capable of supplying locally important abstractions (e.g. smaller public water supplies, group schemes), or good yields ($100m^3/d$ to $400m^3/d$); and

- Poor Aquifers are capable of supplying small abstractions (e.g. domestic supplies), or moderate to low yields (<100m^3/d).

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

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

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

Table 14.13: 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 (GSI 2019b)

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Subsoil Permeability (Type) and Thickness
	High Permeability (Sand / Gravel)	Moderate Permeability (e.g. Sandy Subsoil)	High Permeability (Sand / Gravel)	Sand / Gravel Aquifers Only)	High Permeability (Sand / Gravel)
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 (GSI 2019b) for the region indicates annual groundwater recharge across the region ranges from approximately 1mm/yr (millimetre per year) to 600mm/yr as shown on Figure 14.6 in Volume 3 of this EIAR.

14.3.2.8 Regional Groundwater Abstractions

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

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

In addition to these abstractions, Dublin City Council (DCC), Dún Laoghaire-Rathdown County Council (DLRCC) and Wicklow County Council 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. However, this data is not available to the public.

Source Protection Zones (SPZ) reports have been produced by the GSI (GSI 2019b) in conjunction with the EPA for groundwater sources, particularly public water supplies, group water schemes or important industrial supplies. The reports aim to guide development planning and regulation to provide protection to groundwater sources. To date no SPZ reports have been produced with regard to any sites within the study area.

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

14.3.2.9 Groundwater Quality and Levels

Based on professional experience and previous ground investigations in the area, groundwater levels are generally within 5m of the surface in Dublin City and are closer to the surface near rivers and streams. Historical groundwater monitoring is available from a monitoring borehole at the GSI Beggar's Bush Office, Dublin 4 (monitored from 1990 to 2000). Groundwater level monitoring has commenced at Beggar's Bush since August 2018 with the data available online (GSI 2019e). Beggar's Bush lies approximately 2km 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 Rye water 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
CGS	Oscar Wilde Statue
CGS	51 St. Stephens Green
CGS	Dublin City Walls
CGS	Temple Bar Street Well
CGS	Guinness Wells
CGS	Kippure
CGS	Lucan Esker
CGS	Liffey Valley Centre road sections
CGS	N4 Lucan cutting
CGS	Ballinascorney Quarry
CGS	Newcastle Buried channel
CGS	Carrickgollogan
CGS	Ballycorus
CGS	Killiney Hill
CGS	White Rock, Killiney
CGS	Ballybetagh Bog
CGS	Dalkey Island
CGS	Killiney Bay
CGS	The Scalp
CGS	Three Rock Mountain
CGS	Blackrock Breccia
CGS	Dalkey Hill
CGS	Murphystone Quarry
CGS	Enniskerry Delta
CGS	Glencullen River
CGS, pNHA	River Dargle Valley
CGS, SAC	Bray Head

14.3.3 Site Specific Environment

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

14.3.3.1 Current and Historic Land Use

The current and historic land use is discussed in order to give context to any potential changes to land, soils, geology and hydrogeology that have the potential to influence the importance of a feature and the magnitude of any impacts. The current land use is based on current aerial imagery and mapping available from Ordnance Survey Ireland (OSI) (OSI 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 Leeson Street to Donnybrook (Anglesea Road Junction)

The Corine Land Cover 2018 (EPA 2018) classifies the land use within the area from St. Stephen's Green to the Grand Canal as continuous urban fabric and between the Grand Canal and Donnybrook as discontinuous urban fabric. Two watercourses are recorded as crossing the line of the Proposed Scheme; the Grand Canal north of Mespil Road and the River Dodder north of Beaver Row.

Historically, the OSI 6-inch mapping shows urban development between St Stephen's Green and the Grand Canal with a notable reduction in urban development south of the Grand Canal. In Donnybrook Village a bleach mill was located at Pembroke Cottages, a sawmill was located to the west of Brookvale Road, a gravel pit was located east of Eglinton Terrace and a graveyard was located at The Crescent.

The OSI 25-inch mapping shows an increase in urban development within the study area and the inclusion of a tramway from St Stephen's Green along the line of the Proposed Scheme to a Tramway Depot at Beaver Row. The gravel pit noted in the 6-inch map located east of Eglinton Terrace is not included in the 25-inch map suggesting that it was infilled and converted to a green space (Old Fair Green).

Again, some further development is shown within the study area on the OSI 6-inch Cassini mapping. The further urbanization of the area includes a cemetery at Donnybrook Manor.

It should be noted that the 1995 OSI aerial photography is in black and white and of poor resolution, however significant development is recorded throughout the study area in this imagery comprising numerous commercial and industrial buildings of varying sizes.

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 2022 Google Maps aerial imagery shows no significant development of the land within the study area.

14.3.3.1.2 Donnybrook (Anglesea Road Junction) to Loughlinstown Roundabout

The Corine Land Cover 2018 classifies the land use within the area from Donnybrook to Wyattville Road as discontinuous urban fabric. Elm Park Golf and Sports Club located to the east of the N11 between Nutley Lane and The Elms is classified as sports and leisure facilities. Cabinteely Park and Kilbogget Park are classified as green urban areas. Between Beech Park and Willow Court a proportion of the western part of the study area is

classified as non-irrigated arable land. This land is north of an area classified as industrial and commercial units at the Wyattville Road. The Brewery Stream crosses the Proposed Scheme route at Merville Road.

Historically, the OSI 6-inch mapping shows that the study area between Donnybrook and Newtownpark Avenue comprises predominantly agricultural land with scattered residential development. A quarry existed at the corner of Stillorgan Road and Beaver Row.

A gravel pit was located at Stillorgan Park Avenue, clay pits were located at Merville Road. Between Newtownpark Avenue and Wyattville Road there is less development and the study area was predominantly agricultural land. Sand pits were located at Cairn Hill, Monaloe Avenue and Courtlands. A graveyard was located on the Glenalbyn Road. The Shanganagh watercourse crosses the line of the Proposed Scheme at Cherrywood Road.

The OSI 25-inch mapping shows an increase in residential development within the study area. The sand pit noted in the OSI 6-inch map at Courtlands was noted as a disused gravel pit in the OSI 25-inch map. The Tramway Depot is located where the quarry was identified on the 6-inch map. This suggests that the quarry was infilled.

It should be noted that the 1995 OSI aerial photography is in black and white and of poor resolution and aerial mapping is missing between Cairn Hill and Shanganagh Vale. Areas recorded as being relatively undeveloped are pockets of parklands including the Elm Park Golf and Sports Club south of Nutley Lane, parts of the University College Dublin (UCD) and RTÉ campuses, and Donnybrook Stadium.

However, significant development is recorded throughout the study area between Fosters Avenue and Cairn Hill comprising numerous commercial and industrial buildings of varying sizes. Between Shanganagh Vale and Wyattville Road the area comprises residential land use in the east of the study area and agricultural land to the west.

The 2000 OSI aerial photography shows an increase in development compared to the 1995 OSI aerial photography, most notably at Lawnswood Park, Belmont Terrace, and between Shanganagh Vale and Wyattville Road.

The 2005 OSI aerial photography imagery shows an increase in development of the land within the study area between Shanganagh Vale and Wyattville Road.

The 2022 Google Maps aerial imagery shows a small increase in development of the land within the study area, most notably at Brewery Road and to the west of Wyattville Road.

14.3.3.1.3 Loughlinstown Roundabout to Bray North (Wilford Roundabout)

The Corine Land Cover 2018 classifies the land use within the area from Loughlinstown roundabout to Allies River Road as predominantly discontinuous urban fabric with some area of complex cultivation patterns to the west of the study area and the M11 classified as road and rail network. Between Allies River Road and Wilford Roundabout the land use is classified as complex cultivation patterns with a small area classified as green urban areas.

Historically, the OSI 6-inch mapping shows that in the study area between Loughlinstown Roundabout and Bray North the land use was predominantly mixed urban and residential land with pockets of green areas most notable around Shanganagh Castle. An old rail line is noted on the map and crossed the line of the Proposed Scheme in Shankill at Sean Chill Cross.

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 an increase in development compared to the 1995 OSI aerial photography, most notably at Loughlinstown Roundabout and Rathmichael Park.

The 2005 OSI aerial photography imagery shows an increase in development of the land within the study area around Rathmichael Park and the residential area of Olcovar within Shankill.

The 2019 Google Maps aerial imagery shows a small increase in development of the land within the study area, most notably at the residential area of Olcovar within Shankill.

14.3.3.1.4 Bray North (Wilford Roundabout) to Bray South (Fran O'Toole Bridge)

The land use in this section of the Proposed Scheme becomes increasingly urbanised approaching Bray Town with increasing commercial land use interspersed with some residential and recreational land use.

Historically, the OSI 6-inch mapping shows the study area between Bray North and Bray South to be predominantly urban land. An old sand pit is noted west of Ravenswell.

The OSI 25-inch mapping shows an increase in residential development within the study area. The sand pit identified on the 6-Inch mapping has been backfilled.

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

The 2000 OSI aerial photography shows an increase in development compared to the 1995 OSI aerial photography, most notably at Cois Cairn along Old Connaught Avenue with the construction of residential housing.

The 2005 OSI aerial photography imagery shows an increase in development of the land within the study area around Corke Abbey.

The 2022 Google Maps aerial imagery shows a small increase in development of the land within the study area, most notably around Chapel Lane and Ravenswell with the construction of new infrastructure including local access road and Ravenswell Primary School.

14.3.3.2 Geomorphology and Topography

The geomorphology and topography are discussed in order to give context to any potential changes to land, soils, geology, and hydrogeology that could influence the importance of a feature and the magnitude of any impacts. The geomorphology (GSI 2016a) and the topography are shown on Figure 14.7 in Volume 3 of this EIAR.

14.3.3.2.1 Leeson Street to Donnybrook (Anglesea Road Junction)

The route of the Proposed Scheme begins at St Stephen's Green which according to the OSI 10m contours is at an elevation between 0mOD and 10mOD and gradually rises to between 10 and 20mOD at Donnybrook.

The geomorphology within this section of the study area is characterised by glacial meltwater channels associated with the River Dodder.

