Bonneagar Iompair Éireann
Transport Infrastructure Ireland

NTA
Údarás Náisiúnta Iompair
National Transport Authority

## Luas Finglas

# Environmental Impact Assessment Report
2024

## Chapter 11:
## Land And Soils: Soils, Geology, and Hydrogeology

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# GLOSSARY OF FREQUENTLY USED TERMS

| Acronym | Meaning |
|---|---|
| ACM | Asbestos Containing Materials |
| BGL, bgl | Below Ground Level |
| BRE | Building Research Establishment |
| BTEG | Barry Transportation Egis |
| C&D | Construction And Demolition |
| CEMP | Construction Environmental Management Plan |
| CGS | County Geological Sites |
| CIRIA | Construction Industry Research and Information Association |
| CSM | Conceptual Site Model |
| DCC | Dublin City Council |
| EIA | Environmental Impact Assessment |
| EIAR | Environmental Impact Assessment Report |
| EPA | Environmental Protection Agency |
| EPR | Emerging Preferred Route |
| ERT | Electrical Resistivity Tomography |
| EU | European Union |
| GAC | Generic Assessment Criteria |
| GDTE | Groundwater Dependent Terrestrial Ecosystem |
| GII | Ground Investigation Ireland |
| GPR | Ground Penetrating Radar |
| GQRA | Generic Quantitative Risk Assessment |
| GSI | Geological Survey Ireland |
| GWB | Groundwater Body |
| ICW | Integrated Constructed Wetland |
| IEL | Industrial Emissions Licence |
| IGI | Institute of Geologists of Ireland |
| IPC | Integrated Pollution Control |
| IPCC | Intergovernmental Panel on Climate Change |
| IPPC | Integrated Pollution Prevention Control |
| LRT | Light Rail Transit |
| LRV | Light Rail Vehicle |
| NHA | Natural Heritage Area |
| NIS | Natura Impact Statement |
| NPWS | National Parks and Wildlife Service |
| NRA | National Roads Authority |
| NTA | National Transport Authority |

| Acronym | Meaning |
|---|---|
| OD | Ordnance Datum |
| OSI | Ordnance Survey Ireland |
| P&R | Park & Ride |
| PAH | Polycyclic Aromatic Hydrocarbons |
| PCB | Polychlorinated Biphenyls |
| pNHA | Proposed Natural Heritage Area |
| PPE | Personal Protective Equipment |
| PR | Preferred Route |
| PSSR | Preliminary Sources Study Report |
| PWS | Public Water Scheme |
| RPE | Respiratory Protective Equipment |
| RWMP | Resource and Waste Management Plan |
| S4UL | Suitable 4 Use Levels |
| SAC | Special Area of Conservation |
| SPA | Special Protection Area |
| SuDS | Sustainable Urban Drainage Systems |
| SURGE | Soil Urban Geochemistry |
| SVOC | Semi-Volatile Organic Compound |
| SWL | Static Water Levels |
| TII | Transport Infrastructure Ireland |
| TPH | Total Petroleum Hydrocarbon |
| VOC | Volatile Organic Compound |
| WAC | Waste Acceptance Criteria |
| WFD | Water Framework Directive |
| ZoI | Zone of Influence |

# SECTION 11: LAND AND SOILS: SOILS, GEOLOGY AND HYDROGEOLOGY

## 11.1 Introduction

### 11.1.1 Purpose of this Report

This chapter presents the findings of an impact assessment of the proposed Luas Finglas (hereafter referred to as the proposed Scheme) on the soils, geology and hydrogeology as a result of the Construction and Operational Phases.

This chapter describes and assesses the likely direct and indirect significant effects of the proposed Scheme on soils, geology and hydrogeology, in accordance with the requirements of Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (i.e. the EIA Directive) (European Union, 2014a).

This chapter should be read in conjunction with the following chapters and their appendices, which provide further detail on related impacts and the proposed mitigation measures for several topics discussed within this text:

- Chapter 9 (Biodiversity);
- Chapter 10 (Water);
- Chapter 12 (Land Take);
- Chapter 13 (Air Quality);
- Chapter 14 (Climate);
- Chapter 17 (Material Assets: Infrastructure and Utilities);
- Chapter 19 (Material Assets: Resource and Waste Management);
- Chapter 20 (Cultural Heritage); and
- Chapter 21 (Landscape and Visual Amenity).

### 11.1.2 Outline Scheme Description

The proposed Scheme comprises a high-capacity, high-frequency light rail running from Broombridge to Charlestown, connecting Finglas and the surrounding areas with Dublin’s wider public transport network by providing a reliable, and efficient public transport service to the city centre via Broombridge.

As shown in Volume 4 - Map Figure 1-1, starting from Broombridge, the proposed Scheme travels northwards, crossing the Royal Canal and the Maynooth railway line adjacent to Broome Bridge. It then runs adjacent to the east of Broombridge Road and the Dublin Industrial Estate. It then crosses the Tolka Valley Park before reaching the proposed St Helena’s Stop and then proceeds northwards towards the proposed Luas Finglas Village Stop. From here, the route passes through a new corridor created within the Finglas Garda Station car park, making its eastern turn onto Mellowes Road. The route then proceeds through Mellowes Park, crossing Finglas Road, towards the proposed St Margaret’s Road Stop. Thereafter, the proposed line continues along St Margaret’s Road before reaching the terminus Stop proposed at Charlestown.

The proposed Scheme has been designed to integrate with the existing and future transport network, providing connections with bus services at all new Stops, mainline rail services at Broombridge, and a Park and Ride facility to intercept traffic on the N/M2. In addition, the proposed Scheme through the inclusion of integrated cycle lanes and cycling infrastructure sets out to facilitate multimodal "cycle- light rail transit (LRT) trips" as a key aspect of the Luas Finglas scheme.

The proposed Scheme will comprise a number of principal elements as outlined in Table 11-1 and Table 11-2. A full description of the proposed Scheme is provided in the following chapters of this Environmental Impact Assessment Report (EIAR):

- Chapter 5 (Description of the proposed Scheme); and
- Chapter 6 (Construction Activities).

**Table 11-1: Overview of the Key Features of the proposed Scheme**

| Scheme Key Features | Outline Description |
|---|---|
| **Permanent Scheme Elements** | |
| **Light Rail track** | 3.9km extension to the Luas Green Line track from Broombridge to Finglas (2.8km of grass track, 700m of embedded track and 360m of structure track) |
| **Depot Stabling facility** | A new stabling facility (with stabling for eight additional LRVs) will be located just south of the existing Broombridge terminus, as an extension of the Hamilton depot area. |
| **Luas Stops** | Four Stops located at: St Helena's, Finglas Village, St Margaret's Road and Charlestown to maximise access from the catchment area including the recently re-zoned Jamestown Industrial Estate. |
| **Main structures** | Two new Light Rail Transit (LRT) bridges will be constructed as part of the proposed Scheme. a bridge over the River Tolka within the Tolka Valley Park and a bridge over the Royal Canal and the Iarnród Éireann (IÉ) railway line at Broombridge.<br>A number of existing non-residential buildings shall be demolished to facilitate the proposed Scheme. In addition, the existing overbridge at Mellowes Park will be demolished. |
| **At grade signalised junctions** | 10 at grade signalised junctions will be created at: Lagan Road, Ballyboggan Road, Tolka Valley Road, St. Helena's Road, Wellmount Road, Cappagh Road, Mellowes Road, North Road (N2), McKee Avenue, Jamestown Business Park entrance. Note: The junction at Charlestown will be reconfigured but does not have a LRT crossing. |
| **Uncontrolled crossings** | 13 at grade uncontrolled crossings (11 pedestrian / cycle crossings and two local accesses located at: Tolka Valley Park, St Helena's, Farnham pitches, Patrickswell Place, Cardiff Castle Road, Mellowes Park, St Margarets Road, and ESB Networks. |
| **Cycle facilities** | Cycle lanes are a core part of the proposed Scheme in order to facilitate multimodal "cycle-LRT trips". Approximately 3km of segregated cycle lanes and 100m of non-segregated cycle lanes along the route. Covered cycle storage facilities will be provided at Broombridge Terminus, Finglas Village Stop and St Margaret's Road Stop and within the Park & Ride facility. "Sheffield" type cycle stands will be provided at all stop locations. |
| **Power substations** | Two new traction power substations for the proposed Scheme will be located near Finglas Village Stop behind the existing Fire Station, and near the N2 junction before St Margaret's Road Stop where the current spiral access ramp to the pedestrian overbridge is located.<br>A third substation is required for the Park & Ride facility. |
| **Park & Ride facility** | A new Park & Ride facility, with e-charging substation, located just off the M50 at St Margaret's Road Stop will be provided with provision for 350 parking spaces and secure cycle storage to facilitate multimodal "cycle-LRT trips". The building will feature photovoltaic (PV) panel roofing and is the location for an additional radio antenna.<br>This strategic Park and Ride facility will intercept traffic on the N/M2, before congestion begins to form. |
| **Temporary Scheme Elements** | |
| **Construction compounds** | There will be three principal construction compounds, two located west of Broombridge Road and one located at the northern extents of Mellowes Park. In |

| Scheme Key Features | Outline Description |
|---|---|
| | addition, there are other secondary site compound locations for small works/storage. Details can be found in Chapter 6 (Construction Activities) of this EIAR. |

**Table 11-2: Summary of New Bridges of the proposed Scheme**

| Identity | Location | Description |
|---|---|---|
| Royal Canal and Rail Bridge | Approximately 10m east of the existing Broome Bridge and then continuing north, parallel with Broombridge Road on its east side | The proposed bridge is an eight-span structure consisting of two main parts: a variable depth weathering steel composite box girder followed by a constant depth solid concrete slab. The bridge has the following span arrangement: 35 + 47.5 + 30 + 17 + 3x22 + 17m. Steel superstructure extends over the first three spans. The bridge deck is continuous over the full length of 212.5m and has solid approach ramps at both ends. |
| Tolka Valley Park Bridge | Approximately 30m west of the existing Finglaswood Bridge | A three-span structure with buried end spans, thus appearing as a single span bridge. End spans as well as part of the main span consist of post-tensioned concrete variable depth girder, the central section of the main span is a suspended weathering steel composite box girder. The overall length of the bridge is 65m with spans 10m, 45m, 10m. |

## 11.2 Methodology

### 11.2.1 Study Area

In accordance with the recommendation of the National Roads Authority (now Transport Infrastructure Ireland) '*Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*', 2009, the primary study area for the purpose of this assessment comprises a 250m zone either side of the centreline of the proposed alignment; however, where relevant, the soils, geology and hydrogeology characteristics in the wider region of the proposed Scheme have also been considered and are discussed within this chapter.

### 11.2.2 Relevant Guidelines, Policy and Legislation

In the absence of Light Rail Transit (LRT) specific guidelines, the assessment has been undertaken in accordance with the '*Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes'* (NRA (now TII), 2009). These guidelines are considered appropriate due to the commonalities of road and LRT schemes such as their predominantly linear geometry, their construction methodologies and integration with existing transport infrastructure.

