# 11 Soils, Geology and Hydrogeology

## 11.1 Introduction

This chapter describes and assesses the potential impacts of the proposed Douglas Flood Relief Scheme (including Togher culvert), hereto referred to as the proposed scheme, on soils, geology and hydrogeology. The receiving environment and the characteristics of the proposed scheme during construction and operation are described. The potential impacts of the proposed scheme during the construction and operation phases are evaluated, and mitigation measures described. The chapter concludes with the predicted residual impacts of the proposed scheme.

## 11.2 Methodology

This chapter has been compiled on the basis of a desktop assessment and site investigation (SI). The desktop assessment consisted of information on bedrock geology, soils, landslide risk, economic geology, geological heritage and local potential for contamination sourced from national databases. The SI was designed by the project team and carried out by an appointed SI contractor. A summary of the findings of that SI in relation to the soils, geology and hydrogeology of the proposed scheme works area is also included.

This section of the EIS was prepared in accordance with the following guidance documents:

- Geological in Environmental Impact Statements – A Guide (Geological Survey of Ireland, 2002)
- Guidelines on the information to be contained in EIS (EPA, 2002);
- Advice Notes on Current Practice in the Preparation of EIS (EPA, 2003);
- Revised Guidelines on the Information to be contained in Environmental Impact Statements Draft September 2015 (EPA, 2015);
- Advice Notes for Preparing Environmental Impact Statements Draft September 2015 (EPA, 2015).

Other reference documents used in the preparation of this section include the following:

- Transport Infrastructure Ireland (formerly NRA) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Good practice guidelines on the control of water pollution from construction sites developed by the Construction Industry Research and Information Association (CIRIA);
- Cork County Development Plan 2014-2022 (Cork County Council, 2014)

The following sources were consulted in compiling this section of the EIS:

- Geological Survey of Ireland (www.gsi.ie)
- Aerial photography (Google Earth)
- Envision, EPA online mapping (www.gis.envision.ie)
- Catchments, EPA online database (www.catchments.ie)

This chapter refers to the proposed scheme 'works areas' as the areas of Togher and Douglas where flood relief works are proposed and includes the construction footprint of these works. In general, a construction zone of 10m around the proposed flood relief works may be required to facilitate the construction however this area may be reduced in restricted areas. Refer to **Chapter 3 Description of the Proposed Development** for details of the proposed development.

## 11.3 Receiving Environment

### 11.3.11 Soils and Geology

#### 11.3.11.1 Bedrock Geology

The bedrock geology of South Cork is dominated by Old Red Sandstone rocks laid down during the late Devonian and Carboniferous Periods. For the purposes of mapping and description, related beds of rock are commonly grouped into formations which can be further sub-divided into members. Geological members can represent distinctive features or local variations.

The bedrock geology underlying the proposed scheme works includes the following and is shown on **Figure 11.1**.:

- Ballytrasna Formation (BS) – purple mudstones and sandstones
- Gyleen Formation (GY) – sandstones with mudstones and siltstones
- Old Head Sandstone Formation (OH) – flaser-bedded sandstone and minor mudstone
- Cuskinny Member (KNcu) - flasser-bedded sandstone and mudstone