14.3.3.2.2 Donnybrook (Anglesea Road Junction) to Loughlinstown Roundabout

The Proposed Scheme continues to rise gradually reaching a topographical high between 80mOD and 90mOD near the junction with Newtownpark Avenue before gradually falling towards Wyattville Road to approximately 30mOD before gradually rising to between 30mOD and 40mOD from Wyattville Road to Loughlinstown Roundabout. The Proposed Scheme also passes over the Elm Park Stream near UCD.

There are a number of geomorphology features across this section of the study area including streamlined bedrock around Mount Merrion and Cornelscourt, meltwater channels associated with the Carrickmines Stream / Shanganagh / Loughlinstown River and hummocky sands and gravel deposits near Stillorgan and a drumlin identified east of Deansgrange.

14.3.3.2.3 Loughlinstown Roundabout to Bray North (Wilford Roundabout)

The Proposed Scheme falls from a level of 40mOD at Loughlinstown Roundabout to 20mOD at the Wilford Roundabout.

The geomorphology within this section of the study area is characterised by glacial meltwater channels associated with the Rathmichael River.

14.3.3.2.4 Bray North (Wilford Roundabout) to Bray South (Fran O'Toole Bridge)

The Proposed Scheme gradually falls from 20mOD at the Wilford Roundabout to a level of between 0mOD and 10mOD at the River Dargle.

The geomorphology within this section of the study area is characterised by the Fassaroe Delta at Bray North to Ravenswell and a glacial meltwater channel associated with the River Dargle.

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, 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 Leeson Street to Donnybrook (Anglesea Road Junction)

The soils encountered within the study area for this section of the Proposed Scheme from Leeson Street to Donnybrook is predominately made ground with the exception of urban parks, such as St. Stephen's Green, gardens and green verges.

14.3.3.3.2 Donnybrook (Anglesea Road Junction) to Loughlinstown Roundabout

The soils encountered within the study area for this section of the Proposed Scheme from Donnybrook to Loughlinstown Roundabout is predominantly made ground with topsoil associated with green spaces. As the route approaches Loughlinstown there is topsoil (AminSW, BminDW and BminPD) and alluvium present associated with the rivers in this part of the study area.

14.3.3.3.3 Loughlinstown Roundabout to Bray North (Wilford Roundabout)

The soils encountered within the study area for this section of the Proposed Scheme from Loughlinstown to Bray North is predominantly made ground with topsoil (AminDW and BminPD) associated with green spaces.

14.3.3.3.4 Bray North (Wilford Roundabout) to Bray South (Fran O'Toole Bridge)

The soils encountered within the study area for this section of the Proposed Scheme from Bray North to Bray South is predominantly made ground with topsoil (AminSW and BminPD) associated with green spaces. There is alluvium associated with the River Dargle.

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
Alluvium – AlluvMIN	Typically found along current and historic watercourses	Along River Dargle	Medium	Moderately drained and / or moderate fertility soils
Topsoil - BminSW	Shallow well drained (Mainly basic)	Verges along the Proposed Scheme	High	Well drained and / or high fertility soils
Topsoil - BminDW	Deep well drained (Mainly basic)	Bray North, Loughlinstown	High	Well drained and / or high fertility soils
Topsoil - BminPD	Poorly drained (Mainly Basic)	Loughlinstown to Bray North	Low	Poorly drained and / or low fertility soils
Topsoil - AminSW	Shallow well drained (Mainly acidic)	Loughlinstown	High	Well drained and / or high fertility soils
Topsoil - AminDW	Deep well drained (Mainly acidic)	Loughlinstown to Bray North	High	Well drained and / or high fertility soils
Topsoil - Amin PDPT	Peaty poorly drained (Mainly acidic)	Verges along the Proposed Scheme	Low	Poorly drained and / or low fertility soils
Topsoil - AminPD	Poorly drained (Mainly Acidic)	Verges along the Proposed Scheme	Low	Poorly drained and / or low 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. Additionally, there are areas of made ground (Urban), alluvium, gravels and Irish Sea Till as discussed below.

14.3.3.4.1 Leeson Street to Donnybrook (Anglesea Road Junction)

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

The subsoils north of the Grand Canal are a mix of glacial till and made ground (Urban). There is a pocket of gravels at the former Burlington Hotel and alluvium as you approach the Anglesea Road junction associated with the River Dodder.

14.3.3.4.2 Donnybrook (Anglesea Road Junction) to Loughlinstown Roundabout

The subsoils encountered within the study area for this section of the Proposed Scheme are predominately glacial tills derived from limestone and granite. There is alluvium identified associated with Elm Park Stream and there are gravels and alluvium east of Fosters Avenue, Stillorgan and associated with the river network at Loughlinstown. Bedrock is shallow between Stillorgan and Cornelscourt.

14.3.3.4.3 Loughlinstown Roundabout to Bray North (Wilford Roundabout)

The subsoils encountered within the study area for this section of the Proposed Scheme are predominately glacial tills derived from limestone and granite. There is alluvium associated with the river network and north of Wilford Roundabout. There are gravels and Irish Sea Tills north of Wilford Roundabout.

14.3.3.4.4 Bray North (Wilford Roundabout) to Bray South (Fran O'Toole Bridge)

The subsoils encountered within the study area for this section of the Proposed Scheme are predominately gravels and made ground (Urban) as the route enters Bray. There are some glacial tills and alluvium associated with the River Dargle.

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 Dargle / Loughlinstown River	Low	Low value on a local scale
Glacial gravels - GLs	Gravels derived from limestones	Fosters Avenue, Stillorgan.	Low	Low value on a local scale
Glacial till - TLs	Till derived from limestones	Widespread	Low	Low value on a local scale
Glacial till - TGr	Till derived from granites	Bray	Low	Low value on a local scale
Irish Sea Till - IrSTLs	Irish Sea Till derived from Limestones	Bray	Low	Low value on a local scale
Rock - Rck	Bedrock outcrop or subcrop	Bray	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 1:100,000 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 varies significantly from north to south due to fact that the study area includes the limestones associated with Dublin City and the granites and other formations associated with the Dublin / Wicklow Mountains and Bray.

14.3.3.5.1 Leeson Street to Donnybrook (Anglesea Road Junction)

The bedrock encountered within the study area for this section of the Proposed Scheme comprises of the Lucan Formation (locally known as Calp Limestone).

No major structural bedrock features were identified along this section of the study area.

14.3.3.5.2 Donnybrook (Anglesea Road Junction) to Loughlinstown Roundabout

The bedrock encountered within the study area for this section of the Proposed Scheme comprises of the Lucan Formation (locally known as Calp Limestone). The Ballysteen Formation is encountered from Fosters Avenue to Booterstown Avenue and from Booterstown Avenue to Wyattville Road the underlying bedrock comprises of various granite formations predominately Type 2p microcline porphyritic (Northern and Upper Liffey Valley Plutons).

A south-west / north-east trending fault is located between the contacts of the Lucan Formation and the Ballysteen Formation, and the Ballysteen Formation and the Type 2p microcline porphyritic (Northern and Upper Liffey Valley Plutons).

14.3.3.5.3 Loughlinstown Roundabout to Bray North (Wilford Roundabout)

The bedrock encountered within the study area for this section of the Proposed Scheme is predominately the Maulin Formation, a dark blue-grey slate, phyllite and schist.

The outer limit of a high-grade aureole is identified near Loughlinstown and a metamorphic aureole near Shanganagh.

14.3.3.5.4 Bray North (Wilford Roundabout) to Bray South (Fran O'Toole Bridge)

The bedrock encountered within the study area for this section of the Proposed Scheme is predominately the Maulin Formation, a dark blue-grey slate, phyllite and schist with the exception of the Bray Head Formation, a greywacke and quartzite south of the River Dargle.

The structural geology from Bray North to Bray South is heavily faulted and folded. The main fault line runs north-west/southeast. There are a number of west-east thrust faults, west east synclinal fold axis and north-west / south-east anticlinal fold axis also noted within the area.

Table 14.18: Rock Formations Within the Study Area

Strata	Description	Location	Importance	Justification for Importance Rating
Lucan Formation	(Calp) Dark Limestone and shale	City Centre to Loughlinstown Roundabout	Low	Low value on a local scale
Ballysteen Formation	Dark muddy limestone, Shale – Carboniferous	Loughlinstown	Low	Low value on a local scale
Type 2p microcline porphyritic	Granite with microcline phenocrysts – Caledonian	Loughlinstown	Low	Low value on a local scale
Type 2e equigranular	Pale grey fine to coarse-grained granite – Caledonian	Loughlinstown	Low	Low value on a local scale
Maulin Formation	Dark blue-grey slate, phyllite and schist – Ordovician	Bray	Low	Low value on a local scale
Bray Head Formation	Greywacke and quartzite – Cambrian	Bray	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 a 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 Leeson Street to Donnybrook (Anglesea Road Junction) Section

Strata	General Extent / Location	Top of Strata (mBGL)	Thickness of Strata (m)
Topsoil	Kildare Street / Hume Street	0 to 0.3	0.3
Made Ground	Kildare Street / Hume Street	0 to 3.0	0.6 to 4.0
Alluvial Deposits	Kildare Street / Hume Street	4.8 to 21	2.1 to 5.0
Glacial Till (Brown and Black Boulder Clay with lenses of fluvioglacial sands and gravels)	Kildare Street / Hume Street	0.6 to 18.0	0.7 to 10.0
Bedrock	Kildare Street / Hume Street	9.1 to 16.6	Not proven
Based on a review of GI data listed in Table 14.2			

Table 14.20: Summary of Ground Conditions Expected to be Encountered by the Proposed Scheme between Donnybrook (Anglesea Road Junction) to Loughlinstown Roundabout Section

Strata	General Extent / Location	Top of Strata (mBGL)	Thickness of Strata (m)
Topsoil	St Laurence's Park Subway	0	0.2
Made Ground	St Laurence's Park Subway	0-0.2	1.0-1.10
Glacial Till (Brown and Black Boulder Clay with lenses of fluvioglacial sands and gravels)	St Laurence's Park Subway	1.2	Not proven
Bedrock	St Laurence's Park Subway	Not encountered	Not encountered
Based on review of scheme specific GI			

Table 14.21: Summary of Ground Conditions Expected to be Encountered by the Proposed Scheme between Loughlinstown Roundabout to Bray North (Wilford Roundabout) Section

Strata	General Extent / Location	Top of Strata (mBGL)	Thickness Range (m)
Topsoil	Shankill	0	0.2
Made Ground	Shankill	0	1.4 to 2.8
Alluvial Deposits	Shankill	2.8	2.7
Glacial Till (Brown and Black Boulder Clay with lenses of fluvioglacial sands and gravels)	Shankill	0.2 to 5.5	Not proven
Bedrock	Shankill	Not encountered	Not encountered
Based on a review of GI data listed in Table 14.2			

Table 14.22: Summary of Ground Conditions Expected to be Encountered by the Proposed Scheme between Bray North (Wilford Roundabout) to Bray South (Fran O'Toole Bridge) Section

Strata	General Extent / Location	Top of Strata (mBGL)	Thickness of Strata (m)
Topsoil	Upper Dargle Road	0	0.1
Made Ground	Upper Dargle Road	0.1	3.4
Alluvium	Upper Dargle Road	0.5	Not proven
Glacial Till (Brown and Black Boulder Clay with lenses of fluvioglacial sands and gravels)	Upper Dargle Road	3.5	Not proven
Bedrock	Upper Dargle Road	Not encountered	Not encountered
Based on review of scheme specific GI			

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	General Extent	Location	Depth Range (mBGL)	Thickness Range (m)
Alluvium - AlluvMIN (soils) / A (subsoils)	Typically found along current and historic watercourses	Along River Dargle, Loughlinstown 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 scheme-specific ground investigations as listed in Table 14.3. 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 Box (NRA 2008a).