These guidelines are also used because they give specific examples of what constitutes the importance of a soil geology and hydrogeology attribute, reproduced in Table 11-4 & Table 11-5, and specific examples of what constitutes the estimation of magnitude of an impact on soils, geology & hydrogeology attributes, reproduced in Table 11-6 & Table 11-7. The rating of significant environmental impacts from these guidelines is also used to determine the rating of the impacts on soils, geology & hydrogeology attributes, reproduced in Table 11-8.

This guidance is applied in conjunction with the latest guidance from the Environmental Protection Agency (EPA).

- EPA (2022) '*Guidelines on the Information to be contained in Environmental Impact Assessment Reports*'; and
- EPA (2003) *'Advice Notes on Current Practice (in the preparation of Environmental Impact Statements)'*.

Further supplementary guidance on environmental impact assessment provided by the Institute of Geologists of Ireland (IGI) and European Commission was also consulted. This includes:

- IGI (2013) *'Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements'*;
- European Commission (1999) *'Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions'*; and
- European Commission (2017) *'Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report'*.

The Environmental Impact Assessment (EIA) Directive (2011/92/EU as amended by 2014/52/EU) has also been consulted during the preparation of this assessment.

## 11.2.3 Data Collection and Collation

### 11.2.3.1 Desk Study

Both publicly available datasets and other sources have been consulted throughout the course of this assessment. TII and other stakeholders have provided several reports as background information. These include:

- Luas Finglas – Options Selection Report – Stage 1 (TII, 2019);
- Luas Finglas – Options Selection Report – Stage 2 (AECOM and ROD, 2019);
- Irish Rail – Broombridge Station Footbridge – Factual Ground Investigation Report (GII, 2016);
- Dublin City Council – Miscellaneous reports related to Tolka Valley Park and St Helena's Road; and
- Luas Cross City – BXD Line Package 1 – Factual Ground Investigation Report (Glover Site Investigation, 2010).

Publicly available data sources consulted are summarised in Table 11-3.

**Table 11-3: Publicly Available Datasets**

| Source | Type | Description |
|---|---|---|
| Bing | Aerial photography | Current aerial imagery produced by Bing |
| EPA | CORINE 2018 | Corine Land Cover 2018 |
| | Water Features | Rivers, streams and canals |
| | Waste Licenced Facilities | IEL, IPC, IPPC licences |
| | Historic Mines | Historic mine locations mapped by EPA |
| 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 | |

| Source | Type | Description |
|---|---|---|
| | GSI, Memoirs | |
| Google | Aerial photography | Current & historical aerial imagery produced by Google |
| 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 |
| Ordnance Survey Ireland (OSI)[1] | Current and Historical ordnance survey maps and aerial photography | Current and historical survey maps and aerial imagery produced by the OSI. |
| Teagasc | Teagasc Soils Data | Surface soils classification and description |

#### 11.2.3.2 Field Surveys

Ground Investigations Ireland Ltd. (GII), engaged by TII, completed ground investigation works between September 2021 and January 2022. The purpose of the ground investigation was to provide detailed factual geotechnical information for the underlying ground conditions along the proposed Scheme. This information has been used to establish subsurface conditions along the route and to inform both the geotechnical design and this Chapter of the EIAR.

A walkover survey of the study area was carried out on the 19 August 2021 by representatives from GII and Barry Transportation Egis (BTEG). The location of each proposed exploratory hole was visually assessed with respect to the surrounding landscape, photographing and noting any relevant features.

The scope of the ground investigation works undertaken included:

- Qty: 21 Trial pits to a maximum depth of 4.5m below ground level (bgl);
- Qty: 35 Window sample boreholes to recover soil samples;
- Qty: 35 Dynamic probes to determine soil strength/density characteristics;
- Qty: 41 Cable percussion boreholes to a maximum depth of 16.8m bgl;
- Qty: 44 Rotary core boreholes to a maximum depth of 23m bgl;
- Qty: 20 Soil infiltration test to BRE Digest 365;
- Qty: 9 In-situ plate bearing tests;
- Qty: 20 Groundwater monitoring standpipes;
- Qty: 6 Groundwater monitoring standpipes with gas taps; and
- Geotechnical & Environmental Laboratory testing to determine engineering and chemical properties (including a suite of topsoil nutrient testing).

The results of the ground investigation works are summarised in sections 11.3.17 and 11.3.18. The full Factual Report produced by GII is included in Volume 5 – Appendix A11.1.

A Generic Quantitative Risk Assessment (GQRA) was undertaken to address the presence of potentially contaminated land from historic landfill, as identified during the desk study phase. A GQRA relies on intrusive investigations for site specific data, including testing of soil and groundwater samples. These data are assessed against Generic Assessment Criteria (GAC), as opposed to derived site-specific assessment criteria. GACs within this GQRA were taken from Chartered Institute of Environmental Health (CIEH) / Land Quality Management (LQM) and Environmental Agency Soil Guideline Values (SGV) in

[1] Now Tailte Éireann

accordance with Contaminated Land: Applications in Real Environments (CL:AIRE)[2] sources and were selected to reflect the end use of the proposed Scheme.

The GQRA included assessment of environmental test results from samples obtained route-wide but with a particular focus on the Tolka Valley Park and St Helena's Road sections of the study area, where potential historic waste was identified during early desk studies. Site attendance during the excavation of trial pits, environmental tests on the samples recovered, and evaluation of the corresponding laboratory results was used to characterise the risks associated with historic waste. A summary of the findings is given in section 11.3.17, and the detailed findings are presented in the GQRA report included in Volume 5 – Appendix A11.2.

## 11.2.4 Methodology for the Assessment of Impacts

### 11.2.4.1 General Approach

Impacts may be categorised as one of three types (NRA, 2009):

- Direct Impact – the existing geological or hydrogeological environment along or in close proximity to the proposed Scheme is altered, in whole or in part, as a consequence of the proposed Scheme construction and/or operation;
- Indirect Impact – the geological or hydrogeological environment beyond the proposed Scheme is altered by activities related to the proposed Scheme construction and/or operation; and
- No Predicted Impact – the proposed Scheme has neither a negative nor a positive impact on the geological, hydrological, or hydrogeological environment.

Indirect impacts are also defined as effects on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway (EPA, 2022).

In addition, the impacts may be categorised according to quality of effects (EIAR, 2022):

- Positive Effects – a change which improves the quality of the environment;
- Neutral Effects – no effects or effects that are imperceptible, within normal bounds of variation, or within the margin of forecasting error; and
- Negative/Adverse Effects – a change which reduces the quality of the environment.

### 11.2.4.2 Importance of Receptors

In accordance with the TII Guidelines (NRA, 2009), the rating criteria for assessing the importance of geological and hydrogeological features within the study area are outlined in Table 11-4 and Table 11-5 below.

**Table 11-4: Geological feature importance rating, [Source: Box 4.1 (NRA, 2009)]**

| Importance | Criteria | Typical Examples |
|---|---|---|
| Very High | Attribute has a high quality, significance or value on a regional or national scale.<br>Degree or extent of soil contamination is significant on a national or regional scale.<br>Volume of peat and / or soft organic soil underlying road development is significant on a national or regional scale. | Geological feature rare on a regional or national scale (NHA)<br>Large existing quarry or pit<br>Proven economically extractable mineral resource. |

[2] Refer to www.claire.co.uk

| Importance | Criteria | Typical Examples |
|---|---|---|
| High | Attribute has a high quality, significance or value on a local scale.<br>Degree or extent of soil contamination is significant on a local scale.<br>Volume of peat and / or soft organic soil underlying road development is significant on a local scale. | Contaminated soil on site with previous heavy industrial usage<br>Large recent landfill site for mixed wastes<br>Geological feature of high value on a local scale (County Geological Site)<br>Well drained and/or high fertility soils<br>Moderately sized existing quarry or pit<br>Marginally economic extractable mineral resource. |
| Medium | Attribute has a medium quality, significance or value on a local scale.<br>Degree or extent of soil contamination is moderate on a local scale.<br>Volume of peat and / or soft organic soil underlying road development is moderate on a local scale. | Contaminated soil on site with previous light industrial usage<br>Small recent landfill site for mixed wastes<br>Moderately drained and/or moderate fertility soils<br>Small existing quarry or pit<br>Sub-economic extractable mineral resource. |
| Low | Attribute has a low quality, significance or value on a local scale.<br>Degree or extent of soil contamination is minor on a local scale.<br>Volume of peat and / or soft organic soil underlying road development is small on a local scale*. | Large historical and/or recent site for construction and demolition wastes<br>Small historical and/or recent landfill site for construction and demolition wastes<br>Poorly drained and/or low fertility soils<br>Uneconomically extractable mineral resource. |
| *Relative to the total volume of inert soil disposed of and/or recovered | | |

**Table 11-5: Hydrogeological feature importance rating, [Source: Box 4.3 (NRA, 2009)]**

| Importance | Criteria | Typical Examples |
|---|---|---|
| Extremely High | Attribute has a high quality or value on an international scale. | Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status. |
| Very High | Attribute has a high quality or value on a regional or national scale. | Regionally Important Aquifer with multiple wellfields.<br>Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – e.g. NHA status.<br>Regionally important potable water source supplying >2,500 homes<br>Inner source protection area for regionally important water source. |
| High | Attribute has a high quality or value on a local scale. | Regionally Important Aquifer.<br>Groundwater provides large proportion of baseflow to local rivers.<br>Locally important potable water source supplying >1,000 homes.<br>Outer source protection area for regionally important water source.<br>Inner source protection area for locally important water source. |
| Medium | Attribute has a medium quality or value on a local scale. | Locally Important Aquifer<br>Potable water source supplying >50 homes.<br>Outer source protection area for locally important |

| Importance | Criteria | Typical Examples |
|---|---|---|
| | | water source. |
| Low | Attribute has a low quality or value on a local scale. | Poor Bedrock Aquifer.<br>Potable water source supplying <50 homes. |

### 11.2.4.3 Magnitude of Impacts

The rating criteria for quantifying the magnitude of impacts is outlined in Table 11-6 and Table 11-7. These impact ratings are in accordance with impact assessment criteria provided in the EPA and the IGI Guidelines. The criteria apply to potential impacts during both the Construction and Operational Phases.

**Table 11-6: Magnitude of Impact on Soils/Geology Attribute, [Source Table C4 (IGI, 2013)]**

| Magnitude of Impact | Criteria | Typical Examples |
|---|---|---|
| Large Adverse | Results in loss of attribute | Loss of high proportion of future quarry or pit reserves<br>Irreversible loss of high proportion of local high fertility soils<br>Removal of entirety of geological heritage feature<br>Requirement to excavate / remediate entire waste site<br>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<br>Removal of part of geological heritage feature<br>Irreversible loss of moderate proportion of local high fertility soils<br>Requirement to excavate / remediate significant proportion of waste site<br>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<br>Removal of small part of geological heritage feature<br>Irreversible loss of small proportion of local high fertility soils and / or high proportion of local low fertility soils<br>Requirement to excavate / remediate small proportion of waste site<br>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 | Major enhancement of geological heritage feature. |

| Magnitude of Impact | Criteria | Typical Examples |
|---|---|---|
| | of attribute quality | |

**Table 11-7: Magnitude of Impact on Hydrogeology Attribute, [Source Table C5 (IGI, 2013)]**

| Magnitude of Impact | Criteria | Typical Examples |
|---|---|---|
| Large Adverse | Results in loss 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.<br>Potential high risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >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.<br>Potential medium risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >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.<br>Potential low risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >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 <0.5% annually. |

### 11.2.4.4 Significance of Impacts

The rating criteria for quantifying the significance of impacts is outlined in Table 11-8. These impact ratings are in accordance with impact assessment criteria provided in the EPA and IGI Guidelines and are based on the importance of the attribute and the magnitude of the impact. The criteria apply to potential impacts during both the Construction and Operational Phases.