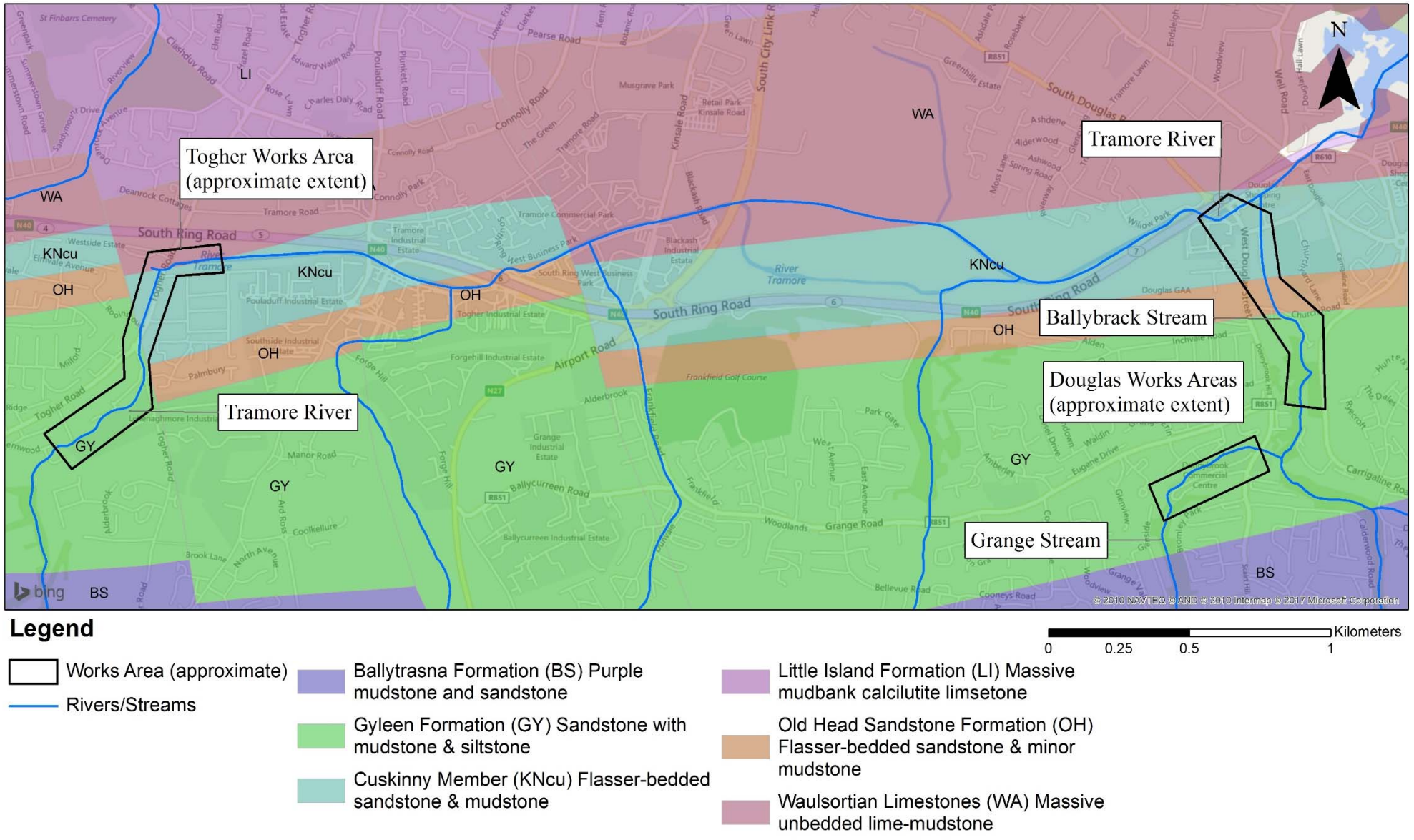


**Figure 11.1: Bedrock geology of the proposed scheme works areas (Geological Survey of Ireland).**

### 11.3.11.2 Site Investigation

Two site investigations to inform the detailed design of the proposed scheme have been carried out. A total of 13 no. slit trenches, 4 no. in Douglas and 9 no. in Togher, were excavated in May 2015 to identify existing utility locations in the vicinity of the proposed flood defence works. A detailed site investigation was completed in June 2016, consisting of the following elements:

- 3 No. Rotary Boreholes
- 16 No. Trial Pits
- 16 No. Inspection Pits to 1.2m below ground level
- 1 No. Slit Trench
- 1 No. Groundwater Monitoring Installation
- 2 No. Wall Cores
- 1 No. Reinforcement Scanning
- In-situ testing including variable head permeability and SPT testing
- Environmental testing
- Soil and rock geotechnical laboratory testing

A topographical survey, including utility identification was undertaken in August 2016.

The trial pits were excavated to depths of between 1.9m below ground level (bgl) and 4.2m bgl by PGL (in 2016). Slit trenches (2 No.) were excavated to depths of between 1.4m and 2.4m bgl. The 3 No. rotary boreholes were drilled to depths of 10.0m bgl and 10.2m bgl.

The site investigations largely reflect the desktop bedrock geology from the GSI database. The rotary cores showed sandstone bedrock at two sites in Douglas at depths 3.5m bgl and 8.5m bgl respectively.

### 11.3.11.3 Soils

During the last Ice Age of the Quaternary Period much of the surface deposits of Ireland were deposited. Rocks picked up by flowing ice were abraded and concurrently grounded by the underlying rock. Rocks deposited directly from the base or margins of the glacier ice were deposited as till. Rocks partly ground down and deposited by glacier melt water were sorted and deposited as gravel, sand, silt or clay.

In south Cork, the Quaternary deposits (subsoils) are dominated by glacial tills derived from sandstones of the Devonian period. Areas where the topsoil is present generally have acid brown earth soils (Teagasc Soil Database, GSI).

Most of the subsoils and topsoils around Cork city and suburbs have been removed or disturbed for development, these areas are dominated by made ground.

The site investigations largely reflect the desktop subsoil information from the GSI database. The typical stratigraphic profile for the sites in Douglas were brown gravelly silt TOPSOIL or made ground over sandy gravelly SILT or silty sandy GRAVEL. The SI at Togher showed some sandy gravelly CLAY at some locations at depths of 1.5- 2.5m bgl beneath sandy gravelly SILT.

**Table 11.1 Summary of overburden from the site investigation in Douglas.**

| Stratum | Depth to top of stratum (m) | Thickness of Stratum (m) |
|---|---|---|
| Brown gravelly silt TOPSOIL | Ground level | 0.2 – 0.7 |
| MADE GROUND | Ground level | 0.7 – 0.96 |
| Brown sandy/gravelly SILT | Ground level – 0.4 | 0.2 – 2.0 |
| Silty sandy GRAVEL | 0.2 – 1.2 | 0.7 – 2.8 |
| Silty gravelly SAND | 2.5 | 1.0 |

**Table 11.2 Summary of overburden from the site investigation in Togher.**

| Stratum | Depth to top of stratum (m) | Thickness of Stratum (m) |
|---|---|---|
| Brown gravelly silt TOPSOIL | Ground level | 0.2 – 1.1 |
| MADE GROUND | Ground level | 0.45 – 1.5 |
| Sandy gravelly SILT | 1.1 – 1.8 | 0.7 – 1.0 |
| Silty sandy GRAVEL | 0.2 – 1.2 | 0.4 – 2.6 |
| Sandy gravelly CLAY | 1.5 – 2.1 | 0.7 – 1.8 |

### 11.3.11.4 Landslide Risk

The GSI online National Landslide Database for Ireland indicates that there are no recorded landslides in the area.

### 11.3.11.5 Economic Geology

The term ‘economic geology’ refers to the commercial use of soils and bedrock. The principal commercial activities include extractive processes, such as sand/gravel pits, and mining. The GSI maintains a Directory of Active Quarries and Pits in Ireland. The Directory indicates that there are no active quarries or pits within 2km of the areas designated under the proposed scheme. The nearest active quarry is Ballygarvan Sandstone Quarry, approximately 5km south of Douglas Community Park (GSI, 2014).