There are potential interactions with petrol stations along the Proposed Scheme at two locations. There are some minor road widening works proposed adjacent to the Circle K in Donnybrook in the northbound side of, Donnybrook Road and more significant widening works proposed at the Circle K on the southbound side of the Dublin Road in Bray.

Soil analysis was carried out on samples retrieved during the ground investigations at depths ranging from 0.4 to 1.0m 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 Causeway Geotechnical.
- One sample was classified as Inert and the second sample was described as concrete therefore is not suitable for a soil recovery facility and has been classified as non-hazardous based on the limited information.

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

Feature	Description	Importance	Justification for Importance Rating
Bleach Mill	Industrial (6-inch OSI Mapping) – Pembroke Cottages	Medium	Degree or extent of soil contamination is moderate on a local scale
Saw Mill	Industrial (6-inch OSI Mapping) – Brookvale Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Gravel Pit	Gravel Pit (6-inch OSI Mapping) - Eglinton Terrace	Medium	Degree or extent of soil contamination is moderate on a local scale
Gravel Pit	Gravel Pit (6-inch OSI Mapping) – Anglesea Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Graveyard	Graveyard (6-inch OSI Mapping) – The Crescent	Medium	Degree or extent of soil contamination is moderate on a local scale
Gravel Pit	Gravel Pit (6-inch OSI Mapping) – Beaver Row	Medium	Degree or extent of soil contamination is moderate on a local scale
Tramway Depot	Industrial (Cassini and 25-inch Mapping) – Beaver Row	Medium	Degree or extent of soil contamination is moderate on a local scale
Graveyard	Graveyard (Cassini OSI Mapping) – Brookfield Manor	Medium	Degree or extent of soil contamination is moderate on a local scale
Gravel Pit	Gravel Pit (6-inch OSI Mapping) – Stillorgan Park Avenue	Medium	Degree or extent of soil contamination is moderate on a local scale
Clay Pits	Clay Pits (6-inch OSI Mapping) – Merville Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Graveyard	Graveyard (6-inch OSI Mapping) – Glenalbyn Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Sand Pit	Sand Pit (6-inch OSI Mapping) – Cairn Hill	Medium	Degree or extent of soil contamination is moderate on a local scale
Sand Pit	Sand Pit (6-inch OSI Mapping) – Monaloe Avenue	Medium	Degree or extent of soil contamination is moderate on a local scale
Sand Pit / Gravel Pit	Sand Pit (6-inch OSI Mapping) / Gravel Pit (25-inch Mapping) – Courtlands	Medium	Degree or extent of soil contamination is moderate on a local scale
Historic / Closed Landfills	Historic landfills / closed landfills are noted adjacent the Proposed Scheme at Kilbogget Park, Ballyogan and Woodbrook Golf Club	Medium	Degree or extent of soil contamination is moderate on a local scale
Petrol stations	A number of petrol stations were identified during the walkover at Donnybrook Junction, Merrion Hall, Cherrywood and Dublin Road near Old Connaught Road, Bray	Medium	Degree or extent of soil contamination is moderate on a local scale
Derelict site	Identified during the site walkover along Castle street	Medium	Degree or extent of soil contamination is moderate on a local scale
Contaminated soils from recent Site Investigations	Sample was described as concrete therefore is not suitable for a soil recovery facility and has been classified as non-hazardous based on the limited information.	Medium	Degree or extent of soil contamination is moderate on a local scale
Widening works at Circle K Bray	Decommissioning works are expected at an existing Circle K petrol station on the southbound side of the Dublin Road in Bray due to proposed widening works. The decommission works will impact 4 no. of pumps and the removal of some of the underground tanks.	Medium	Degree or extent of soil contamination is moderate on a local scale

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

14.3.3.10 Mineral / Aggregate Resources

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

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

No active pits, mines or quarries were identified within the study area. There are no mineral localities within the study area.

14.3.3.10.1 Leeson Street to Donnybrook (Anglesea Road Junction)

The crushed rock aggregate potential along this section of the study area generally ranges from low to moderate. Areas of low potential were identified from Appian Way to the Mount Eden Road. Areas of moderate crushed rock potential were identified from St Stephen's Green to Leeson Street Upper and around Donnybrook. A localised pocket of high to very high crushed rock potential is located in Donnybrook at the River Dodder Crossing.

The granular aggregate potential ranges from low to very high around Donnybrook.

14.3.3.10.2 Donnybrook (Anglesea Road Junction) to Loughlinstown Roundabout

The crushed rock aggregate potential along this section of the study area is highly variable and ranges from low to very high. Areas of low potential were identified from Donnybrook Close to Stillorgan Park. The crushed rock potential from Stillorgan Park to Cornelscourt is highly variable ranging from moderate to very high before falling to low from Cornelscourt to Loughlinstown with localised pockets of high potential crushed rock aggregate potential.

The granular aggregate potential ranges from moderate to very high near Booterstown, Stillorgan Village and Cornelscourt on the Stillorgan Road.

14.3.3.10.3 Loughlinstown Roundabout to Bray North (Wilford Roundabout)

The crushed rock aggregate potential is low from Loughlinstown to Bray North. The granular aggregate potential is very high at Bray North and high form Woodbrook drive to near Castle Farm along the Dublin Road.

14.3.3.10.4 Bray North (Wilford Roundabout) to Bray South (Fran O'Toole Bridge)

The crushed rock aggregate potential is very low to low from Bray North to Bray South.

The granular aggregate potential is generally high to very high around Bray North.

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).

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	Donnybrook, Bray North to Bray South,	Low	Uneconomically extractable mineral resource
Crushed rock aggregate potential	Moderate potential	St. Stephens Green, Donnybrook, Booterstown, Stillorgan Village and Cornelscourt	Medium	Sub-economic extractable mineral resource
Crushed rock aggregate potential	High potential	Donnybrook, Booterstown, Stillorgan Village and Cornelscourt	Medium	Extractable mineral resource
Crushed rock aggregate potential	Very High potential	Booterstown, Stillorgan Village, Stillorgan Park and Cornelscourt	High	Marginally extractable mineral resource
Granular aggregate potential	Very Low potential	Loughlinstown Commons	Low	Uneconomically extractable mineral resource
Granular aggregate potential	Low potential	Donnybrook	Low	Uneconomically extractable mineral resource
Granular aggregate potential	Moderate potential	Donnybrook, Booterstown, Stillorgan Village and Cornelscourt	Medium	Sub-economic extractable mineral resource
Granular aggregate potential	High potential	Bray North, Booterstown, Stillorgan Village and Cornelscourt	Medium	Extractable mineral resource
Granular aggregate potential	Very High potential	Bray North, Booterstown, Stillorgan Village and Cornelscourt	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	Importance	Justification for Importance Rating
51 St. Stephens Green (DC001)	The entrance lobby of the building is original from mid 1800s, and displays a demonstration set of Irish marbles.	High	Geological feature of high value on a local scale (County Geological Site)

14.3.3.12 Aquifer Type and Classification

The National Draft Bedrock Aquifer mapping (GSI 2019b) for the study area (Figure 14.13 in Volume 3 of this EIAR) indicates that there are two aquifer types 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) shows 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.	City Centre to Booterstown, and Loughlinstown to Bray	Medium	Locally important aquifer which supplies the local area
Poor Aquifer (PI)	Bedrock which is Generally Unproductive except for Local Zones.	Booterstown to Loughlinstown	Low	Poor aquifer

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 Leeson Street to Donnybrook (Anglesea Road Junction)

The groundwater vulnerability along this section of the study area ranges from low to extreme. Areas of moderate vulnerability were identified from St Stephen's Green to Leeson Street Upper and around Donnybrook. Areas of low potential were identified from Appian Way to the Mount Eden Road. A localised area of high to extreme groundwater vulnerability was located in Donnybrook at the River Dodder.

14.3.3.13.2 Donnybrook (Anglesea Road Junction) to Loughlinstown Roundabout

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

Areas of low vulnerability were identified from Donnybrook Close to Roebuck Avenue. The groundwater vulnerability increases to moderate from Roebuck Avenue to Stillorgan Park and is highly variable from Stillorgan Park to Loughlinstown ranging from low to extreme.

14.3.3.13.3 Loughlinstown Roundabout to Bray North (Wilford Roundabout)

The groundwater vulnerability along this section of the study area ranges from low to high. Areas of low vulnerability were identified from Loughlinstown to Kentfield, before passing into an area of moderate vulnerability from Kentfield to Cherrington Road and high from Cherrington Road to Bray North.

14.3.3.13.4 Bray North (Wilford Roundabout) to Bray South (Fran O'Toole Bridge)

The groundwater vulnerability along this section of the study area ranges from low to extreme. The groundwater vulnerability is high from Bray North to Chapel Lane before passing into an area of moderate groundwater vulnerability from Chapel Lane to Castle Street and finally an area of low groundwater vulnerability from Castle Street to the end of the study area which has a small area of high to extreme vulnerability to the south-west of the River Dargle.