**Table 11-8: Significance of Impact on Attribute, [Source Table C6 (IGI, 2013)]**

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

## 11.3 Baseline Environment

Information about the baseline environment across the study area was collated from desk studies (sections 11.3.1 to 11.3.16) and Ground Investigations (sections 11.3.17 and 11.3.18).

### 11.3.1 Regional Geomorphology and Topography

The topography along the proposed Scheme is initially dominated by the Tolka valley before steadily increasing in elevation as the alignment progresses northwards. The ground surface can be generally described as locally flat with minor undulations. Ground level is expressed in terms of ordnance datum (OD). There is a gentle gradient with contour data indicating typical elevation levels range from 30m OD near the southern end of the proposed Scheme, steadily increasing along the route to 70m OD in the north.

The Luas Broombridge Hamilton depot and Broombridge Station sit approximately 35m OD, with Broombridge Road starting at a similar elevation before gradually falling to approximately 25m OD at the northern end. The River Tolka has incised the surrounding topography and forms the lowest elevation along the proposed Scheme at 19m OD. The elevation gradually rises moving northwards through Tolka Valley Park and St Helena's to reach approximately 50m OD at Farnham Park. The topography continues, locally flat but gradually increasing along Mellowes Park and St Margaret's Road before reaching the terminus at Charlestown, at approximately 70m OD.

The proposed Scheme will be constructed primarily at grade but does include two new bridge structures as referenced in section 11.1.2.

### 11.3.2 Quaternary Geology

Quaternary Geology are superficial deposits of Quaternary-aged material and include both soils and subsoils.

#### 11.3.2.1 Soils

CORINE 2018 land mapping data indicates 'Artificial Surfaces' underlie the entirety of the study area, comprising a combination of 'discontinuous urban fabrics, industrial, commercial and transport units, and artificial non-agricultural vegetated areas'. Teagasc data also identifies 'mineral poorly drained (mainly basic)' and 'deep well drained mineral (mainly basic)' soils where the proposed Scheme crosses the Tolka Valley Park and at the northernmost 200m of the route.

CORINE 2018 mapping of the study area is shown on Volume 4 – Map Figure 11-1 of this EIAR.

#### 11.3.2.2 Subsoils

GSI Quaternary Sediments mapping indicates that limestone-derived till overlies the bedrock geology across much of the proposed Scheme. These deposits are typically known as the Dublin Boulder Clay. GSI Quaternary Sediments mapping also identifies areas of gravels derived from limestones, alluvium, alluvium (gravelly), and bedrock outcrop or subcrop underlying the proposed Scheme.

Quaternary Sediments mapping is shown on Volume 4 – Map Figure 11-2 of this EIAR.

### 11.3.3 Bedrock Geology

The GSI Bedrock Geology dataset indicates the solid geology underlying the proposed Scheme is predominantly carboniferous limestone of the Lucan Formation. This limestone is generally described as medium to strong, thin to medium bedded, dark grey, fine to medium grained limestone with interbedded shale and mudstone. The strength of the limestone typically increases with depth. A small area of calcareous shale bedrock belonging to the Tober Colleen Formation underlies the northern end of the study area.

Bedrock geology mapping is shown on Volume 4 – Map Figure 11-3 of this EIAR.

### 11.3.4 Mineral Localities and Quarries

According to GSI Mineral Locality datasets, there are no mineral localities, metallic or non-metallic within the study area. Two mineral localities are identified within 2km of the proposed Scheme alignment, as listed in Table 11-9 and shown on Volume 4 – Map Figure 11-5 of this EIAR.

**Table 11-9: Mineral Localities within 2km of the proposed Scheme (GSI, 2024)**

| Mineral Location Ref. | Key Mineral | Minerals | GSI Comments | Distance from proposed Scheme |
|---|---|---|---|---|
| 5310 | Limestone (in general) | Both metallic and non-metallic | Barytes noted in jointed limestone within quarry here | 950m |
| 3260 | Clay, brick | Non-metallic | Brick field noted on old 6-inch map. Kinahan notes a good clay capable of making good bricks. | 1.4km |

The GSI Pits and Quarries Areas dataset identifies an early to mid-20$^{th}$ century quarry within the study area, east of the proposed Scheme within Tolka Valley Park, which was very likely used subsequently as a landfill site (section 11.3.8). The GSI Historic Pits and Quarry Locations dataset identifies a second quarry and a pit within the study area, east of the Finglas Bypass (R135).

There is no record of underground mining within the study area, therefore the risk of underground structure collapse due to sub-surface cavities is considered exceptionally low. The potential impact of underground structure collapse related to underground mining will therefore not be considered further in this assessment.

There are also no active quarries within the study area. A review of the GSI Active Quarry dataset indicates the nearest active quarry is Huntstown Quarry located approximately 1.2km northwest of the northern extent of the proposed Scheme alignment. The quarry location is shown on Volume 4 – Map Figure 11-4 of this EIAR.

### 11.3.5 Aggregate Potential

GSI Crushed Rock Aggregate Potential mapping identifies ‘Low Potential’ to ‘Very High Potential’ regions along the proposed Scheme, likely due to the relatively shallow depth to bedrock in very localised areas. Aggregate potential mapping is shown on Volume 4 – Map Figure 11-5 of this EIAR.

Due to the urban nature of the local environs, and absence of rock excavation planned as part of the proposed Scheme, the potential for crushed rock aggregate recovery is not considered feasible and it is unlikely that an economically viable quarry could be sited at this location in the future. Therefore, impacts associated with crushed aggregate potential will not be considered further in the assessment.

GSI Granular Aggregate Potential mapping, relevant only to the regions of ‘Alluvium’ and ‘Gravels Derived from Limestones’ as identified within the GSI Quaternary Sediments datasets, identifies ‘Very Low’ to ‘Very High’ granular aggregate potential within the study area. Due to the urban nature of the local environs, shallow soil excavation planned along the route, and spatially limited area of ‘High’ or ‘Very High’ potential, the potential for granular rock aggregate recovery is minimal and it is unlikely that an economically viable extraction pit could be sited along the proposed Scheme in the future. Therefore, impacts associated with granular aggregate potential will not be considered further in the assessment.

### 11.3.6 Geological Heritage Areas

No geological heritage areas were identified within the study area using the GSI Geoheritage dataset. County Geological Sites within 2km of the proposed Scheme are listed in Table 11-10. The closest geological heritage constraint is 475m east of the proposed Scheme alignment, consisting of rock workings in Glasnevin Cemetery (Grounds), which will not be impacted by the proposed Scheme.

Therefore, impacts associated with geological heritage areas have not been considered further in the assessment. GSI Geoheritage mapping is shown on Volume 4 – Map Figure 11-6 of this EIAR.

**Table 11-10: County Geological Sites within 2km of the proposed Scheme (GSI, 2024)**

| Name | Code | Designation | CGS Description | Approx. Distance from proposed Scheme |
|---|---|---|---|---|
| Glasnevin Cemetery | DC004 | CGS | A very large cemetery of 120 acres, dating from 1832, with a variety of rock types and rock working. | 475m |
| Phoenix Park | DC009 | CGS, recommended for Geological NHA | An extensive, 707-hectare natural landscape, with complex glacial form. | 1.4km |
| Huntstown Quarry | DF022 | CGS, may be recommended for Geological NHA | A working limestone quarry showing the base of the Tober Collen Formation where it directly overlies Waulsortian rock. | 1.5km |

## 11.3.7 Karst

The GSI Karst features dataset did not identify any karst within 2km of the proposed Scheme alignment. The closest recorded karst feature, a shallow well known as St Doolagh's Well, is approximately 8km to the east. The muddy limestones of the Lucan and Tober Colleen Formation are less susceptible to karst solution than pale, purer limestones. In addition, the area is well developed, and it is unlikely karst features would have remained unidentified. Therefore, impacts associated with karstification are not considered further in the assessment.

## 11.3.8 Contaminated Land

A review of GSI's study on the baseline geochemistry of Dublin's urban topsoil (Dublin Soil Urban Geochemistry (SURGE) project data) identified six sample locations within the study area boundary. The results associated with those samples indicated the presence of elevated metals but not above critical concentration levels (S4UL) and no evidence of persistent organic pollutants such as Polycyclic aromatic hydrocarbons (PAHs) or Polychlorinated biphenyls (PCBs).

A historic landfill is understood to have operated within Tolka Valley Park but was decommissioned and capped by Dublin City Council (DCC) during the 1970s. Information detailing the specific nature of the waste or the spatial extent of the landfill within the park is limited. A technical report (Ref: 95907), commissioned by DCC Parks and Landscape Services and prepared by BHP in 2010, referenced 'an old landfill site' and confirmed inert landfill waste to be present in six trial pit excavations undertaken in the park. The report does not include any location plans or coordinates for trial pits undertaken so the exact relevance to the proposed Scheme cannot be established. Historical mapping indicates a quarry site was once present within the Tolka Valley Park, which is likely to have been subsequently backfilled with waste and/or uncontrolled fill. Refer to section 11.3.17 for discussion of the environmental sampling and testing undertaken during the 2021-2022 ground investigation.

A review of the EPA database indicates there are no active landfill sites within the study area; the closest licenced landfill site is Dunsink Landfill (no longer accepting waste). Also known as Dunsink Civic Amenity, Dunsink Landfill is located approximately 2.2km west of the proposed Scheme alignment. EPA Waste Licenced sites within 2.5km of the proposed Scheme are summarised in Table 11-11 below.

There is one EPA licensed facility recorded within the study area, Colorman, with license number P0496-01. The proposed Scheme will impact access to the site but not the primary (licenced) operations, therefore, impacts associated with the Colorman facility have not been considered further in the Land and Soils assessment. There are a further twelve EPA registered facilities within 2.5km of the proposed Scheme alignment, five of which are currently actively licensed. All thirteen EPA registered facilities are summarised in Table 11-12 below. The locations of EPA licenced facilities and potential sources of land contamination are shown on Volume 4 – Map Figure 11-7 and Volume 4 – Map Figure 11-12, respectively of this EIAR.