GSI also has a database of historical pits and quarries nationally that dates back to sites recorded on six-inch mapping, 1833-1946. There are no recorded historical pits or quarries within the proposed scheme works area. The nearest historical pit or quarry to Togher is a former quarry in Deanrock Avenue, Togher (OSI/GSI Six-inch mapping, 1833-1946: Quarries).

It is approximately 480m north of the Lehenaghmore Industrial Estate in Togher (OSI/GSI Six-inch mapping, 1833-1946: Quarries).

In Douglas, the nearest historical pit or quarry is a small pit recorded in Park Hill, south of the Skehard Road (R582) in Ballinlough. The former pit is approximately 1.5km north east of Douglas Community Park.

The GSI database has a list of active quarries around the country in 2014. There are two crushed rock quarries in Ballygarvan for sandstone/shale and limestone respectively, approximately 5.5km south of Douglas village. Both quarries are operated by Roadstone Ltd.

### 11.3.11.6 Geological Heritage

Areas of Geological Interest in Cork County are listed in Chapter 3 (Section 3.9) of the *Cork County Development Plan 2014-2021*. The GSI online Spatial Resource was also reviewed. Blackrock diamond quarry is listed as a County Geological Site in both resources. It is located approximately 2km north of Douglas village in Blackrock.

### 11.3.11.7 Local Potential for Contaminated Land

The EPA and National Waste Collection Permit Office (NWCPO) databases were searched for potentially contaminating industrial and waste facilities respectively within 2km of the proposed Scheme works areas.

**Industrial Emissions (IE) and Integrated Pollution Prevention Control (IPPC) Licence**

The EPA website was checked for both existing and historically licensed industrial sites which may hold an Industrial Emissions Licence (IE) or an Integrated Pollution Prevention Control (IPPC) within 2km of the proposed Scheme works area, refer to **Table 11.1**.

There are four EPA licensed industrial facilities within 2 km of the proposed works in Togher and Douglas. None of these facilities are located within the proposed works areas. The facilities are listed below in **Table 11.1** and shown in **Figure 11.2**.

**Table 11.2 Industrial facilities which hold an EPA Industrial Emissions or Integrated Pollution Control licence within 2km of the proposed Scheme.**

| Industrial Facility Name | Licence Registration No. | Licence Type | Licence Status |
|---|---|---|---|
| Brooks Haughton Limited | P0343-01 | IPPC | Licensed |
| Galco (Cork) Limited | P0391-01 | IE | Licensed |
| Irish Pioneer Works (Fabricators) Limited | P0407-01 | IE | Licensed |
| Fronville Limited | P0059-02 | IPPC | Licensed |

**Waste Licensing**

Facilities in Ireland carrying out waste disposal and/or recovery activities are required to obtain authorisation in accordance with the Waste Management Act 1996, as amended. Depending on the type of waste activities carried out at the facility may:

- Be exempt with no authorisation required,
- Require a Waste licence (under Part V of the Waste Management Act 1996, as amended);
- Require a Waste Facility Permit (under Waste Management (Facility Permit and Registration) Regulations, SI 821 of 2007, as amended); or
- Require a Certificate of Registration (under Waste Management (Facility Permit and Registration) Regulations SI 821 of 2007, as amended).

The EPA are the competent authority for issuing and enforcing all waste activities listed in the Third and Fourth Schedule to the Waste Management Act 1996, as amended. The EPA issue Certificates of Registration (COR) to local authorities for waste activities listed in the Third Schedule Part II of the Waste Management (Facility Permit and Registration) Regulations, SI 821 of 2007, as amended).

Local authorities are the competent authorities to grant and enforce Waste Facility Permits (WFP) and CORs to private operators for those activities listed in the Third Schedule to the Waste Management (Facility Permit and Registration) Regulations SI 821 of 2007, as amended).

The EPA website was checked for sites holding an EPA Waste Licence within 2km of the proposed scheme works. The National Waste Collection Permit Office (NWCPO) website is a database for all WFPs and CORs within 2km of the proposed scheme works. Refer to **Table 11.2**.

**Table 11.3: Facilities that hold a Waste Licence, Waste Facility Permit or Certificate of Registration within 2km of the proposed scheme works area (Source: EPA and NWCPO, 2016).**

| Waste facility name and address | Registration No. | Status |
|---|---|---|
| Starrus Eco Holdings Limited (Kinsale Road) | W0173-01 | Surrendered |
| Cork University Hospital | W0038-01 | Surrendered |
| Kinsale Road Landfill | W0012-03 | Licensed |
| David O'Leary, Unit 16, Togher Industrial Estate , Ballycurreen, Co Cork | WFP-CK-13-0134-01 | Granted |
| CND Recycling Ltd., South Ring West Business Park, Tramore Road | WFP-CC-08/2015 | Granted |
| Cork Hygiene Ltd., Sarsfield Road | WFP-CK-09-0015-02 | Granted |
| Instant Waste Disposal Ltd., Ballinvuskig, Grange, Douglas | WFP-CK-11-0095-01 | Granted |
| Ocon Chemicals Limited, Unit 5, South Cork Industrial Estate, Vicars Road, Cork City. | WFP-CC-02/2016 | Granted |
| Emerald Waste Company Ltd., Centra, Kinsale Road | COR-CC-04/2013 | Granted |
| Cork Recycling Company, Lehenaghmore, Togher | WFP-CK-14-0141-01 | Granted |
| Pouladuff Dismantlers Cork Ltd., Airport Road | WFP-CK-10-0070-03 | Granted |

There are no licensed landfills operating within the scheme. The closest landfill site to the Study Area is at Bottlehill, approximately 20km north of Douglas however activities at the site have not commenced according to the Plan (2015).