14.3.3.14 Groundwater Recharge

The rate of groundwater recharge (as shown in Figure 14.15 in Volume 3 of this EIAR) corresponds to the soil type as shown in (Figure 14.8 in Volume 3 of this EIAR). The study area predominately has an annual recharge range of 51mm (millimetres) to 100mm in urban areas north of Loughlinstown and 101mm to 200mm south of Loughlinstown to the River Dargle. 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

Groundwater dependent habitats within the study area that have the status of SPA, SAC, NHA or pNHA are listed in Table 14.28 along with their importance as determined by Box 4.1 of the NRA Guidelines (NPSW 2020).

The Grand Canal pNHA is identified within study area. The canal is protected from groundwater ingress or leakage by a liner and therefore not considered to be in hydraulic connectivity with the surrounding groundwater. As such the canal is not considered a groundwater dependent habitat and is not considered further as part of this assessment.

Table 14.28: Groundwater Dependent Habitats within the Study Area

Designated site	Description	Location	Importance	Justification for Importance Rating
Loughlinstown Wood pNHA	Potential alluvial woodland (91EO) on the banks of the Loughlinstown River	Loughlinstown	Very high	Very high value on a local scale

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 14.29 for completeness. Features with an importance ranking of medium or higher are summarised in Table 14.30 and the impact of the Proposed Scheme on these features will be assessed in Section 14.4.

Table 14.29: Summary of Land, Soils, Geology and Hydrogeology Features with Low Importance Within the Study Area

Category	Feature	Description	Location	Importance	Justification
Soil Fertility	Made Ground - Made	Associated with urban development	Widespread	Low	Poorly drained and/or low fertility soils
Soil Fertility	Topsoil - BminPD	Poorly drained (Mainly Basic)	Loughlinstown to Bray North	Low	Poorly drained and/or low fertility soils
Soil Fertility	Topsoil - Amin PDPT	Peaty poorly drained (Mainly acidic)	Verges along the Proposed Scheme	Low	Poorly drained and/or low fertility soils
Soil Fertility	Topsoil - AminPD	Poorly drained (Mainly Acidic)	Verges along the Proposed Scheme	Low	Poorly drained and/or low fertility soils
Subsoils quality and significance	Made Ground - Urban	Associated with urban development	Widespread	Low	Low value on a local scale
Subsoils quality and significance	Alluvium - A	Typically found along current and historical watercourses	River Dargle, Loughlinstown River	Low	Low value on a local scale
Subsoils quality and significance	Glacial gravels - GLs	Gravels derived from limestones	Fosters Avenue, Stillorgan	Low	Low value on a local scale
Subsoils quality and significance	Glacial till - TLs	Till derived from limestones	Widespread	Low	Low value on a local scale
Subsoils quality and significance	Glacial till - TGr	Till derived from granites	Bray	Low	Low value on a local scale
Subsoils quality and significance	Irish Sea Till - IrSTLs	Irish Sea Till derived from Limestones	Bray	Low	Low value on a local scale
Subsoils quality and significance	Rock - Rck	Bedrock outcrop or subcrop	Bray	Low	Low value on a local scale
Bedrock quality and significance	Lucan Formation	(Calp) Dark Limestone and shale	City Centre to Loughlinstown Roundabout	Low	Low value on a local scale
Bedrock quality and significance	Ballysteen Formation	Dark muddy limestone, Shale – Carboniferous	Loughlinstown	Low	Low value on a local scale
Bedrock quality and significance	Type 2p microcline porphyritic	Granite with microcline phenocrysts – Caledonian	Loughlinstown	Low	Low value on a local scale
Bedrock quality and significance	Type 2e equigranular	Pale grey fine to coarse-grained granite – Caledonian	Loughlinstown	Low	Low value on a local scale
Bedrock quality and significance	Maulin Formation	Dark blue-grey slate, phyllite and schist – Ordovician	Bray	Low	Low value on a local scale
Bedrock quality and significance	Bray Head Formation	Greywacke and quartzite - Cambrian	Bray	Low	Low value on a local scale
Soft Soils	Alluvium - AlluvMIN (soils) / A (subsoils)	Typically found along current and historic watercourses	River Dargle, Loughlinstown River	Low	Volume of soft soil underlying the route is small and of a local scale.
Economic Geology	Crushed rock aggregate potential	Low potential	Donnybrook, Bray North to Bray South,	Low	Uneconomically extractable mineral resource
Economic Geology	Granular aggregate potential	Very Low potential	Loughlinstown Commons	Low	Uneconomically extractable mineral resource
Economic Geology	Granular aggregate potential	Low potential	Donnybrook	Low	Uneconomically extractable mineral resource
Aquifer	Poor Aquifer (Pl)	Bedrock which is generally unproductive except for local zones	Booterstown to Loughlinstown	Low	Low yielding aquifer

Table 14.30: Summary of Land, Soils, Geology and Hydrogeology Features with Medium to Extremely High Importance Within the Study Area

Category	Feature	Description	Location	Importance	Justification
Soil Fertility	Alluvium - AlluvMIN	Typically found along current and historic watercourses	River Dargle	Medium	Moderately drained and/or moderate fertility soils
Soil Fertility	Topsoil - BminSW	Shallow well drained (Mainly basic)	Verges along the Proposed Scheme	High	Well drained and/or high fertility soils
Soil Fertility	Topsoil - BminDW	Deep well drained (Mainly basic)	Bray North, Loughlinstown	High	Well drained and/or high fertility soils
Soil Fertility	Topsoil - AminSW	Shallow well drained (Mainly acidic)	Loughlinstown	High	Well drained and/or high fertility soils
Soil Fertility	Topsoil - AminDW	Deep well drained (Mainly acidic)	Loughlinstown to Bray North	High	Well drained and/or high fertility soils
Potential Sources of Contamination	Bleach Mill	Industrial (6-inch OSI Mapping)	Pembroke Cottages	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Saw Mill	Industrial (6-inch OSI Mapping)	Brookvale Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Gravel Pit	Gravel Pit (6-inch OSI Mapping)	Eglinton Terrace	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Gravel Pit	Gravel Pit (6-inch OSI Mapping)	Anglesea Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Graveyard	Graveyard (6-inch OSI Mapping)	The Crescent	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Gravel Pit	Gravel Pit (6-inch OSI Mapping)	Beaver Row	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Tramway Depot	Industrial (Cassini and 25-inch Mapping)	Beaver Row	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Graveyard	Graveyard (Cassini OSI Mapping)	Brookfield Manor	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Gravel Pit	Gravel Pit (6-inch OSI Mapping)	Stillorgan Park Avenue	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Clay Pits	Clay Pits (6-inch OSI Mapping)	Merville Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Graveyard	Graveyard (6-inch OSI Mapping)	Glenalbyn Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Sand Pit	Sand Pit (6-inch OSI Mapping)	Cairn Hill	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Sand Pit	Sand Pit (6-inch OSI Mapping)	Monaloe Avenue	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Sand Pit / Gravel Pit	Sand Pit (6-inch OSI Mapping) / Gravel Pit (25-inch Mapping)	Courtlands	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Historic landfills / closed landfills	Historic landfills / closed landfills are noted adjacent the Proposed Scheme at Kilbogget Park, Ballyogan and Woodbrook Golf Club	Kilbogget Park, Ballyogan and Woodbrook Golf Club	Medium	Degree or extent of soil contamination is moderate on a local scale

Category	Feature	Description	Location	Importance	Justification
Potential Sources of Contamination	Petrol stations	A number of petrol stations were identified during the walkover at Donnybrook Junction, Merrion Hall, Cherrywood and Dublin Road near Old Connaught Road, Bray	Donnybrook Junction, Merrion Hall, Cherrywood and Old Connaught Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Derelict site	Identified during the site walkover along Castle street	Castle street	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Contaminated soils from recent Site Investigations	Sample was described as concrete therefore is not suitable for a soil recovery facility and has been classified as non-hazardous based on the limited information.	St Laurence's Park	Medium	Degree or extent of soil contamination is moderate on a local scale
Potential Sources of Contamination	Widening works at Circle K in Bray	Decommissioning works are expected at an existing Circle K petrol station on the southbound side of the Dublin Road in Bray due to proposed widening works. The decommission works will impact 4 no. of pumps and the removal of some of the underground tanks.	Circle K, Bray	Medium	Degree or extent of soil contamination is moderate on a local scale
Economic Geology	Crushed rock aggregate potential	Moderate potential	St. Stephens Green, Donnybrook, Booterstown, Stillorgan Village and Cornelscourt	Medium	Sub-economic extractable mineral resource
Economic Geology	Crushed rock aggregate potential	High potential	Donnybrook, Booterstown, Stillorgan Village and Cornelscourt	Medium	Extractable mineral resource
Economic Geology	Crushed rock aggregate potential	Very High potential	Booterstown, Stillorgan Village, Stillorgan Park and Cornelscourt	High	Marginally extractable mineral resource
Economic Geology	Granular aggregate potential	Moderate potential	Donnybrook, Booterstown, Stillorgan Village and Cornelscourt	Medium	Sub-economic extractable mineral resource
Economic Geology	Granular aggregate potential	High potential	Bray North, Booterstown, Stillorgan Village and Cornelscourt	Medium	Extractable mineral resource
Economic Geology	Granular aggregate potential	Very High potential	Bray North, Booterstown, Stillorgan Village and Cornelscourt	High	Marginally extractable mineral resource
County geological site	51 St. Stephens Green (DC001)	The entrance lobby of the building is original from mid 1800s, and displays a demonstration set of Irish marbles.	St. Stephen's Green	High	Geological feature of high value on a local scale (County Geological Site)
Aquifer	Locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	City Centre to Booterstown, and Loughlinstown to Bray	Medium	Locally important aquifer which supplies the local area
Groundwater Dependant Habitat	Loughlinstown Wood pNHA	Potential alluvial woodland (91EO) on the banks of the Loughlinstown River	Loughlinstown	Very High	Very high value on a local scale

14.3.5 Conceptual Site Model

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

The Proposed Scheme is predominantly underlain by made ground over alluvium where present over glacial till over limestone bedrock. The relevant subsections of the Proposed Scheme are presented in Table 14.31 to Table 14.34 along with the fill height (average and maximum), cut height (average and maximum), and the soils and geology at each earthwork area.