**Table 11-11: Waste Licenced Facilities within 2.5km of the proposed Scheme (EPA, 2022)**

| License No. | License Type | Facility Name | Activity Description / Background | License Status | Approx. Distance from proposed Scheme |
|---|---|---|---|---|---|
| W0303-01 | Waste | Ballymun Recycling Centre | Operation of a civic amenity for the reception and temporary storage of household waste for recovery. | Licensed | 2km |
| W0302-01 | Waste | North City Operations Depot | Operation of a transfer station to handle waste from Dublin City Council daily operations, including waste from street cleaning, litter bin collection, road and housing maintenance. | Licensed | 2km |
| W0127-01 | Waste | Dunsink Landfill | A capping & restoration programme on site, a green waste composting facility, accepting white goods for recycling and a civic amenity facility/ bring centre for recyclable household materials. | Licensed | 2.2km |
| W0277-03 | Waste | Huntstown Inert Waste Recovery Facility | A Construction & Demolition (C&D) recovery facility and restoration of the quarry through the recovery of waste soil & stone. The proposed maximum annual waste intake at the C&D recovery facility is 95,000 tonnes. 1,500,000 tonnes per annum soil and stone for backfill. | Licensed | 2.5km |

**Table 11-12: Licenced Facilities (Non-Waste) within 2km of the proposed Scheme (EPA, 2022)**

| License No. | License Type | Facility Name | Class of Activity | License Status | Approx. Distance from proposed Scheme |
|---|---|---|---|---|---|
| P0496-01 | IPPC | Colorman | The use of coating materials in processes with a capacity to use at least 10 tonnes per year of organic solvents. | Licensed | 75m |
| P0326-01 | IEL | Protim Abrasives Ltd. | The formulation of pesticides. | Surrendered | 250m |
| P0119-02 | IPPC | Amcor Flexibles | The surface treatment of substances using organic solvents, in particular for printing, coating, degreasing and cleaning, with a consumption capacity of more than 150 kg per hour or more than 200 tonnes per year. | Surrendered | 500m |
| P0484-01 | IPPC | Toruro Enterprises Ltd | The treatment or protection of wood, involving the use of preservatives, with a capacity exceeding 10 tonnes per day. | Surrendered | 700m |

| License No. | License Type | Facility Name | Class of Activity | License Status | Approx. Distance from proposed Scheme |
|---|---|---|---|---|---|
| P0075-03 | IPC | Burgess Galvin and Company Ltd | The chemical manufacture of glues, bonding agents and adhesives.<br>and<br>The manufacture of coating materials in processes with a capacity to use at least 10 tonnes per year of organic solvents. | Licensed | 700m |
| P0293-01 | IPPC | W.I. Ltd | Boiler making and the manufacture of reservoirs, tanks and other steel metal containers where the production area exceeds 500 square metres. | Surrendered | 700m |
| P0131-01 | IEL | Mouldpro International Ltd | The manufacture or use of coating materials in processes with a capacity to make or use at least 10 tonnes per year of organic solvents, and powder coating manufacture with a capacity to produce at least 50 tonnes per year. | Surrendered | 800m |
| P0212-01 | IPPC | Lithographic Web Press Ltd (Bray) | The use of coating materials in processes with a capacity to use at least ten tonnes per year of organic solvents. | Licensed | 1.3km |
| P0537-01 | IPPC | Rentsch Dublin Ltd | The use of coating materials in processes with a capacity to use at least 10 tonnes per year of organic solvents. | Surrendered | 1.3km |
| P0120-03 | IPPC | Lithographic Web Press Ltd (Glasnevin) | The surface treatment of substances, objects or products using organic solvents, in particular for dressing, printing, coating, degreasing, waterproofing, sizing, painting, cleaning or impregnating, with a consumption capacity of more than 150 kg per hour or more than 200 tonnes per year. | Surrendered | 1.4km |
| P0054-02 | IEL | Mater Misericordiae | Disposal or recovery of hazardous waste with a capacity exceeding 10 tonnes per day involving one or more of the following activities:<br>(a) biological treatment;<br>(b) physicochemical treatment; and<br>(c) blending or mixing prior to submission to any other activities listed. | Licensed | 1.9km |
| P0777-02 | IEL | Energia Power Generation Ltd | The operation of combustion installations with a rated thermal input equal to or greater than 50MW. | Licensed | 1.9km |
| P0483-04 | IEL | Huntstown | The operation of combustion | Licensed | 2.0km |

| License No. | License Type | Facility Name | Class of Activity | License Status | Approx. Distance from proposed Scheme |
|---|---|---|---|---|---|
| | | Power Company Ltd | installations with a rated thermal input equal to or greater than 50MW. | | |

### 11.3.9 Landslide Potential

The GSI Landslide Susceptibility mapping shows the greater part of the proposed Scheme to be situated in areas of 'Low' to 'Moderately Low' landslide susceptibility.

The associated risk definitions are as follows:

- Low: The predominant soil type is Fine to Coarse Range material followed by Medium to Coarse Range material which together exceeds all others by a significant extent. Slopes are mainly in the lower ranges of 0-3° (degrees), 3-6° and 6-10° range;
- Moderately Low: The predominant soil type is Medium to Coarse and to a slightly lesser extent Fine to Coarse Range, Rock Near Surface or Peat which occur in equal proportions. Slopes are mainly in the 3-6° band with a significant proportion in the 6-10° range; and
- Moderately High: The predominant soil type is Rock Near the Surface and to a lesser extent Peat and Medium to Coarse Sand. Slopes are mainly in the 10-15° band with a significant proportion in the 6-10° and 15-20° range.

There are localised areas which are mapped as 'Moderately High' landslide susceptibility e.g. Tolka Valley and adjacent to Mellowes Park. This is likely due to the classification algorithm identifying significant elevation differences over relatively short distances in these areas.

For example, the Finglas Bypass (R135) comprises a significant engineered road cutting adjacent to Mellowes Park, but this would not represent a realistic landslide risk. Slope stability in Tolka Valley Park has been considered in the design of the Tolka River Overbridge with the abutments set back from the valley topography. There are no records of landslides held by the GSI within the study area. Landslide potential is assessed to be low, therefore landslide potential has not been considered further in this assessment.

### 11.3.10 Regional Hydrogeology

Groundwater flow in the bedrock aquifers is concentrated in upper fractured and weathered zones and in the vicinity of fault zones. There is a distinct reduction in limestone permeabilities with depth. Packer tests show permeabilities reduce an order of magnitude for each five metres of depth in limestone (Aspinwall & Company, 1979). Most groundwater flow will take place close to the bedrock surface with additional isolated flow along fractures and fissures.

Groundwater flow directions are typically a reflection of the overlying topography. Groundwater is expected to discharge to the nearby watercourses, (the River Tolka, Bachelors Stream, and Finglaswood Stream within the study area), within the short flow paths present in the local bedrock (GSI, 2021).

### 11.3.11 Aquifer Classification

The GSI Groundwater Resources (Aquifers) dataset indicates the greater part of the proposed Scheme is underlain by a 'Locally Important Bedrock Aquifer' that is moderately productive in local zones (LI), comprising the shaley limestone of the Lucan Formation. A small section, at the most northern end of the route, is underlain by a 'Poor Aquifer', described as generally unproductive except for local zones (PI). The bedrock aquifers are characterised by low permeability rocks, with transmissivity values of between 10 and 150$m^2$/d. Locally important aquifers are attributes of medium hydrogeological importance, and Poor aquifers are attributes of low hydrogeological importance.

Earthworks and dewatering have the potential to alter the hydrogeological regime and groundwater flow paths, which could potentially result in groundwater contamination and deterioration in the yields of wells and springs. As the proposed Scheme is designed at grade, the earthworks and dewatering activities are anticipated to be minimal and have been considered in the design of the proposed Scheme. Poor Aquifers generally provide little groundwater for water supply or for baseflow to surface water bodies, however, they are sometimes used for local supply. GSI Groundwater Resources (Aquifers) mapping is shown on Volume 4 – Map Figure 11-8 of this EIAR.

### 11.3.12 Groundwater Vulnerability

Groundwater vulnerability provides an indication of the ease at which potential contaminants may migrate vertically downwards through subsurface strata to an underlying aquifer. GSI groundwater vulnerability classifications are not a measure of the impact on groundwater quality, but rather the degree of protection afforded to the underlying aquifer and consequently the risk to the groundwater quality in the event of a release of a contaminant. The GSI classification of the vulnerability of an aquifer is based on the thickness and permeability of overburden. The greater the thickness and permeability, the greater the protection to the groundwater in the underlying aquifer.

Table 11-13 summarises the vulnerability classification underlying the proposed Scheme. The vulnerability classifications range from 'Moderate' to 'Extreme' with a large proportion of the proposed Scheme (66%) classified as 'High' or 'Extreme'. Removal of overburden through excavation would increase the vulnerability.

GSI Groundwater Vulnerability mapping is shown on Volume 4 – Map Figure 11-9 of this EIAR.

**Table 11-13: GSI Groundwater Vulnerability under the proposed Scheme (GSI, 2022)**

| Vulnerability GSI Classification | Length of proposed Scheme (km) | Percentage of proposed Scheme (%) |
|---|---|---|
| Extreme | 0.840 | 21.4 |
| High | 1.740 | 44.3 |
| Moderate | 1.350 | 34.4 |

### 11.3.13 Groundwater Recharge

The GSI Groundwater recharge map across the area indicates low recharge rates to the bedrock aquifers across the entire area, at 51 - 100mm/year across the greater part of the study area. Within the study area there are small areas with a groundwater recharge rate of 1 - 50mm/year, and 151 - 200mm / year. The ability of the bedrock to accept recharge is based generally on the permeability of the weathered zone of bedrock likely extending 3 - 5m below the bedrock surface. This is because the bedrock offers very little primary porosity with storage occurring predominantly within fractured and weathered zones. Conservatively, it is estimated that 10% of the city area is available for recharge, predominantly in areas such as parks, squares, and gardens, with the remainder of the urban environment comprising human-made impermeable surfaces (GSI, n.d). GSI Aquifer Recharge mapping is shown on Volume 4 – Map Figure 11-10 of this EIAR.

Luas Finglas is predominantly designed at, or close to, existing grade, with no substantial cut excavations, and based on the available groundwater monitoring data, construction will be carried out above the water table. There will be no significant change to the recharge area of the aquifer as a result of the creation of impermeable surfaces. Due to the limited impact of the proposed Scheme on groundwater recharge, recharge has not been considered further in the assessment.

### 11.3.14 WFD Groundwater Quality Status

The Groundwater Body (GWB) is the management unit under the Water Framework Directive (WFD). GWBs are subdivisions of large geographical areas of aquifers so that they can be effectively managed in order to protect the groundwater and linked surface waters. Dublin GWB (Dublin Urban – IE_EA_G_008) underlies the entirety of the proposed Scheme and is identified by EPA as currently having a 'Good' Groundwater Status (2013-2018) and being considered 'Not at risk'.

### 11.3.15 Groundwater Abstraction and Discharge to Groundwater

There are no discharges to, or abstractions from, groundwater as part of the proposed Scheme.

#### 11.3.15.1 Public Groundwater Supply

The GSI Group Scheme and Public Supply Source Protection Areas dataset indicates there are no public water supply wells (or group scheme wells) within 2km of the corridor. The proposed Scheme also does not lie within any source protection area associated with groundwater protection schemes. The closest public water supply area is Dunboyne PWS, ~11.4km from the proposed Scheme. As there are no public groundwater supplies within 2km of the corridor, they have not been further considered in the assessment.

#### 11.3.15.2 Private Groundwater Supply Wells

Wells in the vicinity of the proposed Scheme was assessed using the GSI Wells and Springs dataset. This dataset is not exhaustive and does not distinguish which wells are operational and which are no longer in use. Connections to public water mains are readily available in this area of Dublin and domestic wells are considered an attribute of low importance.

Recorded wells in the vicinity of the proposed Scheme boundary are summarised in Table 11-14 and shown on Volume 4 – Map Figure 11-11 of this EIAR.