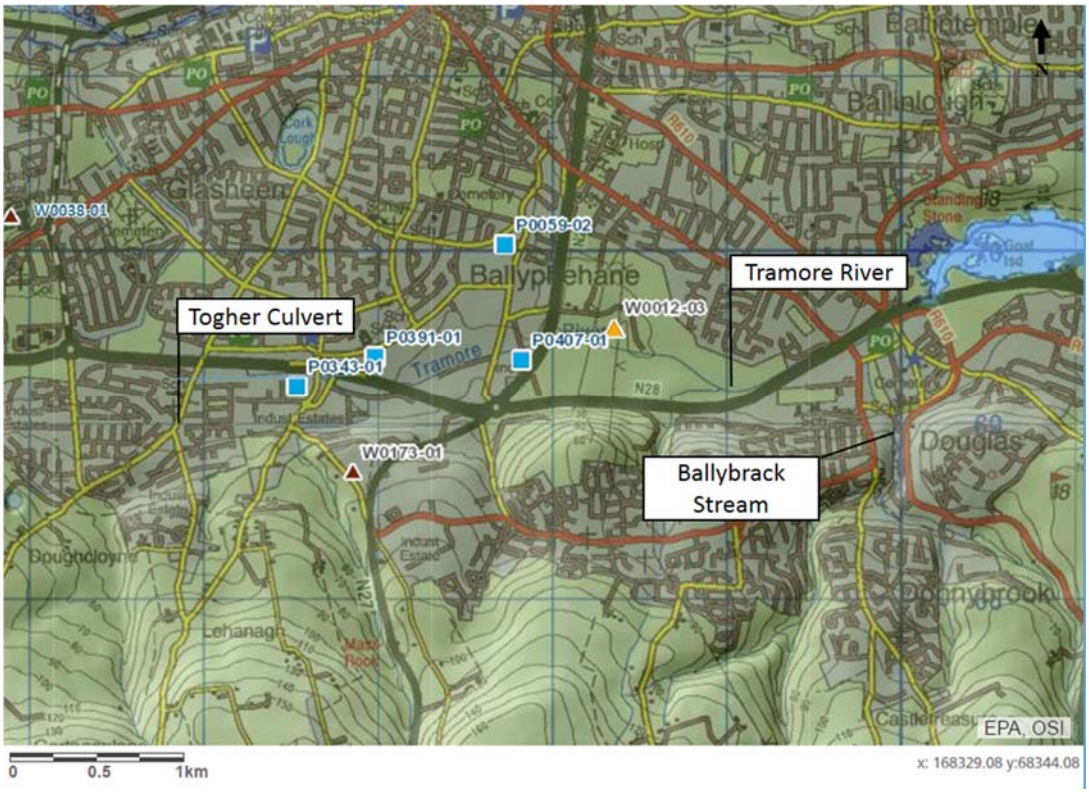


**Figure 11.2: Location of industrial sites currently and formerly licensed by the EPA (Source EPA).**

**Figure 11.2** shows the location of facilities holding an EPA IE licence (denoted P0XX-XX) and facilities that currently or have previously have held a EPA Waste Licence (denoted W0XX-XX) in relation to the location of the proposed works.

### 11.3.11.8 Invasive Species

It has been documented that the invasive plant species, Japanese knotweed is present at a number of locations in Togher and Douglas including within the proposed works areas. This species has an extensive root system that can be up to 3m below the surface and may extend up to 7m laterally from the main plant stem. As a result, root material of this plant is likely to be present within the soils. A survey will be required to be carried out prior to any works taking place. An *Outline Japanese Knotweed Management Strategy* is included in **Appendix 4.1** which outlines the management approach that will be taken to constructing phase of the flood scheme in order to prevent the spread of the plant.

## 11.3.12 Hydrogeology

The proposed works areas in Togher and Douglas are within the Ballinhassig East groundwater body (Code IE_SW_G_004), described as having poorly productive bedrock. Under the WFD, the EPA is required to monitor and assign a groundwater body status, with Ballinhassig East groundwater body being rated as ‘good’ for the period from 2010 to 2015.

### 11.3.12.1 Aquifer Classification

The European Water Framework Directive (WFD) (2000/60/EC) describes a body of groundwater as a '*distinctive volume of water within an aquifer or aquifers*'.

The term 'aquifer' refers to a '*subsurface layer or layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or abstraction of significant quantities of groundwater'*.

In order to develop aquifer classification in Ireland, the GSI developed a system of generalising bedrock formations and members into 27 rock unit groups (RUG) based on similar properties and age. This facilitated in part the development of basic aquifer boundaries and compartments. Togher and Douglas are within the RUG referred to as Devonian Old Red Sandstones (DORS).

The Geological Survey of Ireland (GSI) system for classifying the aquifers in Ireland is based on the hydrogeological characteristics, size and productivity of the groundwater resource. The three main classifications are:

Regionally Important Aquifers (R);

- Karstified bedrock (Rk)[1],
- Fissured bedrock (Rf),
- Extensive sand & gravel (Rg),

Locally Important (L) Aquifers;

- Bedrock which is Generally Moderately Productive (Lm),
- Bedrock which is Moderately Productive only in Local Zones (Ll),
- Locally important karstified bedrock (Lk),
- Sand & gravel (Lg),

Poor (P) Aquifers;

- Bedrock which is Generally Unproductive except for Local Zones (Pl),
- Bedrock which is Generally Unproductive (Pu).