Table 14.31: Conceptual Site Model – Leeson Street to Donnybrook (Anglesea Road Junction)

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)	Additional Notes
			Max	Avg	Max	Avg			
Leeson Street Lower to Morehampton Road (Wellington Place)	1,300	At Grade	0	0	0	0	No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1.5	Localised pavement reconstruction / widening works and junction modification works.
Morehampton Road (Wellington Place) to Anglesea Bridge	1,300	At Grade	1.0	0	0.5	0	No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1.5	Localised pavement reconstruction / widening works and junction modification works. 20m length retaining wall (0.5m retained height, cut of approximately 1m for wall foundations) on west side of Donnybrook Road, north of Anglesea Bridge.
R034 Minor retaining wall	20	Structure	No Cut / Fill due to existence of structure.				No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1.5	Cast In-Situ RC Wall

Table 14.32: Conceptual Site Model – Donnybrook (Anglesea Road Junction) to Loughlinstown Roundabout

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)	Additional Notes
			Max	Avg	Max	Avg			
Anglesea Bridge to Whites Cross (Leopardstown Road)	5,800	At Grade	1.5	0	2.5	0	Minimal GI carried out in this section. 1 borehole near St. Laurance Subway. Approximately 1.2m made ground above boulder clay at this location. Over whole section, inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered - desk study found large variations in made ground thicknesses in the vicinity.	1-3	Localised pavement reconstruction / widening works and junction modification works. 45m long earth embankment (1.5m retained height) and 75m long earth embankment (1m retained height) on west side of N11 near Oatlands College. Widening of N11 at St Laurence Park Subway requiring new wing wall to be built on east side of carriageway with backfilling behind it.
UCD Bus Interchange	n/a	Structure	No Cut / Fill due to existence of structure.				No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1-3	Within the UCD Campus, a new Bus Interchange, with an associated Plaza Island will be constructed, at the campus entrance along Stillorgan Road. The Bus Interchange will include two covered pavilions with enclosed, covered and uncovered seating arrangements. Bus stops and bus information displays will be integrated into the Plaza Island, and the Bus Interchange will be integrated into a woodland walkway, with key pedestrian and cyclist desire lines

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)	Additional Notes
			Max	Avg	Max	Avg			
St Laurence's Subway	32.9	Structure	No Cut / Fill due to existence of structure.				Minimal GI carried out (1 borehole near St. Laurance Subway). Approximately 1.2m made ground above boulder clay at this location.	1-3	The existing underpass structure on Stillorgan Road, at St. Laurence's Park will be extended on the east side to accommodate the Proposed Scheme. The existing structure is located approximately 9km (kilometres) south of Dublin City Centre. The existing structure carries Stillorgan Road over a pedestrian and cyclist link between St Laurence's Park and Patrician Villas. The structure is a box culvert, with an approximate span of 3.7m, and length of 31.1m. The proposed alignment and cross section of the carriageway will require widening of the underpass structure, and construction of a parallel independent structure. The existing carriageway cross section will be extended from 31.1m to 32.9m.
RW039 – Earth Embankment	45	Structure	No Cut / Fill due to existence of structure				Over whole section, inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered - desk study found large variations in made ground thicknesses in the vicinity.	1-3	Stillorgan Road west side of mainline, to accommodate new bus stop, limited land taken. Carriageway is 1.5 m lower level than green area behind the existing bus stop.
RW031 – Earth Embankment	75	Structure	No Cut / Fill due to existence of structure				Over whole section, inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered - desk study found large variations in made ground thicknesses in the vicinity.	1-3	Stillorgan Road west side of mainline, to accommodate proposed cross section. Retained height of 1m.
Whites Cross (Leopardstown Road) to Loughlinstown Roundabout	5,700	At Grade	2.5	0	0	0	Minimal GI carried out (1 borehole near Cornelscourt). Approximately 1.2m made ground above boulder clay at this location. Over whole section, inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered - desk study found large variations in made ground thicknesses in the vicinity.	1-3	Localised pavement reconstruction / widening works and junction modification works.
RW044a and RW044b – Precast RC Walls	20	Structure	No Cut / Fill due to existence of structures				Over whole section, inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered - desk study found large variations in made ground thicknesses in the vicinity.	1-3	Stillorgan Road in central median at Knocksinna, to accommodate pedestrian crossing. Retained height of 1m.
RW043 – Existing wall at Loughlinstown roundabout	110	Structure	No Cut / Fill due to existence of structure				Over whole section, inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered - desk study found large variations in made ground thicknesses in the vicinity.	1-3	Existing retaining structure supporting the embankment at Loughlinstown Roundabout. Ground improvement works required. Composition of structure unknown.

Table 14.33: Conceptual Site Model – Loughlinstown Roundabout to Bray North (Wilford Roundabout)

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)	Additional Notes
			Max	Avg	Max	Avg			
Loughlinstown Roundabout to Shanganagh Road, incl. Stonebridge Road	1,270	At Grade	3.5	0	0	0	No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1	Localised pavement reconstruction / widening works and junction modification works.
RW022 – Precast RC Wall	100	Structure	No Cut / Fill due to existence of structure				No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1	Dublin Road west side of mainline at Woodbank, to accommodate the proposed widening. Retained height of 1m.
RW041 – Earth Embankment	50	Structure	No Cut / Fill due to existence of structure				No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1	Dublin Road west side of mainline. Impact on vegetated verge adjacent to school grounds. Retained height of 2m.
RW023 - Cast In-Situ RC Wall	40	Structure	No Cut / Fill due to existence of structure				No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1	Dublin Road west side of mainline at Stonebridge Road junction, to accommodate the proposed widening. Retained height of 2.5m.
RW024 – Precast RC Wall	30	Structure	No Cut / Fill due to existence of structure				No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1	Dublin Road east side, , between Rathmichael Park and Stonebridge Road junctions to accommodate widening and support traffic surcharge. Retained height of 1.5m.
RW036 - Precast RC Wall	180	Structure	No Cut / Fill due to existence of structure				No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1	Dublin Road east side, north of St. Anne's Church to accommodate proposed widening. Retained height of 0.5m.
RW045 - Existing Masonry Wall at St Annes roundabout	135	Structure	No Cut / Fill due to existence of structure				No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1	Existing retaining wall west of St Anne's Roundabout. No structural works required.

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)	Additional Notes
			Max	Avg	Max	Avg			
RW046 - Existing Masonry Wall at St Annes roundabout	120	Structure	No Cut / Fill due to existence of structure				No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1	Existing retaining structure supporting the Dublin Road, south-east of roundabout. Strengthening works required. Composition of structure unknown.
Shanganagh Road to Quinn's Road	500	At Grade	0	0	0	0	No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1	Localised pavement reconstruction / widening works and junction modification works.
Quinn's Road to Wilford Roundabout	1,800	At Grade	2.2	0	1.8	0	No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1	Localised pavement reconstruction / widening works and junction modification works.
RW042 – Precast RC Wall	130	Structure	No Cut / Fill due to existence of structure				No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1	Dublin Road west side of the mainline, along front of Beech Road. To accommodate proposed cross section. Retained height of 1.2m.
RW027 – Cast In-Situ RC Wall	40	Structure	No Cut / Fill due to existence of structure				No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1	Dublin Road west side of the mainline, opposite Shanganagh Park at proposed bus stop. Retained height of 0.5m.
RW029 – Earth Embankment	55	Structure	No Cut / Fill due to existence of structure				No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1	Dublin Road west side of the mainline, north of Woodbrook Downs junction at proposed bus stop. Retained height of 1.3m.
RW038 - Precast RC Wall	40	Structure	No Cut / Fill due to existence of structure				No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1	Dublin Road east side of the mainline. Level of verge reduces on approach to junction. Retained height of 1.8m.
RW013 – Precast RC Wall	100	Structure	No Cut / Fill due to existence of structure				No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1	Dublin Road east side of mainline, to accommodate the proposed cross section before the Upper Dargle Road junction. No traffic surcharge needs to be considered.

Table 14.34: Conceptual Site Model – Bray North (Wilford Roundabout) to Bray South (Fran O'Toole Bridge)

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)	Additional Notes
			Max	Avg	Max	Avg			
Wilford Roundabout to Old Connaught Avenue	300	At Grade	0	0	0	0	No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1	Localised pavement reconstruction / widening works and junction modification works.
Woodbrook Side Lodge	n/a	Structure	No Cut / Fill due to existence of structure				Over whole section, inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered - desk study found large variations in made ground thicknesses in the vicinity.	1-3	The existing single story residential property south-east of the Wilford roundabout, at the south end of the Woodbrook Estate, will be demolished and reconstructed. The existing lodge will be demolished prior to construction of the proposed lodge, approximately 24m north-west of the existing lodge. Relocation of the lodge will facilitate the proposed carriageway cross section.
Old Connaught Avenue to Upper Dargle Road	400	At Grade	3.5	0	0	0	Minimal GI carried out (2 boreholes in grassland near Ravenswell entrance at Upper Dargle Road junction). No made ground at northern one, 3.5m made ground at southern one. Over whole section, inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered. Gravel deposits are noted from Junction 5 Bray North to Ravenswell along the Dublin Road.	1-3	Localised pavement reconstruction / widening works and junction modification works.
RW014 – Cast In-Situ RC Wall	45	Structure	No Cut / Fill due to existence of structure				No GI carried out. Inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered.	1-3	Dublin Road east side of mainline, to accommodate the proposed cross section. Retained height of 1m.
Circle K Bray	n/a	At grade	1.5	1.0	0.5	0.2	No GI carried out. Desk study indicates variable thickness of made ground overlying gravel deposits and natural boulder clay	1-3	The existing Circle K service station on Dublin Road in Bray will be modified, to facilitate carriageway widening works. Considerable clearance works are required at Circle K Bray, including the demolition of the forecourt awning, demolition of four number pumps, removal of car wash area, and removal of a number of the underground tanks and reconfiguration of the parking spaces. The low height kerb separation and railing will be demolished and removed.
RW016 – Cast In-Situ RC Wall	45	Structure	No Cut / Fill due to existence of structure				Minimal GI carried out (2 boreholes in grassland near Ravenswell entrance at Upper Dargle Road junction). No made ground at northern one, 3.5m made ground at southern one. Over whole section, inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered. Gravel deposits are noted from Junction 5 Bray North to Ravenswell along the Dublin Road.	1-3.5	Dublin Road east side of mainline, to accommodate the proposed cross section before the Upper Dargle Road junction. No traffic surcharge needs to be considered. Retained height of 2.5m.