**Table 11-14: GSI Groundwater Well Data within 2km of the proposed Scheme (GSI, 2022)**

| GSI Name | Well Type | Approx. Distance from proposed Scheme | Townland | Source Use | Yield Class | Yield ($m^3$/day) |
|---|---|---|---|---|---|---|
| 2923SEW003 | Borehole | Within Scheme Boundary* | Finglas East | Agricultural & Domestic | Good | 110 |
| 2923NEW061 | Borehole | 50m | Charlestown | - | - | - |
| 2923NEW062 | Borehole | 70m | Charlestown | - | - | - |
| 2923NEW063 | Borehole | 75m | Charlestown | - | - | - |
| 2923NEW064 | Borehole | 80m | Charlestown | - | - | - |
| 2923NEW042 | Spring | 150m | Cardiffcastle | - | - | - |
| 2923SEWO21 | Borehole | 400m | Finglas | Industrial | Good | 174.6 |
| 2923SEW024 | Borehole | 400m | Glasnevin | Unknown | Poor | 16.5 |
| 2923NEW029 | Borehole | 870m | Balseskin | Other | - | - |
| 2923NEW025 | Borehole | 950m | Balseskin | - | - | - |
| 2923NEW026 | Borehole | 950m | Balseskin | Other | - | - |
| 2923NEW028 | Borehole | 950m | Balseskin | Other | - | - |
| 2923NEW031 | Borehole | 975m | Balseskin | Other | Moderate | 83.8 |
| 2923NEW027 | Borehole | 975m | Balseskin | Other | - | - |
| 2923NEW035 | Borehole | 1.05km | Dubber | Unknown | Moderate | 48.5 |
| 2923SEW027 | Borehole | 1.08km | Glasnevin | Unknown | Good | 300 |
| 2923SEW028 | Borehole | 1.13km | Glasnevin | Unknown | Excellent | 482 |
| 2923SEW004 | Borehole | 1.40km | Cappoge | Agricultural & Domestic | Good | 109.1 |

| GSI Name | Well Type | Approx. Distance from proposed Scheme | Townland | Source Use | Yield Class | Yield ($m^3$/day) |
|---|---|---|---|---|---|---|
| *: No evidence of a well was observed during the site walkover. Location reported to a low degree of confidence (+/- 250m). Conservatively assumed to be present, although a review of historical information suggests the well is most likely associated with Farnham House, this would position the well beyond the proposed Scheme boundary. | | | | | | |

### 11.3.16 Regional Hydro-Ecology Designated Sites

There are no designated European (Natura 2000) or Groundwater Dependent Terrestrial Ecosystem (GDTE) sites located within the proposed Scheme boundary. A proposed Natural Heritage Area (pNHA), Royal Canal [002103], is located within the Scheme boundary.

There are a number of designated European (Natura 2000) sites within the proposed Scheme's 15km zone of influence (ZoI) as identified and assessed in Chapter 9 (Biodiversity). These designated sites include:

- South Dublin Bay and River Tolka Estuary SPA; located 4.8km from the proposed Scheme;
- North Bull Island SPA; located 7.8km from the proposed Scheme;
- North Dublin Bay SAC; located 7.8km from the proposed Scheme; and
- South Dublin Bay SAC; located 7.0km from the proposed Scheme.

As referred to in section 11.3.14, the groundwater body which underlies the proposed Scheme is the Dublin groundwater body (IE_EA_G_008). The site shares this groundwater body with all of the Natura 2000 sites listed above.

The underlying bedrock of the proposed scheme comprises dark-grey to black, fine-grained, occasionally cherty, micritic limestones. This bedrock is largely overlain with low permeability boulder clay, with smaller pockets of limestone gravels and alluvial sediments. There is generally a low sub-soil permeability throughout the boundary of the proposed Scheme (GSI, 2023).

The aquifer within the underlying bedrock is considered to be locally important, with moderate productivity, though only in local zones. Therefore, the aquifer has a limited and relatively poorly connected network of fractures, fissures and joints, giving a low fissure permeability, which tends to decrease further with depth. Generally, the lack of connection between the limited fissures results in relatively poor aquifer storage and flow paths that may only extend a few hundred metres (GSI, 2023).

Regarding the groundwater-to-surface water impact pathway, the characteristics of the underlying aquifer mean it is likely to rapidly discharge to the nearby watercourses, i.e. the River Tolka and Bachelors Stream. Therefore, there is a potential groundwater-to-surface water pathway within the locality of the proposed Scheme.

An integrated constructed wetland (ICW) is located within Tolka Valley Park and provides treatment to the surface waters emerging from the Finglaswood Stream, prior to discharging to the River Tolka. The wetland comprises a primary and secondary cell which outfalls to a small lake and ultimately to the River Tolka. As the ICW is fed by surface water, any impact of the proposed Scheme on the ICW is covered in Chapter 10 (Water). Only the hydrogeology related impacts on groundwater dependant designated sites are assessed within this Chapter. The ecology and surface water aspects of the above areas are discussed further in Chapter 9 (Biodiversity) and Chapter 10 (Water), respectively, and in the Natura Impact Statement (NIS).

### 11.3.17 Ground Investigations – Soils and Geology

The ground investigation indicates that ground conditions are largely as expected for the known geological setting and historical land use of this region. They predominantly consist of Topsoil overlying Made Ground, overlying Glacial Tills, overlying Bedrock, and are summarised in Table 11-15. The factual report for the ground investigation is included in Volume 5 – Appendix A11.1. As anticipated from the Preliminary Sources Study Report (PSSR), Historic Waste was encountered in Tolka Valley Park. This is discussed in greater detail in the GQRA included Volume 5 – Appendix A11.2.

Topsoil, typically described as brown or dark brown, slightly sandy, slightly gravelly Topsoil, was encountered in the majority of the exploratory holes and was present to a maximum depth of 0.40m bgl. Tarmac / concrete surfacing where present was encountered to a maximum depth of 0.20m bgl.

A selection of topsoil samples underwent classification testing in accordance with BS 3882 2015, *Specification for topsoil*. This standard outlines several broad topsoil categories which comprise threshold values for key topsoil characteristics such a texture, organic content, pH, and available plant nutrient levels. The testing classified the in-situ topsoil material as 'Low Fertility / Low Fertility Calcareous'.

Individual result certificates are included in the factual report for the ground investigation, included in Volume 5 – Appendix A11.1.

Made Ground was found to vary in thickness between 0.07m and 5.70m, with an average thickness of 2.00m. Made Ground deposits were encountered beneath the Topsoil/Surfacing and were present throughout the proposed Scheme to a basal depth of between 0.15m bgl and 5.90m bgl. These deposits of Made Ground are predominantly inert, (with some described as non-hazardous,) and classified as Class U1, material excavated from within the Site which, unless it undergoes sufficient processing, shall not be used in the Works (TII, 2011). The Made Ground along the proposed Scheme was interpreted as reworked cohesive glacial deposits (described generally as grey/brown sandy slightly gravelly CLAY with frequent cobbles and boulders) containing variable fraction of construction and demolition waste materials, such as brick, metal, and plastic. A distinct deposit of Made Ground characterised by an elevated concentration of anthropogenic material was designated as Historic Waste.

Historic Waste consistent with domestic waste landfill was encountered at several ground investigation locations in the Tolka Valley Park at thicknesses of between 0.75m and 5.55m. Material composition varied, predominantly comprised gravel and clay derived from various lithologies together with brick, concrete, slag, metal, plastic, glass, ceramic, tile, fabric, topsoil, wood, shells, charcoal, and tar.

During the 2021/2022 GII ground investigation, environmental testing carried out on recovered samples identified heavy metals, TPH, PAH, PCB, VOC and SVOCs in the soils. The levels reported did not exceed the GAC for human health in a Public Open Space (Park) scenario. Based on this data, the material is classified as non-hazardous (Class U1). However, it should be noted that landfill material is inherently variable and, as such, allowance will be made for encountering Class U2 material within Tolka Valley Park. Class U2 material is defined as material having hazardous chemical or physical properties requiring special measures for its excavation, handling, storing, transportation, deposition, and disposal (TII, 2011).

Glacial deposits encountered comprise a highly variable, stratified mixture of cohesive and granular materials. The boundaries between these material types varies from sharp to gradational both laterally and vertically. A detailed review of the available ground investigation data for the site indicates that, although glacial deposits occur as either 'cohesive' or 'granular', they comprise a heterogenous mixture of materials. During Rotary Core drilling, materials described as Cohesive Glacial Tills were found generally to vary in thickness between 0.70m and 19.40m, with an average thickness of 7.80m, and extending to a maximum basal depth of 20.30m bgl. Cohesive deposits were described typically as grey/brown sandy gravelly CLAY with occasional cobbles and boulders. During Rotary Core drilling, materials described as Granular Glacial Tills were found generally to vary in thickness between 0.30m and 9.00m, with an average thickness of 1.60m, and extending to a maximum basal depth of 10.00m bgl. Granular Glacial Tills were typically described as grey very clayey gravelly fine to coarse SAND.

Bedrock encountered during the ground investigation included variably weathered medium strong to very strong grey/dark grey fine to medium grained laminated Limestone interbedded with weak to medium strong black fine grained laminated Mudstone. Rare visible pyrite veins were noted during logging, which are typically present within the Calp Limestone. The depth to weathered rock ranged from 1.30m bgl to 17.20m bgl with an average depth of 9.00m bgl, and a thickness of between 3.10m and 7.80m, with an average thickness of 5.20m. The weathered rock encountered was typically diggable with the large excavator to a depth of up to 0.70m below the top of the stratum. The depth to non-weathered bedrock varies from 1.80m bgl to a maximum of 21.00m bgl in the vicinity of LF-CPRC-1011 with no rock recovery.

**Table 11-15: Summary of Ground Conditions encountered along the proposed Scheme**

| Unit | Material | Description | Depth to Top of Unit (m bgl) | Range of Unit Thickness (m) |
|---|---|---|---|---|
| 1 | Topsoil / Surfacing | Brown or dark brown, slightly sandy, slightly gravelly TOPSOIL<br>OR<br>Tarmac / Concrete SURFACING. | 0.00<br><br>0.00 | 0.10 to 0.40<br><br>0.05 to 0.20 |
| 2 | Made Ground<br>AND / OR<br>Localised Historic Waste in Tolka Valley Park | Grey/brown sandy slightly gravelly CLAY with frequent cobbles and boulders and contained occasional fragments of concrete, red brick, glass, and plastic<br>OR<br>Grey/brown slightly sandy very clayey GRAVEL with crushed rock fill.<br>AND / OR<br>Grey/brown slightly sandy slightly gravelly CLAY with metal, plastic, glass, tile, ceramic fragments, and textile fragments. | 0.00 to 5.00<br><br>0.20 to 4.00 | 0.07 to 5.70<br><br>0.75 to 5.55 |
| 3 | Cohesive Glacial Till | Grey/brown sandy gravelly CLAY with occasional cobbles and boulders. | 0.10 to 19.30 | 0.70 to 19.40 |
| 4 | Granular Glacial Till | Grey very clayey gravelly fine to coarse SAND. | 1.50 to 15.90 | 0.10 to 8.95 |
| 5 | Bedrock | Medium strong to very strong grey/dark grey fine to medium grained laminated LIMESTONE interbedded with weak to medium strong black fine grained laminated MUDSTONE. | 1.30 to 19.00 | Unproven |

## 11.3.18 Ground Investigations - Hydrogeology

Standpipes were installed in 26 exploratory holes to facilitate establishment of baseline groundwater conditions along the proposed Scheme. Groundwater levels (static water level [SWL]) were collected by the GI contractor during, and then following, the ground investigation works. The current monitoring programme is scheduled to continue until January 2024. A summary of groundwater readings recorded to date is included in Table 11-16 below. SWLs are measured on site to the nearest centimetre below the top of casing/standpipe.

A full breakdown of groundwater monitoring data is included in Volume 5 – Appendix A11.2.

**Table 11-16: Groundwater Levels (Static Water Levels)**

| Location ID | Installation Geology | Ground Level (m OD) | Monitoring Period | SWL (m bgl) | SWL (m OD) |
|---|---|---|---|---|---|
| LF-CPRC-1001 | Bedrock | 66.92 | Dec 2021 to Feb 2023 | 0.97 - 1.22 | 65.95 - 65.70 |
| LF-CPRC-1004 | Overburden | 65.22 | Dec 2021 to Feb 2023 | 1.17 - 2.41 | 64.05 - 62.81 |
| LF-CPRC-1007 | Overburden | 62.67 | Dec 2021 to Feb 2023 | 2.29 - 4.42 | 60.38 - 58.25 |

| Location ID | Installation Geology | Ground Level (m OD) | Monitoring Period | SWL (m bgl) | SWL (m OD) |
|---|---|---|---|---|---|
| LF-CPRC-1008 | Bedrock | 63.93 | Dec 2021 to Feb 2023 | 2.22 - 3.97 | 61.71 - 59.96 |
| LF-CPRC-1009 | Overburden | 63.78 | Dec 2021 to Feb 2023 | 0.69 - 5.96 | 63.09 - 57.82 |
| LF-CPRC-1010 | Bedrock | 62.29 | Dec 2021 to Feb 2023 | 5.12 - 5.77 | 57.17 - 56.52 |
| LF-CPRC-1011 | Overburden | 54.63 | Dec 2021 to Feb 2023 | 2.40 - 3.72 | 52.23 - 50.91 |
| LF-CPRC-1014 | Overburden | 33.69 | Dec 2021 to Feb 2023 | 4.47 - 5.26 | 29.22 - 28.43 |
| LF-CPRC-1015 | Overburden | 26.49 | Dec 2021 to Feb 2023 | 1.06 - 1.45 | 25.43 - 25.04 |
| LF-CPRC-1018 | Bedrock | 25.93 | Dec 2021 to Feb 2023 | 3.49 - 3.93 | 22.44 - 22.00 |
| LF-CPRC-1019 | Overburden | 25.7 | Dec 2021 to Feb 2023 | 2.39 - 3.30 | 23.31 - 22.40 |
| LF-CPRC-1028 | Bedrock | 36.43 | Dec 2021 to Feb 2023 | 1.34 - 2.34 | 35.09 - 34.09 |
| LF-CPRC-1031 | Overburden | 37.29 | Dec 2021 to Feb 2023 | 1.44 - 1.88 | 35.85 - 35.41 |
| LF-CPRC-1032 | Bedrock | 37.37 | Dec 2021 to Feb 2023 | 1.86 - 2.21 | 35.51 - 35.16 |
| LF-CPRC-2007 | Bedrock | 25.34 | Dec 2021 to Feb 2023 | 2.73 - 3.44 | 22.61 - 21.90 |
| LF-CPRC-2009 | Overburden | 33.23 | Dec 2021 to Feb 2023 | 5.30 - 5.90 | 27.93 - 27.33 |
| LF-CPRC-3001 | Overburden | 36.22 | Dec 2021 to Feb 2023 | 2.24 - 3.26 | 33.98 - 32.96 |
| LF-WS-1014 | Overburden | 50.86 | Dec 2021 to Feb 2023 | 2.14 - 5.26 | 48.72 - 45.60 |
| LF-WS-1015 | Overburden | 39.37 | Dec 2021 to Feb 2023 | 1.97 - 3.40 | 37.40 - 35.97 |
| LF-WS-1016 | Overburden | 42.25 | Dec 2021 to Feb 2023 | 2.10 - 3.24 | 40.15 - 39.01 |
| LF-WS-1017 | Overburden | 35.65 | Dec 2021 to Feb 2023 | 2.80 - 3.46 | 32.85 - 32.19 |
| LF-WS-1018 | Overburden | 31.49 | Dec 2021 to Feb 2023 | 3.25 - 3.69 | 28.24 - 27.80 |

#### 11.3.18.1 Permeability Testing

Permeability testing in the form of a falling head tests was undertaken within Made Ground deposits to assess the permeability of the subsoil and the ease of groundwater flow through the shallow groundwater pathway.

Table 11-17 presents the results of the permeability testing in terms of an estimated coefficient of permeability, K, and where this value falls in terms of permeability ranges for Irish subsoils (GSI, 2015). The three broad permeability categories are defined as 'high', 'moderate' and 'low'. Most tills in Ireland are considered to have a 'moderate' or 'low' permeability.

Infiltration testing (BRE, 2016) was carried out across the proposed Scheme, but the majority of test locations observed no effective infiltration, resulting in a 'failed' result as per the test methodology. This low permeability is consistent with the GSI subsoil permeability mapping for the area and the permeability characteristics reported in literature for cohesive glacial till, which dominates the make-up of these Made Ground deposits. Generally, permeability will decrease with depth, therefore the subsoil and transition zone will tend to report higher permeability values than the shallow or deep bedrock zones.

**Table 11-17: Permeability test results**

| Location ID | Permeability, K m/s (Hydraulic Conductivity) | Permeability Range | Material Type |
|---|---|---|---|
| LF-WS-1018 | $2.0 \times 10^{-5}$ | Moderate | Made Ground |
| LF-WS-1017 | $1.7 \times 10^{-4}$ | Moderate | Made Ground |

| Location ID | Permeability, K m/s (Hydraulic Conductivity) | Permeability Range | Material Type |
|---|---|---|---|
| LF-WS-1014 | 4.6 x $10^{-6}$ | Moderate | Made Ground |
| LF-TP-2012 | No effective Infiltration | Low | Cohesive Glacial Till |
| LF-IT-2001 | No effective Infiltration | Low | Made Ground |
| LF-IT-2002 | No effective Infiltration | Low | Made Ground |
| LF-IT-2003 | No effective Infiltration | Low | Made Ground |
| LF-IT-2004 | No effective Infiltration | Low | Made Ground |
| LF-IT-2005 | No effective Infiltration | Low | Made Ground |
| LF-IT-2006 | No effective Infiltration | Low | Made Ground |
| LF-IT-2007 | No effective Infiltration | Low | Made Ground |
| LF-IT-2008 | No effective Infiltration | Low | Made Ground |
| LF-IT-2009 | No effective Infiltration | Low | Made Ground |
| LF-IT-2010 | No effective Infiltration | Low | Made Ground |
| LF-IT-2011 | No effective Infiltration | Low | Made Ground |
| LF-IT-2012 | No effective Infiltration | Low | Made Ground |
| LF-IT-2013 | No effective Infiltration | Low | Made Ground |
| LF-IT-2014 | No effective Infiltration | Low | Made Ground |
| LF-IT-2016 | No effective Infiltration | Low | Made Ground |
| LF-IT-2017 | No effective Infiltration | Low | Made Ground |

### 11.3.19 Summary of the importance of Geological & Hydrogeological Features

The criteria for rating site importance of a geological or hydrogeological feature is based on the Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes published by the NRA (NRA, 2009), and which is reproduced in the IGI guidelines (IGI, 2013). The initial assessment is based on the findings of the information listed above (throughout section 11.3). These ratings are used to inform Table 11-18.

**Table 11-18: Importance of Geological and Hydrogeological Features within study area**

| Importance | Feature | Justification |
|---|---|---|
| Medium | Historic Waste | Degree or extent of soil contamination is moderate on a local scale |
| Medium | Locally Important Aquifer | Attribute has a medium quality or value on a local scale. |
| Low | Poor Bedrock Aquifer | Attribute has a low quality or value on a local scale |
| Low | Potable water source supplying <50 homes | Attribute has a low quality or value on a local scale |

## 11.4 Potential Impacts

### 11.4.1 Introduction

This section provides an outline of the potential impacts considered for soils, geology and hydrogeology with respect to the proposed Scheme design under the following scenarios:

- Do-Nothing scenario;
- Construction Phase; and
- Operational Phase.

### 11.4.2 Do-Nothing Scenario

In the event of a Do-Nothing scenario, the proposed Scheme would not be constructed, resulting in no impact to existing soils, geology, or hydrogeology baselines along the proposed Scheme.

### 11.4.3 Construction Phase

#### 11.4.3.1 Introduction

The proposed Scheme will be predominantly constructed at, or close to, existing grade and therefore does not require deep or extensive excavations. The maximum anticipated temporary excavation depth is approximately 2m while the maximum permanent excavation (cutting) is approximately 1.2m.

Most excavation work will comprise localised regrading to achieve the required vertical alignment and integrate with the surrounding topography. Construction will primarily comprise shallow earthworks which will be carried out above the water table. Excavation works associated with bridge foundations will also produce surplus soils although these will be relatively small volumes.

The potential impacts associated with Construction Phase of the proposed Scheme are:

- Surplus soil arising from earthworks;
- Potentially contaminated soils arising from earthworks during construction;
- Importation of fill;
- Loss of soil cover, soil erosion and compaction;
- Contamination of existing soils, geology and groundwater by construction activities; and
- Disruption to an existing well.

The proposed Scheme has the potential to impact the geological and hydrogeological environments through these activities, though mitigation measures are discussed in section 11.5 where impacts would be adverse. The potential impacts are discussed below in terms of quality, significance, duration and type.

#### 11.4.3.2 Potential Impacts

**Surplus Soil Arising from Earthworks**

Impacts on receptors relevant to soils and geology associated with excavation, handling and storage on-site of sub-surface material are considered in this section. Consideration of impacts related to the transport and the off-site re-use or disposal of excavated materials is included in Chapter 18 (Material Assets: Traffic & Transport) and Chapter 19 (Material Assets: Resource & Waste Management), respectively.

Excavation works are proposed at the site of the proposed Scheme in order to facilitate the required vertical alignment, subgrade preparation and foundation construction. This will have a direct and permanent impact on soils and geology. The subsoils to be excavated are generally urban soil comprising Made Ground and are of low commercial value.

The estimated volumes of surplus material to be excavated are outlined in Table 11-19 below.

**Table 11-19: Summary of Predicted Quantities of Excavated Materials**

| Excavated Materials | | Volume ($m^3$) | Tonnage |
|---|---|---|---|
| Total excavated soil material volume | | 30,000 | 54,000 |
| Excavated soil material to be re-used on site | | 13,000 | 23,400 |
| Total surplus excavated soil material | | 17,000 | 30,600 |
| Classification of surplus soil material as waste | Hazardous | 500 | 900 |
| | Non-Hazardous | 1000 | 1,800 |
| | Inert | 15,500 | 27,900 |

The proposed Scheme is to be constructed predominantly at grade, requiring limited overburden removal. Bare earth exposed during the course of excavation works may be subject to erosion and sediment transport if left exposed to the elements over a long period of time. Similarly excavated soil and rock material identified for re-use/disposal shall be stockpiled on site and will require temporary treatment and storage (bunding and silt traps) until re-use or disposal off-site.

### Potentially Contaminated Soils Arising from Earthworks

Construction activities have the potential to result in both adverse (e.g. propagating contamination in the sub-surface) and beneficial (e.g. removal of contaminated material from the site) effects on baseline land contamination conditions.

In accordance with best practice (IGI, 2013; EPA, 2022), a conceptual site model (CSM) has been developed for the proposed Scheme, which defines the relationships between: potential contamination sources; receptors that could be affected by contamination; and the exposure pathways (GDG, 2022). Two different source-pathway-receptor linkages are identified:

- Human health; and
  - Source: Historic municipal landfill and made ground, 2 No. localised instances of asbestos fibres, no elevated contamination levels;
  - Pathway: Direct contact, ingestion, inhalation of dust (asbestos); and
  - Receptor: Site-end user, construction worker.
- Aggressive ground.
  - Source: Aggressive ground conditions;
  - Pathway: Chemical attack; and
  - Receptor: Buried concrete associated with the proposed Scheme and other infrastructure.

Further details and risk assessment for the CSM are given in the GQRA (GDG, 2022) included in Volume 5 - Appendix A11.2.

Historic Waste encountered during construction, including that already identified at Tolka Valley Park, will be removed to a suitably licensed facility, as discussed in Chapter 19 (Material Assets: Resource & Waste Management).

Laboratory certificates for 69 samples of material not identified as historic waste were assessed, and a waste classification exercise undertaken using approved HazWasteOnline™ software. The outcome from this exercise confirmed material sampled was classified as non-hazardous and can be appropriately described under List of Waste Code, 17 05 04 (non-hazardous soil and stone).

Laboratory certificates for 14 samples obtained from the historic landfill site were assessed, and a waste classification exercise undertaken using approved HazWasteOnline™ software. The outcome from this exercise again indicated the material sampled can be classified as non-hazardous and can be appropriately described under List of Waste Code, 17 05 04 (non-hazardous soil and stone).

Using the available laboratory data, HazWasteOnline™ classification and comparison against relevant acceptance criteria for landfill and soil recovery facilities, Waste Categories have been applied to the material. Of the 51 samples assigned a Waste Category, 39 are designated Category A (unlined recovery sites), 10 are designated Category B1 (inert landfills), and 2 are designated Category C (non-hazardous landfills).

Two samples, obtained from exploratory holes, LF-CPRC-1031 and LF-TP-2007, reported a Waste Acceptance Criteria (WAC) corresponding to *Inert Landfill (Increased Limits)*, and one sample from LF-CPRC-2005 reported a WAC corresponding to *Hazardous*.

Chrysotile was identified as fibre bundles within two samples recovered from two separate exploratory hole locations, specifically LF-CPRC-2010 and LF-TP-3001, both at 0.5m bgl. Quantification of the asbestos has shown that the amount of asbestos accounts for <0.1% in both samples.

Potential asbestos containing material (ACM) was observed (not sampled) by the drillers in an exploratory hole located towards the northern extent of the study area (LF-CPRC-2011 at 1.2m bgl). This potential ACM is considered to be sufficiently deep that there is negligible risk to site users. Identified instances of ACM are considered to pose a very low risk to the end user on the basis that asbestos in the materials is not pervasive, and exposure to this material is extremely unlikely.

### Importation of Fill

While there is anticipated to be a net surplus of site-won material, approximately 12,000m$^3$ of structural fill (Class 6) will require importation onto site to achieve the required engineering performance for track and structural elements. It is anticipated that, where possible, existing concrete structures scheduled for demolition as part of the project scope, will be crushed and processed for re-use as structural fill. Any shortfall in fill material will be made up of imported manufactured, or recycled, aggregate products.

### Loss of Soil Cover, Soil Erosion, and Compaction

The removal of topsoil and overburden material, and the treatment of those materials, shall require their temporary storage, handling and re-use within the construction of the proposed Scheme. Stored and stockpiled materials will be subject to erosion if left exposed over a long period of time.

During construction, vehicles and plant will track over areas of topsoil and subsoil. The vehicle and plant movements have the potential to erode soil cover and/or compact the underlying subsoil (following topsoil removal).

### Contamination of Existing Soils, Geology and Groundwater by Construction Activities

Soils: The following construction activities have the potential to impact on soil and groundwater quality.

- Exposure of historic waste deposits during earthworks may result in mobilising potential contaminated material through leaching or surface run-off; and
- Localised accidental spillages of fuel or chemicals on the site have the potential to contaminate the underlying soils. These localised accidental spillages may result in the requirement to excavate/remediate a small proportion of contamination or result in a minimal risk of pollution to soils.

Groundwater: Deep excavation in the form of piling for bridge structures has the potential to impact on groundwater quality. Piling methodologies vary; some result in removal of sub-surface material and/or the creation of new contaminant migration pathways. There is, however, limited exposure to potential contamination at the proposed bridge locations, and construction phase risks to groundwater are primarily associated with unplanned activities.

The unplanned activities which may impact the groundwater quality on site during the construction phase include:

- Accidental spillages of polluting materials on site, with a pathway to the groundwater;
- Release of fines into the groundwater; and
- Contaminated run-off entering the groundwater.

If the above were to occur during construction, contamination of groundwater underlying the site and at receptors such as wells would occur. The River Tolka, Royal Canal, Finglaswood Stream, and Bachelors Stream are all located within the study area. These water features would be vulnerable to potential groundwater contamination from the above unplanned activities. The lack of connection between the limited fissures results in relatively poor aquifer storage and flow paths that may only extend a few hundred metres (GSI, 2023). Therefore, if contamination of the groundwater were to occur, adverse impacts via the groundwater pathway are not anticipated during the Construction and Operational Phases of the proposed Scheme given the distance to the Natura 2000 sites within the ZoI as identified in the AA screening report (JBA, 2023) .

Excavation associated with the construction of the proposed Scheme will increase the vulnerability of the underlying aquifer by altering the thickness of the overlying soil profile, causing changes in the pathway in the source-pathway-receptor model. However, as the vertical alignment of the proposed Scheme is predominantly at-grade, most excavations will be both spatially and temporally limited. As it is not proposed to discharge any hazards to ground, the only potential contamination hazard is associated with accidental spills and poor site management. Surface water pollution relating to surface water run-off is addressed in Chapter 10 (Water).

#### Disruption to an Existing Well

A well has been identified as being potentially within the proposed Scheme boundary (2923SEW003). This well was reportedly drilled in 1899 for ‘agricultural and domestic use’. Considering the urban setting and readily available main water supply, this well is likely no longer in use. The location of this well is reported with a low level of confidence (+/- 250m). Despite the mapping showing the well as being potentially within the proposed Scheme boundary, no evidence of a well was observed during the site walkover. Further review of historical information suggests the well is most likely associated with Farnham House, which would position the well beyond the proposed Scheme boundary.

The probability of encountering unknown groundwater supply wells in an urban setting is low, and the available data considered in this chapter and set out above is sufficient to assess the potential impacts of the proposed Scheme on wells.

### 11.4.3.3 Assessment of Potential Impacts on Receptors

#### Surplus Soil Arising from Earthworks

The proposed Scheme will involve shallow excavation to achieve the required design levels for track construction. These excavation works will result in the production of excess material that requires placement elsewhere within the proposed Scheme, or removal off-site.

As the anticipated surplus material is characterised as being of low commercial value, generally comprising construction and demolition waste, low fertility topsoil and made ground, the importance and magnitude of this impact is considered low and negligible, respectively.

The impact associated with removal of this surplus material is assessed to be of neutral quality, imperceptible significance, and permanent duration.

#### Contaminated Soils Arising from Earthworks during Construction

Excavation and transport of potentially contaminated soil may pose a risk to the surrounding environment, or underlying soil, if not managed in a controlled manner. While environmental screening tests undertaken to date indicate the in-situ materials to be non-hazardous, there remains a residual risk that excavation works may result in exposure of undetected buried hazardous material. The highest likelihood of encountering potential sources of contamination is within Tolka Valley Park as the site of a former landfill.

As the existing soil is urban and the proposed excavation volumes are relatively small, the importance and magnitude of this impact is considered medium and small adverse, respectively.

Excavation and appropriate disposal of potentially contaminated material to a suitably licensed facility can also be considered a positive impact by removing a potential source of contamination.

The impact associated with excavation of contaminated soils is assessed to be of neutral quality, slight significance, and permanent duration.

### Importation of Fill

Fill material will require importation onto site to achieve the proposed design levels. This will produce additional truck movements, potentially increasing the risk of damage to soils (sealing) and vegetation. This impact is assessed to be of neutral quality, imperceptible significance and have a short-term duration.

### Loss of Soil Cover, Soil Erosion, and Compaction

During construction, vehicles and plant will track over areas of topsoil and subsoil. The vehicle and plant movements have the potential to erode soil cover and compact the subsoil (following topsoil removal).

As the existing soil is urban and the proposed excavation areas are relatively small, the importance and magnitude of this impact is considered is low and small adverse, respectively.

This impact is assessed to be of negative quality, imperceptible significance and have a short-term duration.

### Contamination of Existing Soils, Geology and Groundwater by Construction Activities

Soils: There is the potential for materials on site to be spilled, resulting in the pollution of the underlying ground. 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. The importance and magnitude of this impact is considered low and small adverse, respectively.

This impact is assessed to be of negative quality, slight significance and have a permanent duration.

Groundwater: Changes to groundwater vulnerability due to excavation during the Construction Phase are expected to be slight negative impacts of temporary duration and of slight significance (NRA, 2009).

The importance of the locally important (LI) and poor (P) aquifers is medium and low, respectively. In the event that pollutants do enter the underlying aquifer the impact will be slight, negative impacts of temporary duration and slight significance.

The potential occurrence of run-off from areas of construction works infiltrating downwards would be a slight negative impact of temporary duration.

### Disruption to an Existing Well

In general, significant excavations have the potential to negatively impact the yield of wells in the vicinity of the excavation. However, as the proposed Scheme is to be constructed predominantly at, or close to, existing grade, the yield of any wells in the vicinity of the Scheme will not be impacted, and disruption to wells is restricted to those directly underlying the proposed Scheme. Though there is incomplete data regarding source use, yield class and yield of several wells within the study area, as shown in Table 11-14, due to the shallow nature of proposed excavations these wells will not be impacted, and will not be considered further in this assessment.

In the event an existing well (Ref: 2923SEW003) is found underlying the scheme, abandonment of the well would be a slight negative impact of permanent duration with a slight / moderate significance.

**Summary**

A summary of the impact assessment (NRA, 2009) is provided in Table 11-20. Importance of attribute is as defined in Table 11-4 and Table 11-5, magnitude of impact is as defined in Table 11-6 and Table 11-7, and significance is as defined in Table 11-8.

**Table 11-20: Summary of Construction Phase Impact Assessment (NRA, 2009)**

| Impact | | Importance of Attribute | Magnitude of Impact | Significance |
|---|---|---|---|---|
| Surplus soil arising from shallow earthworks | | Low | Negligible | Imperceptible |
| Contaminated soils arising from earthworks | | Medium | Small adverse | Slight |
| Importation of fill | | Low | Negligible | Imperceptible |
| Loss of soil cover, soil erosion and compaction | | Low | Negligible | Imperceptible |
| Contamination of existing soils, geology and groundwater by construction activities | Soils | Low | Negligible | Imperceptible |
| | Groundwater | Medium (LI Aquifer) | Small adverse | Slight |
| | | Low (P Aquifer) | Small adverse | Imperceptible |
| Disruption to an existing well | | Low | Large adverse | Slight / Moderate |

## 11.4.4 Operational Phase

### 11.4.4.1 Potential Impacts

No potential direct impacts associated with the Operational Phase have been identified. Indirect impacts may include accidental leaks or discharges at the (proposed extension of the) Luas Broombridge Hamilton depot, car parking areas and maintenance compounds, which could result in potential contamination of soils and groundwater. As the Luas is an electrified transport system, the operational contamination risks are significantly lower compared to transport vehicles powered by internal combustion engines and hydrocarbon fuels.

**Climate Change**

According to the IPCC (Intergovernmental Panel on Climate Change), temperature increase has caused a global sea level rise, and it is very likely that sea levels will continue to rise throughout the 21st century (IPCC, 2021). It is reported that the sea level around Ireland has risen by approximately 2-3mm/year since the early 1990s. Analysis of sea level data from Dublin Bay suggests a rise of approximately 1.7mm/year since 1938, which is consistent with global average rates (EPA, 2021).

Increased sea levels will increase the risk of coastal flooding and higher water levels upstream in river estuaries. Implications for hydrogeology include a reduction in the thickness of the unsaturated ground as the sea level and water table rises. The result will be a shortening of pathways to groundwater aquifers and an increased risk of potential contaminant mobilisation. While acknowledging the above scenario, this does not alter our current assessment of the proposed Scheme's impact on hydrogeology.

Refer to Chapter 14 (Climate) for further discussion on climate and the proposed Scheme.

### 11.4.4.2 Assessment of Potential Impacts on Receptors

**Soil & Groundwater Pollution**

While the likelihood of an accidental spillage may increase in comparison to the Do-Nothing Scenario, the drainage system will capture surface water, including accidental spillages, which will pass through a pollutant interceptor prior to outfall. The receiving environment is a low permeability cohesive soil which will retard the movement of contaminants into the underlying aquifer, therefore, the magnitude of the impact is negligible. The significance of the impact will be imperceptible on land, soils, geology and hydrogeology.

### Summary

A summary of the impact assessment (NRA, 2009) is provided in Table 11-21, with further detail provided below.

**Table 11-21: Summary of Operation Phase Impact Assessment (NRA, 2009)**

| Impact | Importance of Attribute | Magnitude of Impact | Significance |
|---|---|---|---|
| Soil Pollution | Low | Negligible | Imperceptible |
| Pollution of Groundwater Supplies | Medium (LI aquifer) | Negligible | Imperceptible |
| | Low (P aquifer) | Negligible | Imperceptible |

## 11.5 Mitigation and Monitoring Measures

### 11.5.1 Introduction

Undertaking appropriate mitigation and monitoring measures will minimise the potential impacts discussed in section 11.4. The recommended mitigation measures are based on the currently available information. The results of the ground investigation are sufficient to assess the nature of in-situ materials and the overall earthworks balance for the proposed Scheme. In order to avail of potential opportunities to improve the design through contractor engagement or advancements in technology, minor modifications may be made to the earthworks balance at the detailed design stage. However, any such minor modifications will be such that they will not give rise to any impacts that are more significant than those already identified and assessed in this EIAR.

The mitigation measures below are summarised in Chapter 25 (Summary of Mitigation Measures, Monitoring and Residual Impacts).

### 11.5.2 Construction Phase

#### 11.5.2.1 Surplus Soil Arising from Earthworks

The measures identified below are proposed to mitigate the potential impact of the proposed Scheme.

- The Construction Environmental Management Plan (CEMP) will detail procedures to manage the excavation and removal of soil during construction works;
- Where unidentified contamination (such as potential asbestos containing material or free phase hydrocarbon product) is encountered, material shall be segregated and stockpiled on a low permeability surface with bunding and shall be covered to allow further testing of the impacted soils to enable specification of treatment and re-use, or disposal;
- Notwithstanding the results of geoenvironmental testing and associated assessment included in the GQRA (Volume 5 - Appendix A11.2), it remains the responsibility of the Contractor to ensure that material is appropriately managed during the development. In particular, the Contractor will be responsible for the appropriate segregation of excavated materials. The Contractor will retain a competent person to manage and supervise soil excavation and removal from the site. This person will ensure correct procedures are followed and that waste soils are appropriately logged and tracked using appropriate docketing system;

- The appointed Contractor for future groundworks will retain the services of an experienced environmental engineer or scientist during bulk excavation works, primarily to identify any previously unidentified contamination; and
- In recognition of national policy and sustainability, where material cannot be re-used as part of the on-site development works and requires transfer off site, consideration will be given to the transfer of this material as a by-product under Article 27 of the European Communities (Waste Directive) Regulations 2011.

Representative samples of in-situ materials have undergone testing to assess their suitability for re-use. These materials are largely considered suitable for re-use, though in some instances may require mechanical screening e.g. to remove oversize or isolated anthropogenic material.

Material that is not suitable for re-use, will be removed off site for treatment, recycling or disposal at an authorised waste management facility. The Construction and Demolition Resource and Waste Management Plan (CDRWMP) included in the Construction Environmental Management Plan (CEMP) will address the analysis of waste arisings, methods proposed for the prevention, re-use and recycling of wastes, and material handling procedures. Refer to Chapter 19 (Material Assets: Resource and Waste Management).

#### 11.5.2.2 Potentially Contaminated Soils Arising from Earthworks during Construction

The appointed Contractor will be responsible for the compliant management of all waste generated by construction activities and will be responsible for updating and implementing the CEMP, where modifications to the prepared CEMP will not give rise to any impacts more significant than those already identified and assessed in this EIAR or the NIS. The updated CEMP will identify construction methodologies for the proposed Scheme and standard operating procedures that will be implemented to minimise the impact. The appointed contractor(s) will implement in full all measures set out in the CEMP.

The Contractor will be responsible for regular testing of excavated soils to monitor the suitability of the soil for re-use. Samples of ground suspected of contamination will be tested for contamination by the Contractor and ground excavated from these areas will be disposed of to a suitably licensed or permitted sites in accordance with the current Irish waste management legislation.

While the risk of asbestos containing materials is exceptionally low, construction workers will be briefed on the possible presence of localised asbestos. Dermal contact with soils (particularly Made Ground) will be avoided wherever possible and appropriate training and Personal Protective Equipment (PPE) and Respiratory Protective Equipment (RPE) will be provided to mitigate the risk of inhalation of asbestos.

#### 11.5.2.3 Importation of Fill

In order to minimise the impacts of importation of construction materials, where possible, a proportion of site-won materials generated during the works will be re-used within the proposed Scheme. Where importation of fill is necessary, imported materials will be sourced from reputable quarries as listed on the registers maintained by Fingal County Council, Dún Laoghaire Rathdown County Council, and South Dublin County Council (EPA, n.d.). Volume 4 – Map Figure 11-4 of this EIAR identifies the location of active and historic quarries in the region that may be used to source suitable structural fill materials.

#### 11.5.2.4 Loss of Soil Cover, Soil Erosion, and Compaction

Subsoil removal is an unavoidable consequence of the construction works. The earthworks balance (refer to Table 11-19) has been designed to minimise residual surplus soil.

Topsoil stripping and earthworks removal will not be carried out over large areas in advance, which will limit soil erosion by limiting the time during which these areas are exposed. Control measures will involve the immediate use of topsoil wherever practicable after its stripping.

The principal avoidance measures regarding compaction of topsoil include the following: topsoil and overburden shall not be unnecessarily trafficked either before stripping or when in a stockpile. When the construction cut level has been achieved, the underlying overburden shall not be left exposed for extended periods of time before construction and refilling of the excavations.

#### 11.5.2.5 Contamination of Existing Soils, Geology and Groundwater by Construction Activities

Soils: Excavation in areas of historic waste will be carried out as per requirements specified in the CEMP to minimise exposure to surface run-off and to have the appropriate temporary surface drainage in place to minimise the risk of uncontrolled discharge.

In the event of accidental soil pollution, excavation / remediation of a small proportion of contamination may be required. Mitigation measures proposed for soil pollution are consistent with the design mitigation measures outlined below for the protection of groundwater, as potential contaminants could travel through soil before entering the groundwater system. As such, measures to protect the groundwater from contamination will also protect the soils.

Groundwater: Topsoil stripping and earthworks removal will not be carried out over large areas in advance, which will limit the time for which groundwater vulnerability in these areas is increased during construction.

During piling activities, an appropriate piling method will be selected that will reduce the risk of cross-contamination from made ground into the underlying groundwater.

Construction activities will be undertaken in compliance with guidance set out in CIRIA’s *Control of water pollution from linear construction projects* (CIRIA, 2006). All potentially harmful substances (e.g. oils, diesel, herbicides, pesticides, concrete etc.) will be stored in accordance with the manufacturer’s guidelines regarding safe and secure buildings/compounds and hardstanding areas. Adequate means to absorb or contain any spillages of these chemicals shall be made available at all times.

#### 11.5.2.6 Disruption to an Existing Well

The mitigation measures outlined above to protect the groundwater quality will also benefit any existing wells in the area. Groundwater monitoring was carried out to establish baseline conditions for water quality (hydrochemical impact).

In the unlikely event the identified well (Ref: 2923SEW003) is intercepted by the proposed Scheme, it will be duly recorded by an experienced Hydrogeologist and tested to confirm existing yield rates in advance of being decommissioned. If required, either a replacement supply well will be sited accordingly, designed, drilled, installed, and tested prior to follow-on commissioning or the supply will be replaced by a connection to public supply, subject to local constraints.

### 11.5.3 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 TII, or 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.

## 11.6 Residual Impacts

An overall analysis of the impacts, in light of the proposed mitigation measures, concludes that all of the potential impacts (both during Construction and Operational Phases) are predicted to be reduced to neutral quality and negligible magnitude. As such, the significance of the impact on the identified attributes is imperceptible. There are no likely significant residual impacts on the land, soils, and hydrogeological environments as a result of the proposed Scheme, from either the Construction or Operational Phase.

## 11.7 Cumulative Impacts

The cumulative assessment of relevant plans and projects has been undertaken separately in Chapter 24 (Cumulative Impacts) of this EIAR.

## 11.8 Difficulties Encountered in Compiling Information

No significant difficulties were encountered in undertaking this assessment. As an urban site, ground investigation access was restricted in some areas due to existing structures or utilities. While some residual uncertainty remains regarding ground conditions at these locations (and will only be resolved upon removal or relocation of these structures or utilities), the investigations conducted are considered to be sufficient to assess the likely significant impacts of the proposed Scheme on lands, soils, and hydrogeology.

## 11.9 References

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