The GSI aquifer classification classifies the aquifer underlying the proposed works areas (both Togher and Douglas) and surrounds as a "*Locally Important Aquifer (LI) – bedrock which is Moderately Productive in Local Zones"*.

[1] Note that, depending on the degree and nature of the karstification, regionally important karstified bedrock aquifers (Rk) may be further characterised as either Rkc – dominated by conduit flow or Rkd – dominated by diffuse flow.

### 11.3.12.2 Aquifer Properties

According to the GSI document, *Irish Aquifer Properties – A Reference Manual and Guide* (2015), locally important (Ll) (and poor) aquifers, with the exception of sands and gravels are:

- dominated by impure limestones, shales and sandstones, granites and other rock types;
- dominated by poor yielding boreholes (less than 40 $m^3$) with fewer and fewer productive boreholes (which tend to be unsustainable over long pumping periods/dry weather spells);
- a high drainage density with low base flow; and
- often many small springs and seepages present, that dry out in long periods.

In the case of the aquifer beneath Togher and Douglas the bedrock geology is in agreement with the rock type (sandstone) that was logged in the site investigation as well as shown in the GSI database.

**Groundwater Flow**

Permeability describes the ability of fluids to flow through an aquifer. Permeability increases with increasing porosity. For example sand and gravel aquifers have typically greater permeability than those composed of clayey material, refer to **Table 11.4**. Aquifers with greater permeability may be more vulnerable to contamination.

Permeability is quantified as transmissivity (T) [$m^2$/day], the rate by which water can pass through the full aquifer thickness. Kelly et al. (2015) on behalf of GSI and the EPA, created a summary transmissivity table for RUGs and corresponding aquifer classification.

The ('best' estimate) transmissivity rate for DORS is 5$m^2$/day for a Ll aquifer, which underlies Togher and Douglas. In comparison, the 'best' estimate for the general flow type Sand and Gravel Aquifers (Rg and Lg categories) have a greater transmissivity of approximately 350$m^2$/day (Kelly et al. 2015) due to much greater aquifer permeability.

**Aquifer Recharge Rates**

The GSI groundwater database provides information on the recharge rates of groundwater bodies around Ireland. The main hydrogeological controls on groundwater recharge include subsoil permeability, subsoil thickness, saturated soils and the ability of the underlying aquifer to accept percolating waters (Hunter Williams et al. 2011). The GSI groundwater database shows the groundwater for the proposed works areas at Togher and Douglas have an average groundwater recharge rate of 200mm per year.

### Water Table Level

The site investigation encountered groundwater in Douglas at depths of 1.4mbgl to 2.5mbgl during rotary coring and at depths of 1.4mbgl to 2.2mbgl for trial pits dug within the proposed works area. In Togher, groundwater was encountered at 2.1mbgl to 2.2mbgl in trial pits dug within the proposed works area.

## 11.3.12.3 Groundwater Vulnerability

The vulnerability of a groundwater body is the term used to describe the ease with which the groundwater in the area can be contaminated by human activities. The vulnerability is determined by many factors including the travel time, the quantity of contaminants and the capacity of the deposits overlying the bedrock to attenuate contaminants.

These factors in turn are based on the thickness and permeability of the subsoil deposits, e.g. groundwater in bedrock which has a thick cover of low permeability clay is less vulnerable than the groundwater in bedrock which is exposed at the surface. The criteria for determining groundwater vulnerability, as developed by the GSI, is shown in **Table 11.4** below.

The Extreme vulnerability class is further sub-divided into '*Extreme (E) – rock near Surface or Karst'* and '*Extreme (E) - subsoils <3m thick*'.

**Table 11.4: GSI Groundwater Vulnerability Mapping Guidelines (DoELG 1999)**

| Vulnerability Rating | Hydrogeological Conditions | | | | |
|---|---|---|---|---|---|
| | Subsoil Permeability (Type) & Thickness | | | Unsaturated Zone | Karst Features |
| | High Permeability (sand/gravel) | Moderate permeability (e.g. sandy subsoil) | Low permeability (e.g. clayey subsoil, clay, peat) | (sand/gravel aquifers only) | (<30m radius) |
| Extreme (E) | 0 – 3.0m | 0 – 3.0m | 0 – 3.0m | 0 – 3.0m | - |
| High (H) | >3.0m | 3.0 – 10.0m | 3.0 – 5.0m | >3.0m | N/A |
| Moderate (M) | N/A | >10.0m | 5.0 – 10.0m | N/A | N/A |
| Low (L) | N/A | N/A | >10.0m | N/A | N/A |

Notes: (1) N/A = not applicable
(2) Precise permeability values cannot be given at present
(3) Release point of contaminants is assumed to be 1-2m below ground surface

The GSI groundwater vulnerability maps show that the vulnerability rating varies across the proposed works areas. Refer to **Figure 11.3**.

In Togher the groundwater vulnerability rating ranges from 'Moderate' to 'Extreme'. The groundwater vulnerability in Douglas ranges from 'Moderate' to 'Extreme' including 'Rock at or near the surface or Karst'. The GSI bedrock maps do not indicate karst (e.g. limestone) in the proposed works area in Douglas nor did the site investigation report any karst geology. It is known from site visits that there are bedrock outcrops in the Ballybrack Woods, south of Ravensdale in Douglas.