Subsection	Length (m)	Dominant Earthworks Type	Cut (m)		Fill (m)		Ground Conditions	Average Thickness of Made Ground (m)	Additional Notes
			Max	Avg	Max	Avg			
Upper Dargle Road to Ravenswell Road (Fran O'Toole Bridge)	350	At Grade	1*	0	2	0	Minimal GI carried out (2 boreholes in grassland near Ravenswell entrance at Upper Dargle Road junction). No made ground at northern one, 3.5m made ground at southern one. Over whole section, inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered. Gravel deposits are noted from Junction 5 Bray North to Ravenswell along the Dublin Road.	1-3.5	Localised pavement reconstruction / widening works and junction modification works. 50m cast in-situ RC wall (estimated retained height of 2m but no topography for the area) on east side of Dublin Road south of Upper Dargle Road. Estimated 1m cut for all retaining wall foundations, however deep Made Ground (3.5m) at Upper Dargle Road wall may require deeper foundation.
RW017 – Cast In-Situ RC Wall	40	Structure	No Cut / Fill due to existence of structure				Minimal GI carried out (2 boreholes in grassland near Ravenswell entrance at Upper Dargle Road junction). No made ground at northern one, 3.5m made ground at southern one. Over whole section, inferred road pavement and foundation on reworked / natural boulder clay. Variable thickness of made ground may be encountered. Gravel deposits are noted from Junction 5 Bray North to Ravenswell along the Dublin Road.	1-3.5	Along Castle Street, south of Upper Dargle Road to accommodate road widening and support traffic surcharge. Retained height of 2m.

14.3.5.1 Environment Type

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

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

14.4 Potential Impacts

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

14.4.1 Characteristics of the Proposed Scheme

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

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

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

14.4.1.1 Leeson Street to Donnybrook (Anglesea Road Junction)

Section 1a: Leeson Street Lower to Morehampton Road (Wellington Place)

- The construction activities at Section 1a will comprise reconstruction and resurfacing of the roads, footpaths, and cycle tracks, and new kerbs; and
- Trees will be removed along Leeson Street Lower and Leeson Street Upper, and replanted along Sussex Road and Wellington Place.

Section 1b: Morehampton Road (Wellington Place) to Anglesea Bridge

- A minor retaining wall (RW034) will be constructed along Donnybrook Road opposite Donnybrook Stadium, approximately 20m in length and maximum 0.5m in retained height;
- Construction works are required at Circle K Donnybrook, These works will include potential alteration of the forecourt canopy to reduce its overhang over the footpath, reconfiguration of the parking provision and landscaping works. In addition, one of the fuel pumps would be inoperable for the duration of works; and
- Urban realm enhancement works will be carried out at 2 to 12 Donnybrook Road. Utility (gas mains) diversions and/or protections will be required. Trees will be removed and replanted along Morehampton Road and Donnybrook Road.

14.4.1.2 Donnybrook (Anglesea Road Junction) to Loughlinstown Roundabout

Section 2a: Anglesea Bridge to Whites Cross (Leopardstown Road)

- The construction activities at Section 2a will comprise reconstruction and resurfacing of the roads, footpaths, and cycle tracks, and new kerbs;
- The subway at St. Laurence's will be extended across the width of Stillorgan Road on one side (east) and new footpaths and cycle tracks will run parallel to the N11 mainline in both directions;
- At the UCD Campus a new UCD Bus Interchange will be constructed;
- A principal retaining wall (RW039) will be constructed along Stillorgan Road, west of the Priory Drive, Dublin Road Junction. approximately 45m in length and maximum 1.5m in retained height. A minor retaining wall (RW031) approximately 75m in length will be constructed along Stillorgan Road, east of the Priory Drive, Dublin Road Junction, both retaining walls are earth embankments;

- At Coláiste Eoin / Coláiste Íosagáin, tie-in works will be carried out including: removal of a section of boundary wall; lowering of the boundary wall to 0.6m; relocation of a monument; tow-way cycle connection to the school and construction of an access gate;
- The Construction Compound (BR2) will be located at Fosterbrook;
- A two-way cycle track will be constructed along Stillorgan Road, between Belfield Bridge (UCD Campus) and Coláiste Eoin / Coláiste Íosagáin, and between Merville House (UCD Campus) and Foster's Avenue;
- Boundary walls will be relocated along Stillorgan Road, and accesses will be modified; and
- Various utility diversions and/or protections will be required, including electricity underground cables, water distribution, gas mains and telecommunications infrastructure. Vegetation and trees will be removed, and trees will be replanted along Stillorgan Road.

Section 2b: Whites Cross (Leopardstown Road) to Loughlinstown Roundabout

- The construction activities at Section 2b will comprise conversion of the Loughlinstown roundabout to a signalised roundabout (on three of the four arms), reconstruction and resurfacing of the roads, footpaths, and cycle tracks, and new kerbs;
- An existing principal retaining wall (RW043) will be structurally strengthened through ground improvement works along the north bend of the Loughlinstown Roundabout, approximately 110m in length and maximum 3.6m in retained height. Minor retaining walls (RW044a and RW044b) each approximately 20m in length will be constructed along Stillorgan Road, in the central median, at Knocksinna. Boundary walls will be relocated along Stillorgan Road and Bray Road, and accesses will be modified;
- A pedestrian path will be constructed linking Bray Road and South Park. A two-way cycle track will be constructed between Wyattville Road and Loughlinstown roundabout in the east side; and
- Various utility diversions and/or protections will be required, including electricity underground cables, water distribution, gas mains and telecommunications infrastructure. Vegetation and trees will be removed, and trees will be replanted along Stillorgan Road and Bray Road.

14.4.1.3 Loughlinstown Roundabout to Bray North (Wilford Roundabout)

Section 3a: Loughlinstown Roundabout to Shanganagh Road, incl. Stonebridge Road

- The construction activities at Section 3a will comprise conversion of the Dublin Road, Shanganagh Road, Corbawn Lane roundabout to a signalised junction, reconstruction and resurfacing of the roads, footpaths, and cycle tracks, and new kerbs;
- A principal retaining wall (RW041) will be constructed along Dublin Road, south of Rathmichael Park, approximately 50m in length and maximum 2m in retained height;
- A principal retaining wall (RW023) will be constructed at the Dublin Road, Stonebridge Road Junction, approximately 40m in length and maximum 2.5m in retained height;
- A principal retaining wall (RW045) will be constructed along the south side of the Dublin Road, Shanganagh Road, Corbawn Lane Junction, approximately 135m in length and maximum 1.5m in retained height;
- A minor retaining wall (RW022) approximately 100m in length will be constructed along Dublin Road, along the front of Woodbank;
- A principal retaining wall (RW024) will be constructed along the Dublin Road, between Rathmichael Park and Stonebridge Road junctions, approximately 30m in length and maximum 1.5m in retained height;
- A minor retaining wall (RW036) will be constructed along the Dublin Road, on the east side of the road, north of the Dublin Road, Shanganagh Road, Corbawn Lane Junction, approximately 180m in length and maximum 0.5m in retained height;
- An MV Sub Station will be constructed at Rathmichael Park;
- A two-way cycle track will be constructed along Stonebridge Road, Dublin Road and Corbawn Lane; and
- Various utility diversions and/or protections will be required, including electricity overhead lines and underground cables, water distribution, gas mains and telecommunications infrastructure.

Vegetation and trees will be removed, and trees will be replanted along Dublin Road and Stonebridge Road.

Section 3b: Shanganagh Road to Quinn's Road

- The construction activities at Section 3b will comprise reconstruction and resurfacing of the roads, and footpaths, and new kerbs; and
- An existing retaining wall (RW046) will have structural strengthening works along the Dublin Road, Shankill, approximately 120m in length and maximum 3.2m in retained height. Utility (gas mains) diversions and/or protections will be required.

Section 3c: Quinn's Road to Wilford Roundabout

- The construction activities at Section 3c will comprise conversion of the Dublin Road, Quinn's Road, Cherrington Road roundabout to a signalised junction, reconstruction and resurfacing of the roads, footpaths, and cycle tracks, and new kerbs;
- A principal retaining wall (RW038) will be constructed along the Dublin Road, north of the entrance road to Woodbrook Golf Club, approximately 40m in length and maximum 1.8m in retained height;
- A principal retaining wall (RW013) will be constructed along the east side of the Dublin Road, north of Wilford roundabout, approximately 100m in length and maximum 1.5m in retained height;
- A minor retaining wall (RW042) will be constructed along the Dublin Road, at the front of Beach Road, approximately 130m in length and maximum 1.2m in retained height;
- A minor retaining wall (RW027) will be constructed along the Dublin Road, opposite Shanganagh Park, approximately 40m in length and maximum 0.5m in retained height;
- A minor retaining wall (RW029) will be constructed along the Dublin Road, north of Woodbrook Downs, approximately 55m in length and maximum 1.3m in retained height.
- Extensive modifications will be made to boundary walls, fencing, and accesses along Dublin Road. The footpath will be realigned at Castlefarm to retain prominent trees;
- The existing wall adjacent to the road will be removed and reinstated as a low wall to the back of the realigned footpath;
- A two-way cycle track will be constructed along Shanganagh Park and Shanganagh Cemetery; and
- Various utility diversions and/or protections will be required, including electricity overhead lines and underground cables, water distribution, gas mains and telecommunications infrastructure. Vegetation and trees will be removed, and trees will be replanted along Dublin Road.

14.4.1.4 Bray North (Wilford Roundabout) to Bray South (Fran O'Toole Bridge)

Section 4a: Wilford Roundabout to Old Connaught Avenue

- The construction activities at Section 4a will comprise conversion of the Wilford roundabout to a signalised junction, reconstruction and resurfacing of the roads, footpaths, and cycle tracks, and new kerbs;
- Accommodation works will be carried out at Woodbrook Side Lodge, including demolition and rebuild of the building;
- The Construction Compound (BR1) will be located at the Wilford Junction;
- Boundary walls, fencing, and bollards will be relocated along Dublin Road, and accesses will be modified; and
- An MV Sub Station will be constructed at the Wilford Junction. Various utility diversions and/or protections will be required, including electricity overhead lines and underground cables, water distribution, gas mains and telecommunications infrastructure. Vegetation and trees will be removed, and trees will be replanted along Dublin Road.