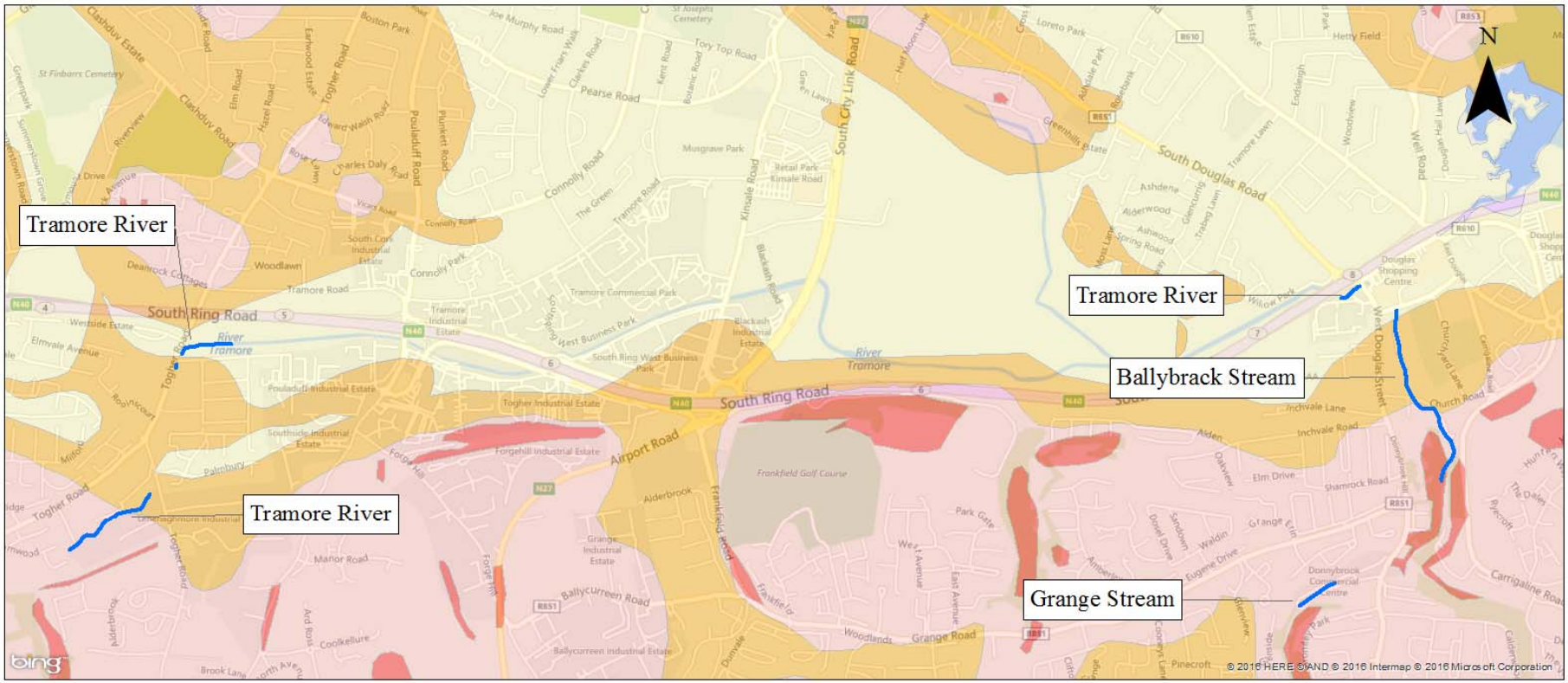


**Figure 11.3: Aquifer vulnerability for Togher (west) and Douglas (east) works areas. Source GSI.**

### 11.3.12.4 Wells and Springs

The GSI database shows that there is a potential for a number of groundwater wells to be within the proposed scheme works area. These wells are listed below for both Togher and Douglas. These locations are recorded as being accurate to within 1km or 2km. Refer to **Tables 11.4** and **11.5**.

In Douglas, one of the three wells potentially located within the study area are reported as poor yielding, refer to **Table 11.5**. A review of wells and springs located within the study area in Togher shows that the wells and boreholes are poor yielding, refer to **Table 11.6**.

**Table 11.5: Groundwater wells and springs potentially within the proposed Scheme works area in Douglas (GSI).**

| GSI Code | Well Type | Well Use | Location Accuracy (km) | Yield Class | Yield ($m^3$/day) | Well depth (m) |
|---|---|---|---|---|---|---|
| 1405NWW003 | Borehole | Unknown | 1.0 | Good | 140.0 | 47.9 |
| 1705NWW001 | Borehole | Unknown | 1.0 | Good | 130.9 | 45.7 |
| 1705NWW002 | Borehole | Unknown | 1.0 | Poor | 9.8 | 117.3 |

**Table 11.6: Groundwater wells and springs potentially within the proposed Scheme works area in Togher (GSI).**

| GSI Code | Well Type | Well Use | Location Accuracy (km) | Yield Class | Yield ($m^3$/day) | Well depth (m) |
|---|---|---|---|---|---|---|
| 1405NEW066 | Borehole | Unknown | 2.0 | Poor | 21.8 | 24.4 |
| 1405NEW060 | Borehole | Unknown | 2.0 | Poor | 28.0 | 25.0 |
| 1405NEW053 | Borehole | Unknown | 2.0 | Poor | 27.3 | 30.5 |

### 11.3.12.5 Groundwater Source Protection Areas

The GSI has identified certain areas nationwide as groundwater Source Protection Areas in order to provide protection for groundwater resources, particularly group water schemes and public water schemes. A groundwater Source Protection Area is delineated according to the hydrogeological characteristics of the aquifer, the pumping rate, and the recharge in the area. Activities that may impact on groundwater are tightly controlled within the Source Protection Area. The closest Source Protection Area is located approximately 12 km south of the proposed works areas in Minane Bridge.