Section 4b: Old Connaught Avenue to Upper Dargle Road

- The construction activities at Section 4b will comprise reconstruction and resurfacing of the roads, footpaths, and cycle tracks, and new kerbs;

- Considerable clearance works are required at Circle K on the southbound side of the Dublin Road in Bray, including the demolition of the forecourt awning, demolition of four number pumps, removal of car wash area, removal of a number of underground tanks and reconfiguration of the parking spaces and works to the overhead canopy structure. The low height kerb separation and railing will also be demolished and removed;
- Accommodation works will be carried out at the AXA premises directly adjacent to Circle K Bray, including construction of a new low height wall, reconfiguration of the car park, improved access and landscaping works;
- A principal retaining wall (RW016) will be constructed along the Dublin Road, north of Upper Dargle Road, approximately 45m in length and maximum 2.5m in retained height;
- A minor retaining wall (RW014) will be constructed along the Dublin Road, south of Corke Abbey Avenue, approximately 130m in length. Boundary walls and fencing will be relocated along Dublin Road, and accesses will be modified; and
- Various utility diversions and/or protections will be required, including electricity overhead lines, water distribution, and gas mains. Vegetation and trees will be removed, and trees will be replanted along Dublin Road.

Section 4c: Upper Dargle Road to Fran O'Toole Bridge

- The construction activities at Section 4c will comprise widening, reconstruction and resurfacing of the roads, footpaths, and cycle tracks, and new kerbs;
- A principal retaining wall (RW017) will be constructed along the east side of Castle Street, south of Upper Dargle Road. Boundary walls and fencing will be relocated along Castle Street, approximately 40m in length and maximum 2.0m in retained height;
- Accommodation works will be carried out at Castle Street Shopping Centre Car Park; and
- Various utility diversions and/or protections will be required, including electricity overhead lines and underground cables, water distribution, and gas mains. Trees and vegetation will be removed along Castle Street.

14.4.1.5 Operational Phase

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

14.4.2 'Do Nothing' Scenario

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

14.4.3 Construction Phase

The potential land, soils, geology and hydrogeology impacts during the Construction Phase for the relevant construction activities described in Section 14.4.1 are presented in this Section, along with their impact significance. These potential impacts also relate and interact with other environmental factors which are described within the EIAR. Specific interactions are outlined in Section 14.1.

The Proposed Scheme will have the following potential impacts on the land soils geology and hydrogeology as discussed below and summarised in Table 14.35:

- Loss or 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;
- Change to groundwater regime; and

- Loss or damage of a groundwater dependent habitat.

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 discussed.

14.4.3.1 Loss and Damage of Topsoil

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

- There is the potential for materials on site to be spilled, resulting in the pollution of the topsoil. For example, raw or uncured concrete and grouts, washed down water from exposed aggregate surfaces, cast-in-place concrete from concrete trucks, fuels, lubricants and hydraulic fluids for equipment used on the development site, bitumen, and sealants used for waterproofing concrete surfaces can all potentially impact on soils and groundwater during the Construction Phase;
- These excavated soil materials will be stockpiled using appropriate methods to minimise the impacts of weathering. Materials that are stockpiled incorrectly can be exposed to erosion and weathering which reduces the quality of the resource;
- Excavations in areas of contaminated ground during 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; and
- 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 at urban parks, gardens and green verges along the Proposed Scheme. Topsoil will also be encountered at Construction Compound BR1 at Wilford Junction and at Construction Compound BR2 east of Stillorgan Road.

The magnitude of these impacts of the Proposed Scheme on the topsoil will be small adverse as it will result in a permanent irreversible loss of a small proportion of locally high fertility topsoil and/or a high proportion of locally low fertility topsoils within the study area. As the topsoil is of high importance, the resulting significance of this permanent small adverse impact will be Slight.

The magnitude of impact of the Proposed Scheme on the alluvium will be negligible. As these soils are of medium importance, the resulting significance of this negligible potential impact will be Imperceptible

14.4.3.2 Excavation of Potentially Contaminated Land

The excavation of made ground results in the production of excess material that requires placement elsewhere in the Proposed Scheme 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 14.3.3.3 and Section 14.3.3.4.

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 the Management of Contaminated Land and Groundwater at EPA Licensed Sites (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 petrol stations, graveyards, historic sand and gravel pits, historic tramway depots and historic mills.

Decommissioning works are expected at an existing Circle K petrol station on the southbound side of the Dublin Road in Bray due to proposed widening works. The decommissioning works will impact four of the pumps, include

the removal of a car wash area and the removal of a number of the underground tanks which will lead to a risk of excavation of contaminated land and potential ground contamination. The works will also include trimming the overhead canopy structure.

The magnitude of this impact will be small adverse as it results in the excavation of a small proportion of 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 sand and gravel pits on Monaloe Avenue, Courtlands, Cairn Hill, Beaver Row, Stillorgan Park Avenue, Anglesea Road and Eglinton Terrace. 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 will be negligible as it will result in an insufficient permanent irreversible change at a local scale to affect the integrity of the land and soils as a potential future quarry or pit reserve above the Do-Nothing scenario. As the aggregate potential is of medium to high importance, the resulting significance of this negligible impact will be Imperceptible and will not be considered further.

14.4.3.4 Loss or Damage of Proportion of 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. The land, soils and geology on a local scale will be negatively impacted by the construction of new pavements and structures in the vicinity of the St. Stephen's Green CGS.

However, 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 CGS. The St. Stephen's Green CGS is of high importance and the resulting significance of this negligible impact will be Imperceptible and 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 resource. Likewise, the mobilisation of contaminants into the aquifer, either through accidental spillage or disturbance of contaminated ground during excavation, will reduce the quality of the groundwater within the aquifer.

The underlying limestone bedrock is defined as a locally important aquifer, where there will be minimal excavation into the limestone rock as part of the Proposed Scheme. The magnitude of this impact will be negligible as it will result 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 will be Imperceptible and will not be considered further.

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

14.4.3.6 Change to Groundwater Regime

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

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

14.4.3.7 Loss or Damage of a Groundwater Dependent Habitat

Groundwater dependent habitats may be potentially impacted through accidental contamination of the groundwater which supports them, the alteration of groundwater levels and/or the reduction in the groundwater contribution to the ecosystem. The characteristics which determine the potential impact are:

- The proximity to the feature;
- The level of hydraulic connection between the feature and the section of aquifer at the Proposed Scheme i.e. is the feature in the same aquifer unit as the Proposed Scheme, or is there a hydraulic divide between the feature and the Proposed Scheme;
- The groundwater flow direction in the vicinity;
- The level of cut of the Proposed Scheme, which may determine the degree of variation in the groundwater level and also the extent of dewatering which may occur; and
- The water quality of the feature and the groundwater from which it receives its baseflow.

Loughlinstown Wood is directly adjacent to the Proposed Scheme where the proposed design is at grade. There are ground improvement works approximately 400m from the Loughlinstown Wood pNHA. Any drawdown from the excavation is expected to be limited, localised (not extend to the boundary of the pNHA site) and temporary. There is a risk of pollutants entering the groundwater as a result of spillages or accidents where mitigation measures are not implemented. Therefore, the magnitude of this impact is considered moderate adverse. As the importance of the Loughlinstown Wood is very high, the resulting significance of the impact is Significant

Table 14.35: Summary of Potential Construction Phase Impacts

Feature	Description	Importance	Location	Impact	Quality	Duration	Scale	Magnitude	Significance
Loss or Damage of Topsoil									
Alluvium	Typically found along current and historic watercourses	Medium	River Dargle	Loss or damage of topsoil	Negative	Permanent	Local	Negligible	Imperceptible
Topsoil	Shallow well drained (Mainly basic) – Verges along the Proposed Scheme	High	Verges along the Proposed Scheme	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Slight
Topsoil	Deep well drained (Mainly basic) – Bray North, Loughlinstown	High	Bray North, Loughlinstown	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Slight
Topsoil	Shallow well drained (Mainly acidic) – Loughlinstown	High	Loughlinstown	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Slight
Topsoil	Deep well drained (Mainly acidic) Loughlinstown to Bray North	High	Loughlinstown to Bray North	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Slight
Excavation of Potentially Contaminated Ground									
Potential Sources of Contamination	Industrial (6-inch OSI Mapping) – Pembroke Cottages	Medium	Pembroke Cottages	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight
Potential Sources of Contamination	Industrial (6-inch OSI Mapping) – Brookvale Road	Medium	Brookvale Road	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight
Potential Sources of Contamination	Gravel Pit (6-inch OSI Mapping) – Eglinton Terrace	Medium	Eglinton Terrace	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight
Potential Sources of Contamination	Gravel Pit (6-inch OSI Mapping) – Anglesea Road	Medium	Anglesea Road	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight
Potential Sources of Contamination	Graveyard (6-inch OSI Mapping) – The Crescent	Medium	The Crescent	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight
Potential Sources of Contamination	Gravel Pit (6-inch OSI Mapping) – Beaver Row	Medium	Beaver Row	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight
Potential Sources of Contamination	Industrial (Cassini and 25-inch Mapping) – Beaver Row	Medium	Beaver Row	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight
Potential Sources of Contamination	Graveyard (Cassini OSI Mapping) – Brookfield Manor	Medium	Brookfield Manor	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight

Feature	Description	Importance	Location	Impact	Quality	Duration	Scale	Magnitude	Significance
Potential Sources of Contamination	Gravel Pit (6-inch OSI Mapping) – Stillorgan Park Avenue	Medium	Stillorgan Park Avenue	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight
Potential Sources of Contamination	Clay Pits (6-inch OSI Mapping) – Merville Road	Medium	Merville Road	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight
Potential Sources of Contamination	Graveyard (6-inch OSI Mapping) – Glenalbyn Road	Medium	Glenalbyn Road	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight
Potential Sources of Contamination	Sand Pit (6-inch OSI Mapping) – Cairn Hill	Medium	Cairn Hill	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight
Potential Sources of Contamination	Sand Pit (6-inch OSI Mapping) – Monaloe Avenue	Medium	Monaloe Avenue	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight
Potential Sources of Contamination	Sand Pit (6-inch OSI Mapping) / Gravel Pit (25-inch Mapping) – Courtlands	Medium	Courtlands	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight
Potential Sources of Contamination	Historic landfills / closed landfills are noted adjacent the Proposed Scheme at Kilbogget Park, Ballyogan and Woodbrook Golf Club	Medium	Kilbogget Park, Ballyogan and Woodbrook Golf Club	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight
Potential Sources of Contamination	A number of petrol stations were identified during the walkover at Donnybrook Junction, Merrion Hall, Cherrywood and Dublin Road near Old Connaught Road, Bray	Medium	Donnybrook Junction, Merrion Hall, Cherrywood and Old Connaught Road	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight
Potential Sources of Contamination	Derelict site Castle Street	Medium	Castle Street, Bray	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight
Potential Sources of Contamination	Contaminated soils from recent Site Investigations – Sample was described as concrete therefore is not suitable for a soil recovery facility and has been classified as non-hazardous based on the limited information.	Medium	St Laurence's Subway	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight
Potential Sources of Contamination	Decommissioning works are expected at an existing Circle K petrol station on the southbound side of the Dublin Road in Bray due to proposed widening works. The decommission works will impact 4 no. of pumps and the removal of some of the underground tanks.	Medium	Circle K Bray	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight

Feature	Description	Importance	Location	Impact	Quality	Duration	Scale	Magnitude	Significance
Loss of Future Quarry or Pit Reserve									
Crushed rock aggregate potential	Moderate potential	Medium	St. Stephens Green, Donnybrook, Booterstown, Stillorgan Village and Cornelscourt	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Crushed rock aggregate potential	High potential	Medium	Donnybrook, Booterstown, Stillorgan Village and Cornelscourt	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Crushed rock aggregate potential	Very High potential	High	Booterstown, Stillorgan Village, Stillorgan Park and Cornelscourt	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Granular aggregate potential	Moderate potential	Medium	Donnybrook, Booterstown, Stillorgan Village and Cornelscourt	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Granular aggregate potential	High potential	Medium	Bray North, Booterstown, Stillorgan Village and Cornelscourt	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Granular aggregate potential	Very High potential	High	Bray North, Booterstown, Stillorgan Village and Cornelscourt	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Loss or Damage of Geological Heritage Area									
County geological site	51 St. Stephens Green (DC001)	High	St. Stephens Green	Loss or damage of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible
Loss or Damage of Portion of Aquifer									
Locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	City Centre to Booterstown, and Loughlinstown to Bray	Loss or damage of proportion of aquifer through excavation.	Negative	Permanent	Local	Negligible	Imperceptible
Locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	City Centre to Booterstown, and Loughlinstown to Bray	Loss or damage of proportion of aquifer through pollution.	Negative	Permanent	Local	Moderate Adverse	Moderate
Change in Groundwater Regime									
Locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	City Centre to Booterstown, and Loughlinstown to Bray	Change to groundwater regime.	Negative	Permanent	Local	Negligible	Imperceptible
Loss or Damage of Groundwater Dependant Habitat									
Loughlinstown Wood pNHA	Potential alluvial woodland (91EO) on the banks of the Loughlinstown River	Very High	Loughlinstown River	Loss or damage of Groundwater Dependant Habitat	Negative	Permanent	Local	Moderate Adverse	Significant

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. There will still be the potential for accidental spillages as with the Do Nothing scenario, therefore the magnitude of the impact is negligible.

Therefore, the significance of the potential impact is Imperceptible on any assessed aspects of the land, soil, geology and hydrogeology.

14.5 Mitigation and Monitoring Measures

The following Sections outline the mitigation and monitoring measures associated with the impacts identified in Section 14.4 for both the Construction and Operational Phases of the Proposed Scheme. A summary of the pre-mitigation and post-mitigation impacts is contained in Table 14.36.

14.5.1 Construction Phase

14.5.1.1 Loss or Damage of Topsoil

Excavated topsoils will be stockpiled by the appointed contractor using appropriate methods to minimise the effects of weathering. Care will be taken in reworking this material to minimise dust generation, groundwater infiltration and 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's 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 offsite 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 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 by the appointed contractor during the detailed ground investigation, and ground excavated from these areas will be disposed of to suitably licensed or permitted sites in accordance with the current Irish waste management legislation.

The decommissioning works at Circle K in Bray will require mitigation if ground contamination is encountered during the construction works. A ground investigation shall be undertaken prior to the construction works to inform a remedial strategy for the decommissioning and removal of any below ground infrastructure associated with the storage of fuel under the forecourt. This remedial strategy will include any measures required to remediate soil contamination and/or determine the appropriate ultimate disposal options for contaminated material.

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 Construction Industry Research and Information Association (CIRIA) 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 shall include:

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

14.6 Residual Impacts

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).

14.6.1 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 14.36: Summary of Predicted Construction Phase Impacts Following the Implementation of Mitigation and Monitoring Measures

Feature	Description	Importance	Location	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Loss or Damage of Topsoil											
Alluvium	Typically found along current and historic watercourses	Medium	River Dargle	Loss or damage of topsoil	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Topsoil	Shallow well drained (Mainly basic) – Verges along the Proposed Scheme	High	Verges along the Proposed Scheme	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Topsoil	Deep well drained (Mainly basic) – Bray North, Loughlinstown	High	Bray North, Loughlinstown	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Topsoil	Shallow well drained (Mainly acidic) - Loughlinstown	High	Loughlinstown	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Topsoil	Deep well drained (Mainly acidic) Loughlinstown to Bray North	High	Loughlinstown to Bray North	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Excavation of Potentially Contaminated Ground											
Potential Sources of Contamination	Industrial (6-inch OSI Mapping)	Medium	Pembroke Cottages	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Industrial (6-inch OSI Mapping)	Medium	Brookvale Road	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Gravel Pit (6-inch OSI Mapping)	Medium	Eglinton Terrace	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Gravel Pit (6-inch OSI Mapping)	Medium	Anglesea Road	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Graveyard (6-inch OSI Mapping)	Medium	The Crescent	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible

Feature	Description	Importance	Location	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Potential Sources of Contamination	Gravel Pit (6-inch OSI Mapping)	Medium	Beaver Row	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Industrial (Cassini and 25-inch Mapping)	Medium	Beaver Row	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Graveyard (Cassini OSI Mapping)	Medium	Brookfield Manor	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Gravel Pit (6-inch OSI Mapping)	Medium	Stillorgan Park Avenue	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Clay Pits (6-inch OSI Mapping)	Medium	Merville Road	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Graveyard (6-inch OSI Mapping)	Medium	Glenalbyn Road	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Sand Pit (6-inch OSI Mapping)	Medium	Cairn Hill	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Sand Pit (6-inch OSI Mapping)	Medium	Monaloe Avenue	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Sand Pit (6-inch OSI Mapping) / Gravel Pit (25-inch Mapping)	Medium	Courtlands	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Historic landfills / closed landfills are noted adjacent the Proposed Scheme at Kilbogget Park, Ballyogan and Woodbrook Golf Club	Medium	Kilbogget Park, Ballyogan and Woodbrook Golf Club	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible

Feature	Description	Importance	Location	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Potential Sources of Contamination	A number of petrol stations were identified during the walkover at Donnybrook Junction, Merrion Hall, Cherrywood and Dublin Road near Old Connaught Road, Bray	Medium	Donnybrook Junction, Merrion Hall, Cherrywood and Old Connaught Road	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Derelict site Castle Street	Medium	Castle Street, Bray	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Contaminated soils from recent Site Investigations - Sample was described as concrete therefore is not suitable for a soil recovery facility and has been classified as non-hazardous based on the limited information.	Medium	St Laurence's Subway	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible
Potential Sources of Contamination	Decommissioning works are expected at an existing Circle K petrol station on the southbound side of the Dublin Road in Bray due to proposed widening works. The decommission works will impact 4 no. of pumps and the removal of some of the underground tanks.	Medium	Circle K Bray	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small Adverse	Slight	Negligible	Imperceptible
Loss of Future Quarry or Pit Reserve											
Crushed rock aggregate potential	Moderate potential	Medium	St. Stephens Green, Donnybrook, Booterstown, Stillorgan Village and Cornelscourt	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Crushed rock aggregate potential	High potential	Medium	Donnybrook, Booterstown, Stillorgan Village and Cornelscourt	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible

Feature	Description	Importance	Location	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Crushed rock aggregate potential	Very High potential	High	Booterstown, Stillorgan Village, Stillorgan Park and Cornelscourt	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Granular aggregate potential	Moderate potential	Medium	Donnybrook, Booterstown, Stillorgan Village and Cornelscourt	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Granular aggregate potential	High potential	Medium	Bray North, Booterstown, Stillorgan Village and Cornelscourt	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Granular aggregate potential	Very High potential	High	Bray North, Booterstown, Stillorgan Village and Cornelscourt	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Loss or Damage of Geological Heritage Area											
County Geological Site	51 St. Stephens Green (DC001)	High	St. Stephens Green	Loss or damage of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Loss or Damage of Portion of Aquifer											
Locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	widespread	Loss or damage of proportion of aquifer through excavation.	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	widespread	Loss or damage of proportion of aquifer through pollution.	Negative	Permanent	Local	Moderate Adverse	Moderate	Negligible	Imperceptible
Change in Groundwater Regime											
Locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	widespread	Loss or damage of proportion of aquifer through excavation.	Negative	Permanent	Local	Negligible	Imperceptible	Negligible	Imperceptible
Loss or Damage of Groundwater Dependant Habitat											
Loughlinstown Wood pNHA	Potential alluvial woodland (91EO) on the banks of the Loughlinstown River	Very High	Loughlinstown River	Loss or damage of Groundwater Dependant Habitat	Negative	Permanent	Local	Moderate Adverse	Significant	Negligible	Imperceptible

14.6.2 Operational Phase

No significant residual impacts on land, soils, geology and hydrogeology as a result of the Operational Phase of the Proposed Scheme have been identified.

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