### 11.3.12.6 Groundwater Dependent Terrestrial Ecosystems

The National Parks and Wildlife Service (NPWS) online database was consulted to establish whether any groundwater dependent terrestrial ecosystems are located within the vicinity of the scheme. No groundwater dependent terrestrial ecosystems in the vicinity of the scheme were identified from the database. Refer to ***Chapter 6 Biodiversity*** for the description of the impact of the proposed scheme on biodiversity and ecology.

## 11.4 Characteristics of the Proposed Scheme

### 11.4.11 General

The proposed scheme comprises of a combination of direct defences and conveyance improvements. Construction works which are of relevance for soils, geology and hydrogeology include the excavations required for flood defence walls and embankments, river channel deepening and widening and culvert construction.

A detailed description of the works and the locations are presented in **Chapter 3 Description of the Proposed Development**. A summary of the works in terms of the soils, geology and hydrogeology where relevant is described below in **Table 11.6**.

**Table 11.7: Summary of the proposed flood relief scheme works in relation to soils, geology and hydrogeology.**

| Area | Location | Proposed Works |
|---|---|---|
| 1 | Ballybrack Stream through Douglas | New flood defence walls and/or replacement of existing walls with new flood defence walls; new alternative access bridge for the ICA hall; removal of Church Road cycle track bridge and construction of new combined cycle/pedestrian track in this area; replacement of Lower Ravensdale vehicular bridge and new access road to residences on western bank; local channel widening and channel realignment of Ballybrack stream in Ravensdale; replacement of Church Road culvert; channel widening of Ballybrack Stream in Douglas Community Park; right bank in community park to be raised (small embankment); realignment of existing footpath in community park; installation of non-return valves on drainage outlets along the line of the flood defence works. |
| 2 | Tramore River through St Patrick's Mills | New flood defence wall on right bank of the Tramore River. |
| 3 | Grange Stream at Donnybrook Commercial Centre | Regrading the existing channel upstream of the existing trash screen; removal of the existing trash screen; new coarse screen to replace the existing; reinforcement of channel banks with reinforced rock armour/gabions; replacement of existing culvert with new 2.4m wide by 1.8m high reinforced concrete culvert. |
| 4 | Tramore River in Togher | Replacement and extension of existing culvert with new culvert between Lehenaghmore Industrial Estate and downstream of Greenwood Estate; replacement of existing trash screen with new trash screen at Lehenaghmore Industrial Estate; realignment of a section of river channel immediately upstream of the proposed new trash screen to facilitate tie-in with new culvert. |

### 11.4.12 Site Investigation

Refer to Section 11.3.11.2.

### 11.4.13 Site Preparation

Site preparation will include the removal of existing structures such as existing river bank walls, culverts, bridges, vegetation removal and road surface removal. Excavation of soil and river bank material will be required for foundations, regrading, river widening and deepening, and trash screen construction.

### 11.4.14 Channel Realignment

Channel realignment will require excavation and regrading of the existing channel. Excavated material will be reused on-site or in the wider flood relief works areas where possible, for example, in embankments. Where material must be disposed off-site it will be sent to a suitable facility depending on prior soil characterisation.

### 11.4.15 Excavation

It is envisaged that excavation works for flood defence walls and culverts will be required between 1.5m to 2.5m below ground level depending on local site conditions. Local dewatering may be required during the excavations.

Construction works in the vicinity of Japanese knotweed will require the implementation of an Invasive Species Management Plan in order to control the spread of Invasive Species during construction. Material containing Japanese knotweed will require a licence from the NPWS if it is to be transported off-site. Further details are provided in **Chapter 4 Construction Activities**. **Appendix 4.1** presents the outline management strategy that will be taken to manage invasive plant species during the construction and operation of the proposed scheme.

### 11.4.16 Construction Environmental Management Plan

As part of standard good construction practice a construction environmental management plan (CEMP) will be implemented during the construction phase of the proposed scheme by the contractor.

The CEMP will minimise the risk of pollution of soil, storm water run-off, adjacent watercourses and groundwater. The construction management of the site will take account of the recommendations of the CIRIA guidance *Control of Water Pollution from Construction Sites, guidance for consultants and contractors* (Masters-Williams et al 2001) to minimise as far as possible, the risk of soil, groundwater and surface water contamination. Refer to **Chapter 4 Construction Activities** for a detailed description the proposed construction of the scheme.

The construction compounds will be used to store all construction related materials including any chemical, fuel or oil stores. The construction compounds will also have contractor facilities including toilets. Wheel wash areas will also be present where vehicles enter and depart the construction site.

The management of all potential polluting materials on site will be managed in accordance with the construction environmental management plan (CEMP), as discussed in **Chapter 4 Construction Activities**.

## 11.5 Evaluation of Impacts

### 11.5.11 Construction Impacts

#### 11.5.11.1 Soils and Geology

During construction there will be significant quantities of soil including river bank material excavated for the proposed flood defence structures. It is proposed that as much of this excavated material as possible will be reused within the scheme for flood defence works such as the reinstatement and construction of new embankments and the re-grading of footpaths as described in **Section 11.4**. The residual material will need to be removed off-site to a suitable facility. **Table 11.8** presents the estimated volumes of material that will need to be excavated and imported from/to each works Area respectively.

**Table 11.8: Estimate volumes of material excavated and imported.**

| Works Areas | Estimate volume of excavated material | Estimated volume of imported material |
|---|---|---|
| Area 1: Douglas Community Park | 2,050m$^3$ | 800m$^3$ |
| Area 1: Ravensdale | 5,100m$^3$ | 3,225m$^3$ |
| Area 2: St Patrick's Mills | 60m$^3$ | 75m$^3$ |
| Area 3: Donnybrook Commercial Centre | 2,250m$^3$ | 65m$^3$ |
| Area 4: Togher | 9,000m$^3$ | 65m$^3$ |
| Total excavated volumes: | 18,460m$^3$ | 4,230m$^3$ |

During excavation there is also the potential for silt or mud to enter the river channel.

There is potential for soil contamination due to the potential spread of Japanese Knotweed during construction works.

#### 11.5.11.2 Hydrogeology

There is potential for the contamination of groundwater as a result of construction activities. There are numerous substances likely to be used during the construction phase that have the potential to contaminate groundwater including fuel and hydrocarbons, lubricants and cement.

The washing of construction vehicles also poses a risk of groundwater contamination. However the risks will be significantly reduced by the implementation of the CEMP. Further details are provided in **Chapter 4 Construction Activities**.

It is not envisaged that local water supplies will be impacted due to the construction works as the area is generally served by a local authority water supply rather than directly from groundwater wells.

Due to the shallow nature of the excavations, it is not envisaged that there will be significant impacts on groundwater flow pathways and indeed groundwater vulnerability in the area. Most of the proposed flood walls and culverts that could potentially impact groundwater flow, are replacing such existing structures. Therefore the construction of additional structures will be neither be significant nor extensive.

Any impact on groundwater levels due to the construction of the scheme will be limited to the possible dewatering of excavations.

There are no groundwater dependent terrestrial ecosystems in the vicinity of the works.

With the implementation of standard good construction practices (including the CEMP), it is envisaged there will be no significant impact on the local hydrogeology during the construction of the proposed scheme.

### 11.5.12 Operational Impacts

#### 11.5.12.1 Soils and Geology

Routine maintenance of the scheme area will be carried out as required and will typically include works such as clearing blockages and debris, clearing trash screens or treating invasive species. It is not envisaged that these works will significantly impact the soils, geology or hydrogeology in the vicinity of the proposed scheme.

#### 11.5.12.2 Hydrogeology

The construction of flood defence walls and embankments will result in higher water levels within the channel during flood events. This may result in a short term localised reversal in groundwater hydraulic gradients. However, the high water levels in the watercourse will occur over a limited time period and the impact on groundwater is considered to be low. There may also be localised impacts on groundwater levels in the immediate vicinity of the proposed flood defence walls and embankments. It is not envisaged that these flood event changes will significantly impact the local hydrogeology.

# 11.6 Mitigation Measures

## 11.6.11 Construction Mitigation Measures

As discussed in **Section 11.4.15**, standard good construction management practices will be employed as part of the construction phase of this scheme which include the implementation of a CEMP which will serve to minimise the risk of pollution of soils (and groundwater) during construction. These will be implemented by the contractor. These measures have been described in detail in **Section 4.6.2** in **Chapter 4 Construction Activities** and specific measures are outlined below:

- Designated fuel storage facilities, designed in accordance with guidelines produced by CIRIA, and will be fully bunded;
- All vehicles and plant will be regularly inspected for fuel, oil and hydraulic fluid leaks. Suitable equipment to deal with spills will be maintained on site;
- Where feasible, soil excavation will be completed during dry periods and undertaken with excavators and dump trucks. Topsoil and subsoil will not be mixed together;
- Ensure that all areas where liquids are stored or cleaning is carried out are in a designated impermeable area that is isolated from the surrounding area, e.g. by a roll-over bund, raised kerb, ramps or stepped access;
- Use collection systems to prevent any contaminated drainage entering groundwater, or draining onto the land;
- Wheel wash at site entrance to clean vehicles prior to exiting onto public road network;
- Minimise the use of cleaning chemicals;
- Use trigger-operated spray guns, with automatic water-supply cut-off;
- To minimise any impact on the underlying subsurface strata from material spillages all oils, solvents and paints used during construction will be stored within temporary bunded areas. The design (volume and construction) of all bunds will conform to standard bunding specifications.
- Spill kits / absorbent pads and boom should be used in the event of a spillage.
- Spill kits will be retained on site, in particular at refuelling areas and other high risk areas, to ensure that any spillages or leakages are dealt with immediately.
- All dispensing of fuels and hazardous materials will occur over areas of concrete hardstanding or other impermeable surface with drainage directed to an oil / water interceptor or a suitably constructed bund. No refuelling will be permitted in or near soil or rock cuttings.
- All associated waste residuals will also be stored within temporary bunded storage areas prior to removal by an appropriate waste disposal contractor for off-site treatment/recycling/disposal.

### 11.6.12 Operational Mitigation Measures

No mitigation measures will be required for soils, geology or hydrogeology during operation of the proposed Scheme.

## 11.7 Residual Impacts

A wide range of construction management measures have been specified for the construction and operational phase of the project. These measures seek to ensure that construction and operational discharges are controlled to prevent potential pollution impacts to all soils, subsurface material and groundwater bodies.

No negative residual impacts to the subsurface (soils and geology) or groundwater are anticipated with the implementation of the construction and operational measures described above and in **Chapter 4 Construction Activities**.

## 11.8 References

Construction Industry Research and Information Association (CIRIA) (2001) Good practice guidelines on the control of water pollution from construction sites

Cork County Council (2014) Cork County Development Plan 2014-2022

Environmental Protection Agency (2002) Guidelines on the information to be contained in EIS

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Geological Survey of Ireland (2015) Irish Aquifer Properties – A Reference Manual and Guide

Hunter Williams, N., Misstear, B., Daly, D., Johnston, P., Lee, M., Cooney, P., Hickey, C. (2011) A National groundwater recharge map for Ireland. National Hydrology Conference 2011

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Transport Infrastructure Ireland (formerly NRA) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes