7. HYDROLOGY AND HYDROGEOLOGY

7.1 Introduction

7.1.1 Background & Objectives

McCarthy Keville O'Sullivan (MKO), on behalf of Glenveagh Living, has carried out an assessment of the likely significant effects of a proposed mixed use development at Knocknacarra west of Knocknacarra on water aspects (hydrology and hydrogeology) of the receiving environment.

This chapter provides a baseline assessment of the environmental setting of the proposed development in terms of hydrology and hydrogeology and discusses the potential impacts that the construction and operation of the proposed development will have. Where required, appropriate mitigation measures to limit any identified significant impacts to water are recommended and an assessment of residual impacts and significance of effects provided.

The objectives of the assessment are:

- Produce a baseline study of the existing water environment (surface water and groundwater including connectivity with local designated sites) in the area of the proposed development site;
- Identify likely negative impacts of the proposed development on surface water and groundwater during construction and operational phases of the development;
- Identify mitigation measures to avoid, remediate or reduce significant negative effects; and,
- Assess significant residual effects and cumulative impacts of the proposed development along with other local commercial and infrastructural developments.

7.1.2 Statement of Authority

McCarthy Keville O'Sullivan Ltd. (MKO) is a specialist planning and environmental consultancy. Based in Galway but working nationwide, we deliver challenging and complex projects on behalf of our clients. MKO employs over 50 people across the company's four planning, ecology, environmental and ornithology teams. Our multi-disciplinary service offering and broad range of nationwide experience add real value to our client's projects.

MKO company experience spans the full range of industry sectors, including renewable energy, commercial development, roads and transport infrastructure, ports and marinas, tourism, energy infrastructure, retail, sport and leisure, quarrying and aggregates, manufacturing, education, housing, waste management, water, telecoms and other utilities.

Our areas of expertise and experience include a wide variety of environmental topics, including hydrology and hydrogeology. We routinely are involved with carrying out impact assessments for hydrology and hydrogeology for a large variety of project types.

This chapter of the EIAR was prepared by Michael Watson and Thomas Blackwell.

Michael Watson completed an MA in Environmental Management at NUI, Maynooth in 1999. He is a professional geologist (PGeo) and full member of IEMA (MIEMA) as well as a Chartered Environmentalist (CEnv). Michael joined McCarthy Keville O'Sullivan Ltd. in 2014 having gained over 15 years' experience in a Cork-based environmental & hydrogeological consultancy firm. Thomas Blackwell is a Senior Environmentalist with MKO with over 15 years of progressive experience in environmental consulting. Thomas holds a BA (Hons) in Geography from Trinity College Dublin and a M.Sc. in Environmental Resource Management from University College Dublin. Prior to taking up his

position with MKO in August 2019, Thomas worked as a Senior Environmental Scientist with HDR, Inc. in the United States and held previous posts with private consulting firms in both the USA and Ireland.

7.1.3 Relevant Legislation

The EIAR is carried out in accordance with the follow Irish legislation:

- European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2001 - 2018
- Planning and Development Act, 2000, as amended;
- Directives 2011/92/EU and 2014/52/EU on the assessment of the effects of certain public and private projects on the environment, including Circular Letter PL 1/2017: Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive);
- S.I. No. 94 of 1997: European Communities (Natural Habitats) Regulations, resulting from EU Directives 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and 79/409/EEC on the conservation of wild birds (the Birds Directive);
- S.I. No. 293 of 1988: Quality of Salmon Water Regulations, resulting from EU Directive 78/659/EEC on the Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life;
- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 and S.I. No. 722 of 2003 European Communities (Water Policy) Regulations which implement EU Water Framework Directive (2000/60/EC) and provide for implementation of 'daughter' Groundwater Directive (2006/118/EC). Since 2000 water management in the EU has been directed by the Water Framework Directive (WFD). The key objectives of the WFD are that all water bodies in member states achieve (or retain) at least 'good' status by 2015. Water bodies comprise both surface and groundwater bodies, and the achievement of 'Good' status for these depends also on the achievement of 'good' status by dependent ecosystems. Phases of characterisation, risk assessment, monitoring and the design of programmes of measures to achieve the objectives of the WFD have either been completed or are ongoing. In 2015 it will fully replace a number of existing water related directives, which are successively being repealed, while implementation of other Directives (such as the Habitats Directive 92/43/EEC) will form part of the achievement of implementation of the objectives of the WFD;
- S.I. No. 41 of 1999: Protection of Groundwater Regulations, resulting from EU Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);
- S.I. No. 249 of 1989: Quality of Surface Water Intended for Abstraction (Drinking Water), resulting from EU Directive 75/440/EEC concerning the quality required of surface water intended for the abstraction of drinking water in the Member States (repealed by 2000/60/EC in 2007);
- S.I. No. 439 of 2000: Quality of Water intended for Human Consumption Regulations and S.I. No. 278 of 2007 European Communities (Drinking Water No. 2) Regulations, arising from EU Directive 98/83/EC on the quality of water intended for human consumption (the Drinking Water Directive) and WFD 2000/60/EC (the Water Framework Directive);
- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009;
- S.I. No. 9 of 2010: European Communities Environmental Objectives (Groundwater) Regulations 2010; and,
- S.I. No. 296 of 2009: European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009.

7.1.4 Relevant Guidance

- The water section of the EIAR is carried out in accordance with guidance contained in the following:
- Environmental Protection Agency (2017): Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- Environmental Protection Agency (September 2015): Draft - Advice Notes on Current Practice (in the preparation on Environmental Impact Statements);
- Environmental Protection Agency (September 2015): Draft – Revised Guidelines on the Information to be Contained in Environmental Impact Statements;
- European Commission (2017), Environmental Impact Assessment of Projects Guidance on the preparation of the Environmental Impact Assessment Report.
- Institute of Geologists Ireland (2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- National Roads Authority (2008): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 – Works or Maintenance in or Near Watercourses
- (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) 2006: Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006); and,
- CIRIA 2006: Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2006.

7.2 Methodology

7.2.1 Desk Study

A desk study of the proposed development study area was largely completed prior to the undertaking of field mapping and walkover assessments. The desk study involved collecting all relevant geological, hydrological, hydrogeological and meteorological data for the area. The desk study also included a review of the Infrastructure Design Report and Site-Specific Flood Risk Assessment compiled by DBFL Consulting Engineers which sets out the proposed surface water drainage, foul water drainage, watermain design and flood protection measures for the proposed development. The following data sources were reviewed:

- Environmental Protection Agency database (www.epa.ie);
- Environmental Protection Agency River Catchment Mapper (www.catchments.ie);
- Geological Survey of Ireland - National Draft Bedrock Aquifer map;
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- Water Framework Directive Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 14 (Geology of Galway Bay). Geological Survey of Ireland (GSI, 2003);
- Geological Survey of Ireland - Groundwater Body Characterisation Reports;
- OPW Indicative Flood Maps (www.floodinfo.ie);
- Environmental Protection Agency – "Hydrotool" Map Viewer (www.epa.ie);
- CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie); and,
- Department of Environment, Community and Local Government on-line mapping viewer (www.myplan.ie).
- Hydrological survey data associated with historical projects on the site
- Site Specific Flood Risk Assessment Report (DBFL 2019)

- Infrastructure Design Report (DBFL 2018)

7.2.2 Site Investigations

A walkover survey, including drainage mapping and water sampling, was undertaken by MKO staff on 28th September 2018, 9th October 2018 and the 23rd October 2018, and 5th September 2019. DBFL Consulting Engineers visited the site on the 30th of November 2018 to establish any potential sources of flooding, likely routes of floodwaters and key features of the site to inform their Site Specific Flood Risk Assessment completed for the development.

The hydrological walkover survey involved:

- Walkover survey and hydrological mapping of the proposed site the surrounding area were undertaken whereby water flow directions and drainage patterns were recorded (where present);

7.2.3 Impact Assessment Methodology

Please refer to Chapter 1 of the EIAR for details on the impact assessment methodology (EPA, 2002, 2003, 2015 and 2017). In addition to the above methodology, the sensitivity of the water environment receptors was assessed on completion of the desk study and baseline study. Levels of sensitivity which are defined in Table 7.1 are then used to assess the potential effect that the Proposed Development may have on them.

Table 7-1 Receptor Sensitivity Criteria (Adapted from www.sepa.org.uk)

Sensitivity of Receptor	
Not sensitive	Receptor is of low environmental importance (*e.g.* surface water quality classified by EPA as A3 waters or seriously polluted), fish sporadically present or restricted). Heavily engineered or artificially modified and may dry up during summer months. Environmental equilibrium is stable and is resilient to changes which are considerably greater than natural fluctuations, without detriment to its present character. No abstractions for public or private water supplies. GSI groundwater vulnerability "Low" – "Medium" classification and "Poor" aquifer importance.
Sensitive	Receptor is of medium environmental importance or of regional value. Surface water quality classified by EPA as A2. Salmonid species may be present and may be locally important for fisheries. Abstractions for private water supplies. Environmental equilibrium copes well with all natural fluctuations but cannot absorb some changes greater than this without altering part of its present character. GSI groundwater vulnerability "High" classification and "Locally" important aquifer.
Very sensitive	Receptor is of high environmental importance or of national or international value *i.e.* NHA or SAC. Surface water quality classified by EPA as A1 and salmonid spawning grounds present. Abstractions for public drinking water supply. GSI groundwater vulnerability "Extreme" classification and "Regionally" important aquifer

7.3 Receiving Environment

7.3.1 Site Description & Topography

The Proposed Development site is located in the townland of Rahoon, west of Galway City in Co. Galway. The total study area is approximately 2.8 hectares in area.

The elevation of the site ranges between approximately 27m and 32m OD (metres above Ordnance Datum). The overall local topography generally slopes from north to south with an undulating topography. The dominant land use on the bordering land is commercial development to the west, a primary school to the north, and residential development to the south and east. A portion of the proposed site is currently used as a construction compound and the remainder consists of vacant scrubland.

There are no surface watercourse on the site and it is likely that much of the rainfall that falls on the site drains through the soils.

7.3.2 Water Balance

Long term rainfall and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall (1981 - 2010) recorded at Shannon Airport station, located approximately 65 kilometres south of the Proposed Development site, are presented in Table 7.2 below. This is the closest station to the proposed development site for which recent 30-year annual average rainfall data are available.

(Please note that these rainfall data are used for baseline characterisation purposes only and are not used for assessing runoff volumes pre/post development or for drainage design).

Table 7-2 Local Average long-term Rainfall Data (mm) at Shannon Airport

Station		X-Coord		Y-Coord		Ht (MAOD)		Opened		Closed		
Shannon Airport		08°53'58" W		52°42'19" N		15		1937		N/A		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
102.3	76.2	78.7	59.2	64.8	69.8	65.9	82	75.6	104.9	94.1	104	977.6

The long-term average potential evapotranspiration (PE) for the Shannon Airport station is 562 mm/yr. This value is used as a best estimate of the site PE. Actual Evaporation (AE) at the site is estimated as 534mm/yr (which is 0.95 PE).

The effective rainfall (ER) represents the water available for runoff and groundwater recharge. The ER for the site is calculated as follows:

$$\text{Effective rainfall (ER)} = \text{AAR} - \text{AE}$$

$$= 977.6 \text{ mm/yr} - 534 \text{ mm/yr}$$

$$\text{ER} = 443.6 \text{ mm/yr}$$

Based on groundwater recharge coefficient estimates (22.5%) from the GSI (www.gsi.ie) an estimate of 100 mm/year average annual recharge is given for the study area. This means that the hydrology of the study area is characterised by high surface water runoff rates and low groundwater recharge rates.

Therefore, annual recharge and runoff rates for the site are estimated to be 100 mm/yr and 344 mm/yr respectively. The greenfield runoff rates for the site have been calculated in the Site-Specific Flood Risk Assessment (SSFRA) for the project. A copy of the SSFRA is included as Appendix 7-1 of this EIAR.

7.3.3 Regional & Local Hydrology

On a regional scale, the site is located within Hydrometric Area 31, Galway Bay North. The site is located in the 31 Galway Bay North catchment and in the Knock [Furbo]_SC_010 sub-catchment under the Water Framework Directive (WFD). A regional hydrology map is shown as Figure 7.1.

The Knocknacarra Stream rises to the north of the site at Letteragh and flows southward over a distance of 3km to the sea. A large portion of the lower reach of the Knocknacarra Stream is culverted almost to its sea outfall at Rusheen Bay near Blakes Hill at Salthill. A tributary stream which formerly ran through the site was culverted and realigned to form the surface water sewer network as part of a nearby development in 1996. There are currently no open surface watercourses or drains on the site.

A local hydrology map is shown as Figure 7.2.

7.3.4 Site Drainage

In general, the site of the proposed development is well drained with rainfall percolating to ground and likely travelling via subsurface flow to the culverted stream located at the eastern side of the site., There is a gently sloping topography which is likely to reflect the direction of groundwater flow at the site which is likely from northwest to southeast. There was no surface water or ponding of water observed on the site. The existing roadway that bisects the site is served by gullies which discharge to the municipal storm water drainage system.

7.3.5 Flood Risk Identification

To identify those areas as being at risk of flooding OPW's indicative river and coastal flood map (www.floodmaps.ie), CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie), Department of Environment, Community and Local Government on-line planning mapping (www.myplan.ie) and historical mapping (i.e. 6" and 25" base maps) were consulted.

There is no identifiable map text on local available historical 6" or 25" mapping for the study area that identify lands that are "prone to flooding".

There are no recurring flood incidents within the study area boundary according to the OPW's flood mapping. There are no areas within the study area mapped as "Benefiting Lands". Benefiting lands are defined as a dataset prepared by the Office of Public Works identifying land that might benefit from the implementation of Arterial (Major) Drainage Schemes (under the Arterial Drainage Act 1945) and indicating areas of land subject to flooding or poor drainage.

Tidal flooding is not relevant as the site is approximately 1.8 Km from the coast and more than 28m above sea level.

The OPW PFRA map for the area indicates that the eastern area of the site could be impacted by a potential fluvial flood risk zone. No risk of pluvial or coastal flooding is highlighted on the site. The PFRA report and maps are available at www.floodinfo.ie and identify areas deemed to be at risk of flooding (referred to as Areas for Further Assessment, or 'AFAs'), as they require more detailed assessment on the extent and degree of flood risk by the later CFRAM Studies. The flood extents maps indicates that the eastern area of the subject site could be impacted by a potential fluvial flood risk zone. No risk of pluvial or coastal flooding is highlighted on the site. The Western Catchment Flood Risk Assessment and Management (CFRAM) study provides further assessment of areas identified in the PFRA for further investigation. The subject site's catchment area was not identified in the PFRA for further investigation therefore it is outside the Western CFRAM "Area of Further Assessment" boundary for Galway City.

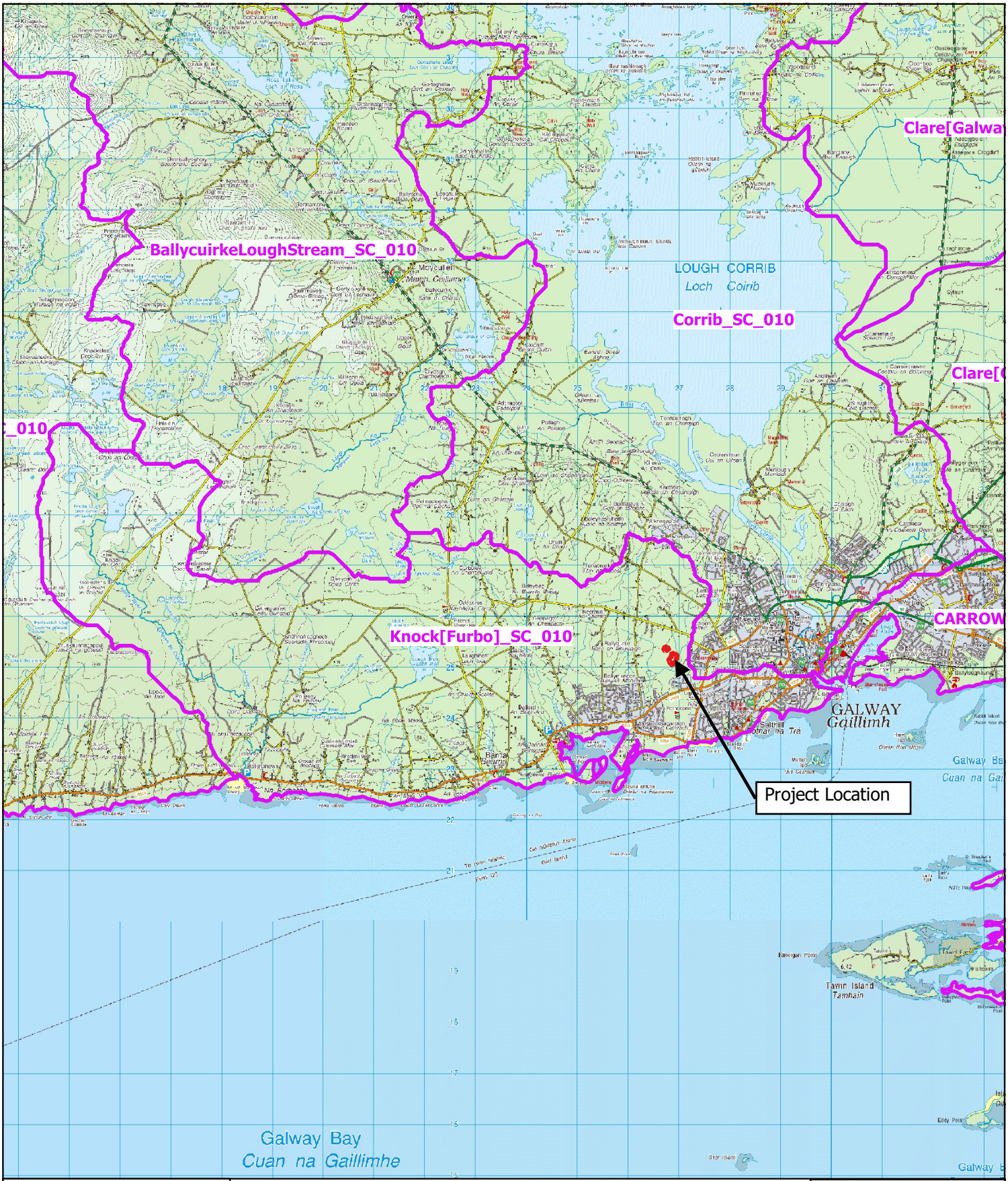
A Site-Specific Flood Risk Assessment (SSFRA) has been prepared for the proposed development (DBFL Consulting Engineers, 2019). This report determined that the Site is within Flood Zone C and concluded that the residential development proposed is appropriate for the Site's flood zone category.

The assessment found that the development has a good level of flood protection up to the 100-year return event. For pluvial floods exceeding the 100-year capacity of the drainage system then the proposed flood routing mitigation measures should protect the areas with lower finish floor levels by directing flood water to the drainage outfall.

7.3.6 Surface Water Hydrochemistry

There are no open surface waters on the project site. Therefore, no surface water quality testing was carried out.

The EPA Envision map viewer was consulted on 04th of April 2019 regarding the water quality status of the watercourses downstream of the Study Area. The following water quality status results were determined from the online EPA Envision map viewer. The water quality of Rusheen Bay to which the culverted Knocknacarra stream discharges has a Coastal Waterbody Status of 'good' and a coastal waterbodies risk projection of 'not at risk'. Groundwater in the study area has a ground waterbody status of 'good'.



Map Legend

- Site Boundary
- WFD Sub-Catchments Boundary

Drawing Title: **Regional Hydrology**

Project Title	
SHD at Knocknacarra District Centre	
Drawn By: TJB	Checked By: MH
Project No.: 180531-a	Drawing No.: Figure 7.1
Scale: 1:100000	Date: 23.10.2019

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Map Legend

- Site Boundary
- Streams

Drawing Title	Local Hydrology
Project Title	SHD at Knocknacarra District Centre
Drawn By: TJB	Checked By: MH
Project No.: 180531-a	Drawing No.: Figure 7.2
Scale: 1:20000	Date: 23.10.2019

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7.3.7 Hydrogeology

Granites and other igneous intrusive rocks, which are mapped to underlie the proposed development site are classified by the GSI (www.gsi.ie) as a Poor Aquifer – Bedrock which is Generally Unproductive except for Local Zones. A bedrock aquifer map is shown as Figure 7.3.

This aquifer has expected transmissivity in the range of 20-30m2/d (this may be higher in the vicinity of faults) and low storativity (<0.5%). Groundwater here should be unconfined (GSI, 2004).

Groundwater flow paths are expected to be concentrated in fractures and weathered zones in the vicinity of faults. The flow paths are typically short (up to 100 metres). The flow direction is generally to the south, driven by topography (GSI, 2004).

Shallow groundwater from this aquifer generally discharges to streams and lakes. Small springs and seeps are likely to occur at the stream heads and along their course (GSI, 2004).

Map Legend

Site Boundary

Bedrock Aquifers

Poor aquifer, bedrock which is generally unproductive except for local zones (Pl)

Regionaly important aquifer, Karstified (conduit) - Rkc

N

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Drawing Title: Bedrock Aquifers	
Project Title: SHD at Knocknacarra District Centre	
Drawn By: TJB	Checked By: MH
Project No.: 180531-a	Drawing No.: Figure 7.3
Scale: 1:50000	Date: 23.10.2019

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7.3.8 Groundwater Vulnerability

The vulnerability rating of the aquifer within the overall site is classified as “Extreme” due to rock near the surface.

Due to the low permeability and transmissivity of the fractured bedrock aquifer underlying the site, there is a relatively low potential for groundwater recharge, dispersion and movement within the aquifer.

7.3.9 Groundwater Hydrochemistry

There are no groundwater quality data for the proposed development site and groundwater sampling would generally not be undertaken for this type of development in terms of EIAR reporting as groundwater quality impacts would not be anticipated. There are also no proposed discharges to ground.

The WFD status for the local groundwater body in terms of water quality is Good and therefore this is assumed to be the baseline condition for groundwater in the area of the proposed development.

Based on data from GSI publication Calcareous/Non calcareous classification of bedrock in the Republic of Ireland (WFD,2004), alkalinity for this bedrock type generally ranges from 43 – 199mg/L while electrical conductivity and hardness were reported to have mean values of 442µS/cm and 148mg/L respectively.

7.3.10 Water Framework Directive Water Body Status & Objectives

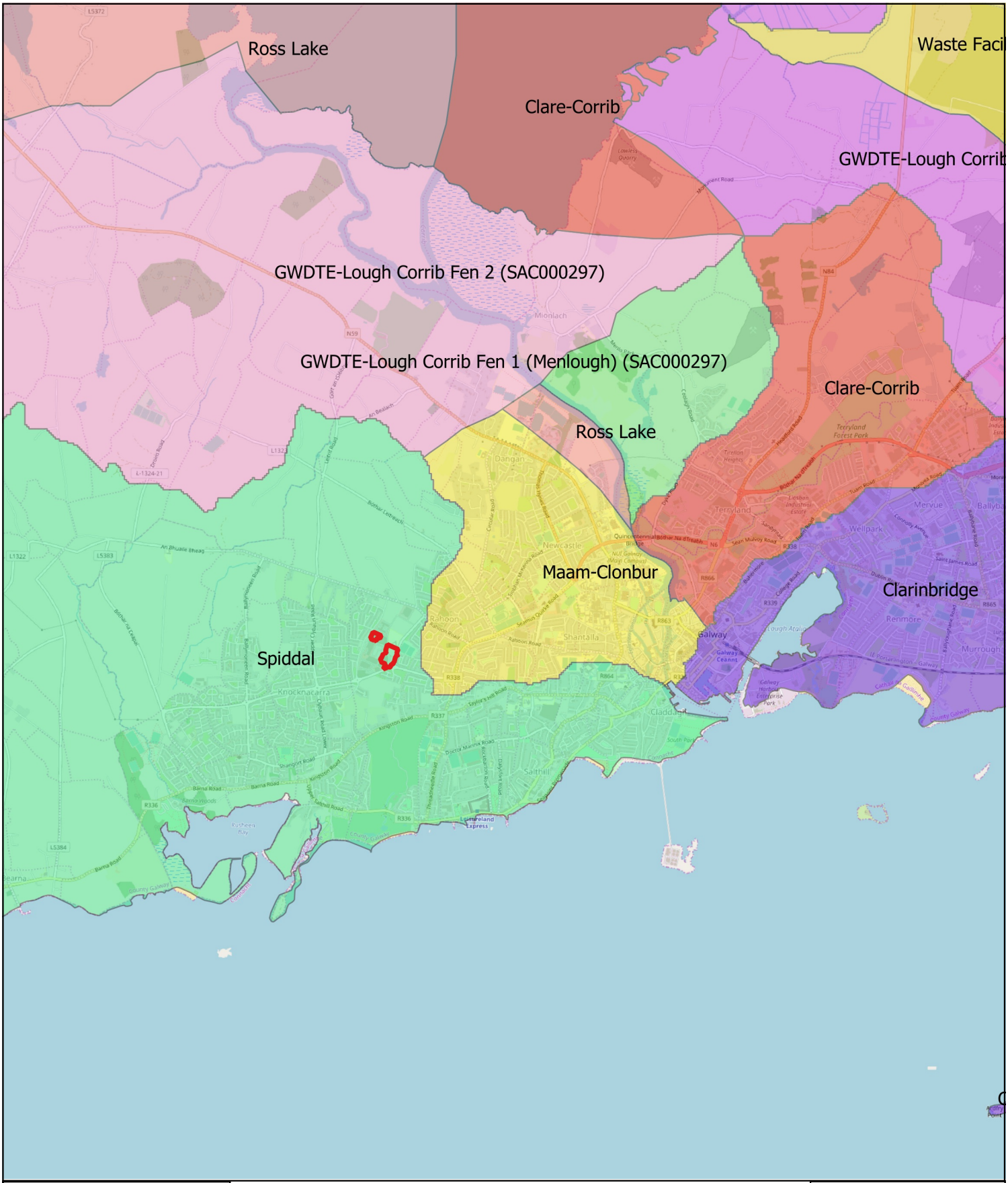
Local Groundwater Body and Surface Water Body status and risk result are available from (www.catchments.ie). The Knocknacarra Stream rises to the north of the site at Letteragh and flows southward over a distance of 3km to the sea. A large portion of the lower reach of the Knocknacarra Stream is culverted almost to its sea outfall at near Blakes Hill at Salthill. The stream which formerly ran through the site was culverted and realigned to form the surface water sewer network as part of a nearby development in 1996. The WFD status for the Knocknacarra Stream (IE_WE_31K160960) is Unassigned. This stream has been assigned a “Review” risk status. The stream discharges to Inner Galway Bay North (IE_WE_170_0000) which has been assigned a WFD water quality status of “Good” and a risk status of “Not at Risk”.

The proposed development site predominantly drains to both the underlying subsoil and aquifer. The WFD status for the local groundwater body (IE_WE_G_0004) in terms of water quality is Good.

7.3.11 Groundwater Body Status

Local Groundwater Body (GWB) status information are available (www.catchments.ie). Refer to Figure 7.3 for the location and extent of local groundwater body.

The Spiddal GWB (IE_WE_G_0004) which underlies the Proposed Development site is assigned a ‘Review’ risk status based on the quantitative status and chemical status of the GWB. This refers to the risk of deteriorating or being at less than Good status in the future.



Map Legend

- Site Boundary

Ground Water Bodies

- Clare-Corrib
- Clarinbridge
- GWDTE-Lough Corrib Fen 1 (Menlough) (SAC000297)
- GWDTE-Lough Corrib Fen 2 (SAC000297)
- GWDTE-Lough Corrib Fens 3 & 4 (SAC000297)
- Maam-Clonbur
- Ross Lake
- Spiddal

Drawing Title: Groundwater Bodies

Project Title: SHD at Knocknacarra District Centre

Drawn By	Checked By
TJB	MH
Project No.	Drawing No.
180531-a	Figure 7.4
Scale	Date
1:50000	23.10.2019

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7.3.12 Designated Sites & Habitats

Designated sites include National Heritage Areas (NHAs), Proposed National Heritage Areas (pNHAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs).

The Galway Bay Complex SAC (Code: 000268) is located approximately 1.3 kilometres southwest of the site and the Inner Galway Bay SPA (Code: 004031) is located approximately 1.5 kilometres to the southwest of the site. The Culverted Knocknacarra Stream which flows adjacent to the site, enters the Inner Galway Bay SPA (Code: 004031) approximately 1.5m downstream of the proposed site.

The Lough Corrib SAC (Code: 000297), Connemara Bog Complex SAC (Code: 002034), Ross Lake and Woods SAC (Code: 001312), East Burren Complex SAC (Code: 001926), Moneen Mountain SAC (Code: 000054), Lough Corrib SPA (Code: 004042), Cregganna Marsh SPA (Code: 004142) and Connemara Bog Complex SPA (Code: 004181) are all located within 15 kilometres of the site. Detailed discussion of designated sites is provided in the NIS for the project and in Section 5.3 of this EIAR.

7.3.13 Water Resources

There are no groundwater protection zones mapped within the proposed development site or study area. There are no mapped private well locations (GSI database to accuracy of <50m) within 1km, which were obtained from the GSI well database (www.gsi.ie).

Only a small number of groundwater wells would be expected in the area, given the urban setting and the high availability of water networks in the area. Notwithstanding this, an assessment of groundwater resources relative to the proposed development is completed below.

7.3.14 Receptor Sensitivity

Due to the nature of residential developments, being near surface construction activities, impacts on groundwater are generally negligible and surface water is generally the main sensitive receptor assessed during impact assessments. The primary risk to groundwater at the site would be from cementitious materials, hydrocarbon spillage and leakages. These are common potential impacts on all construction sites (such as road works and industrial sites). All potential contamination sources are to be carefully managed at the site during the construction and operational phases of the development and mitigation measures are proposed below to deal with these potential minor impacts.

Based on criteria set out in Table 7.1 above, the Poor Aquifer at the site can be classed as Sensitive to pollution. Also, any contaminants which may be accidently released on-site may also discharge to local storm water sewer that discharges to Rusheen Bay and the public sewer system.

The Galway Bay Complex SAC (Code: 000268) and the Inner Galway Bay SPA (Code: 004031) are located approximately 1.5 km downstream of the proposed site. The culverted Knocknacarra Stream which is located adjacent to the site discharges to these designated areas.

Comprehensive surface water mitigation and controls are outlined below to ensure protection of all downstream receiving waters during construction and operational phases of the development. Mitigation measures will ensure that surface runoff from the developed areas of the site will be of a high quality and will therefore not impact on the quality of downstream surface water bodies. Any introduced drainage works at the development site will mimic the existing hydrological regime, and discharge will be to ground via soakaways, thereby avoiding changes to surface water flow volumes leaving the site.

7.3.15 Proposed Site infrastructure and Drainage Management

The proposed storm-water proposals and drainage design for the development are designed in accordance with the GDSDS. The proposals include SUDs measures to reduce the runoff for the development including a landscaped podium with planting, and part of the civic plaza paved with porous asphalt. One Stormtech attenuation tank and one concrete storage tank are proposed to accommodate the 100 year critical storm plus a 10% climate change provision. The concrete tank storage system accommodating surface water will be located under the ground floor car park.

It is proposed to provide a SUDs solution to the surface water drainage for the site. The SUDS proposals for the development include;

- One concrete attenuation tank under the ground floor car park in Site 2 to provide storage (172 m3).
- One Stormtech attenuation tank in Site 1 to provide storage (361m3).
- A landscaped courtyard with green areas and raised planters in Site 2 to provide interception storage and treatment.
- An area within the civic plaza in Site 1 paved with porous asphalt to provide interception storage and treatment.
- A Class 1 Bypass Separators to be provided on the outfall from each network.

Storm-water attenuation for the development has been sized in accordance with the requirements of the GDSDS. Run-off rates from the proposed development to the public system are in accordance with the GDSDS.

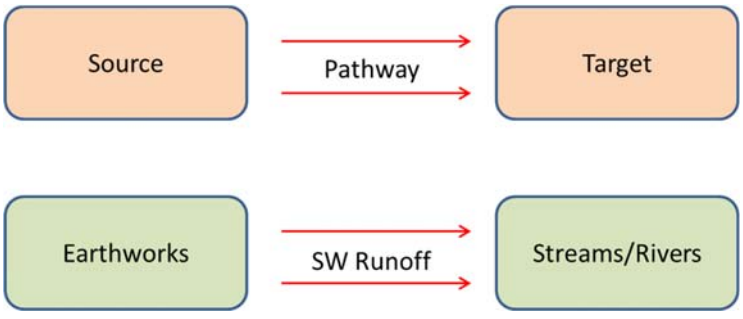
Water supply to the site will be via connection to the adjacent public (Irish Water) watermain.

The proposed on-site foul sewers will discharge by gravity where possible to the adjacent public (Irish Water) foul sewer network. It is considered that some of the development may require a foul water pump station due to the topography of the site.

7.4 Potential Impacts and Mitigation Measures

7.4.1 Overview of Impact Assessment Process

The conventional source-pathway-target model (see below, top) was applied to assess potential impacts on downstream environmental receptors (see below, bottom as an example) as a result of the proposed housing development.



Where potential impacts are identified, the classification of impacts in the assessment follows the descriptors provided in the Glossary of Impacts contained in the following guidance documents produced by the Environmental Protection Agency (EPA):

- Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2017);
- Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (EPA, 2003);
- Guidelines on the Information to be contained in Environmental Impact Statements (EPA, 2002).

The description process clearly and consistently identifies the key aspects of any potential impact source, namely its character, magnitude, duration, likelihood and whether it is of a direct or indirect nature.

In order to provide an understanding of the stepwise impact assessment process applied below (Section 7.4.2 and 7.4.3), we have firstly presented below a summary guide that defines the steps (1 to 7) taken in each element of the impact assessment process. The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact descriptors are combined.

Using this defined approach, this impact assessment process is then applied to the development construction and operational activities which have the potential to generate a source of significant adverse impact on the geological and hydrological/ hydrogeological (including water quality) environments.

Step 1	Identification and Description of Potential Impact Source This section presents and describes the activity that brings about the potential impact or the potential source of pollution. The significance of effects is briefly described.	
Step 2	**Pathway / Mechanism:**	The route by which a potential source of impact can transfer or migrate to an identified receptor. In terms of housing developments, surface water and groundwater flows are the primary pathways, or for example, excavation or soil erosion are physical mechanisms by which a potential impact is generated.
Step 3	**Receptor:**	A receptor is a part of the natural environment which could potentially be impacted upon, *e.g.* human health, plant / animal species, aquatic habitats, soils/geology, water resources, water sources. The potential impact can only arise as a result of a source and pathway being present.
Step 4	**Pre-mitigation Impact:**	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place.
Step 5	**Proposed**	Control measures that will be put in place to prevent or reduce all identified significant adverse

	Mitigation Measures:	impacts. In relation to housing developments, these measures are generally provided in two types: (1) mitigation by avoidance, and (2) mitigation by engineering design.
Step 6	**Post Mitigation Residual Impact:**	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impacts after mitigation is put in place.
Step 7	**Significance of Effects:**	Describes the likely significant post mitigation effects of the identified potential impact source on the receiving environment.

7.4.2 Construction Phase Potential Impacts

7.4.2.1 Earthworks (Removal of Vegetation Cover, Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Waters

Construction phase activities including site levelling, service trench construction, levelling/construction and building foundation excavation will require earthworks resulting in removal of vegetation cover and excavation of any minor local pockets of organic soil/subsoils, and bedrock. The main risk will be from surface water runoff from bare soil and soil storage areas during construction works.

Much of the surface water generally percolates to ground. However, the construction activities can result in the release of suspended solids to local drainage features and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality in downstream waters (Knocknacarra Stream).

Pathways: Drainage and surface water discharge routes. Pathways are limited as there are no open watercourses onsite.

Receptors: Down-gradient transitional and water dependent ecosystems.

Pre-Mitigation Impact

Indirect, negative, moderate, short-term, likely impact.

Proposed Mitigation Measures

The closest sensitive receptor is the culverted Knocknacarra Stream. It is not proposed to alter the existing alignment or culvert associated with this stream. However, attenuated surface water runoff will ultimately discharge to the municipal storm drainage system of which this stream forms a part of.

Management of surface water runoff and subsequent treatment prior to release off-site will be undertaken during construction work as follows:

- Prior to the commencement of earthwork silt fencing will be placed down-gradient of the construction areas where drains or drainage pathways are present. These will be embedded into the local soils to ensure all site water is captured and filtered;

- As construction advances there may be a small requirement to collect and treat surface water within the site. This will be completed using perimeter swales at low points around the construction areas, and if required water will be pumped from the swales into sediment bags prior to overland discharge allowing water to percolate naturally to ground or disperse by diffuse flow into local drainage ditches;
- Discharge onto ground will be via a silt bag which will filter any remaining sediment from the pumped water. The entire discharge area from silt bags will be enclosed by a perimeter of double silt fencing;
- Any proposed discharge area will avoid potential surface water ponding areas, and will only be located where suitable subsoils are present;
- No pumped construction water will be discharged directly into any local watercourse;
- Daily monitoring and inspections of site drainage during construction will be completed;
- Earthworks will take place during periods of low rainfall to reduce run-off and potential siltation of watercourses;
- Good construction practices such wheel washers and dust suppression on site roads, and regular plant maintenance will ensure minimal risk. The Construction Industry Research and Information Association (CIRIA) provide guidance on the control and management of water pollution from construction sites ('Control of Water Pollution from Construction Sites, guidance for consultants and contractors', CIRIA, 2001), which provides information on these issues. This will ensure that surface water arising during the course of construction activities will contain minimum sediment.

Mitigation by Design:

A summary of surface water controls that can be employed during the earthworks and construction phase are as follows:

- Source controls:
  - Interceptor drains, vee-drains, diversion drains, flume pipes, erosion and velocity control measures such as use of sand bags, oyster bags filled with gravel, filter fabrics, and other similar/equivalent or appropriate systems.
  - Small working areas, covering stockpiles, weathering off stockpiles, cessation of works in certain areas or other similar/equivalent or appropriate measures.
- In-Line controls:
  - Interceptor drains, vee-drains, oversized swales, erosion and velocity control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, silt bags, silt fences, sedimats, filter fabrics, and collection sumps, temporary sumps/attenuation lagoons, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriates systems.
- Treatment systems:
  - Temporary sumps and attenuation ponds, temporary storage lagoons, sediment traps, and settlement ponds, and proprietary settlement systems such as Siltbuster, and/or other similar/equivalent or appropriate systems.
- Silt Fences:
  - Silt fences will be placed up-gradient of all drains where construction is proposed. Silt fences are effective at removing heavy settleable solids. This will act to prevent entry to watercourses of sand and gravel sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin, and entrained in surface water runoff. Inspection and maintenance of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase.
- Silt Bags:

- Silt bags will be used where small to medium volumes of water need to be pumped from excavations or swales. As water is pumped through the bag, most of the sediment is retained by the geotextile fabric allowing filtered water to pass through. Silt bags will be used with natural vegetation filters.

Residual Impact

Indirect, negative, imperceptible, short-term, medium probability impact on downstream surface waters.

Significance of Effects

No significant impacts on surface water quality are expected due to site excavation work. There is limited hydraulic connectivity between the site and watercourses and mitigation measures will be employed on a precautionary basis.

7.4.2.2 Potential Surface Water Quality Impacts from Shallow Excavation Dewatering

Some groundwater seepages may potentially occur in foundation excavations. Dewatering will create additional volumes of water to be treated by the runoff management system. Inflows will likely require management and treatment to reduce suspended sediments. No contaminated land was noted at the site and therefore historical pollution sources are not anticipated.

Pathway: Overland flow and site drainage network.

Receptor: Down-gradient surface water bodies.

Pre-Mitigation Impact

Indirect, negative, moderate, short-term, medium probability impact to surface water quality.

Impact Assessment

Management of excavation seepages and subsequent treatment prior to discharge into the site drainage network will be undertaken as follows:

- Appropriate interceptor drainage, to prevent upslope surface runoff from entering excavations will be put in place if required;
- The interceptor drainage will be discharged to the site constructed drainage system or onto natural vegetated surfaces and not directly to surface waters;
- If required, pumping of excavation inflows will prevent build-up of water in the excavation;
- The pumped water volumes will be discharged via volume and sediment attenuation ponds adjacent to excavation areas, or via silt bags;
- There will be no direct discharge to the on-site main drains, and therefore no risk of hydraulic loading or contamination will occur; and,
- Daily monitoring of excavations by a suitably qualified person will occur during the construction phase. If high levels of seepage inflow occur, excavation work should immediately be stopped and a geotechnical assessment undertaken.

Residual Impact

Indirect, negative, imperceptible, short-term, low probability impact on downstream surface waters. The pathway between the site works areas and receptors are broken by the nature of the site which does not have open water courses onsite combined with the proposed mitigation.

Significance of Effects

No significant impacts on surface water quality are expected due to excavation dewatering.

7.4.2.3 Potential Release of Hydrocarbons during Construction Stage

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a significant pollution risk to groundwater, surface water and associated ecosystems, and to terrestrial ecology. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. It is also a nutrient supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in waters, resulting in death of aquatic organisms.

Pathway: Groundwater flowpaths and site drainage network.

Receptor: Groundwater and surface water.

Pre-Mitigation Impact

Indirect, negative, slight, short term, likely impact to local groundwater quality.

Indirect, negative, moderate, short term, unlikely impact to surface water quality.

Proposed Mitigation Measures:

Mitigation by Design:

- On site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled off site and will be towed around the site by a 4x4 jeep to where machinery is located. The 4x4 jeep will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;
- Fuels stored on site will be minimised. Any storage areas will be bunded appropriately for the fuel storage volume for the time period of the construction;
- The plant used should be regularly inspected for leaks and fitness for purpose; and,
- Refueling and servicing of construction machinery will take place in a designated hardstand area which is also remote from any drainage systems.
- A response procedure will be put in place to deal with any accidental pollution events and spillage kits will be available and construction staff will be familiar with the emergency procedures and use of the equipment.
- Spill kits will be available to deal with accidental spillages.

Residual Effects

Indirect, negative, imperceptible, short-term, unlikely impact on groundwater and surface water. The pathway between the hydrocarbons and the receptor is broken by the nature of the site, which is dry combined with the proposed mitigation measures.

Significance of Effects

No significant effects on surface water or groundwater quality are anticipated.

7.4.2.4 Groundwater and Surface Water Contamination from Wastewater Disposal

Release of effluent from on-site wastewater systems has the potential to impact on groundwater and surface waters if not properly managed.

Pathway: Groundwater flowpaths and site drainage network.

Receptor: Down-gradient well supplies, groundwater quality and surface water quality.

Pre-mitigation Impact

Indirect, negative, significant, short-term, unlikely impact to surface water quality.

Indirect, negative, slight, short-term, unlikely impact to local groundwater.

Proposed Mitigation Measures

Mitigation by Avoidance:

- A self-contained port-a-loo with an integrated waste holding tank will be used at the site compounds, maintained by the providing contractor, and removed from site on completion of the construction works;
- No wastewater will be discharged on-site during either the construction or operational phase.

Residual Impact

No impact.

Significance of Effects

No significant effects on surface water or groundwater quality are anticipated.

7.4.2.5 Release of Cement-Based Products

Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative impacts on water quality. They generate very fine, highly alkaline silt (pH 11.5) that can physically damage fish by burning their skin and blocking their gills. A pH range of $\geq 6 \leq 9$ is set in S.I. No. 293 of 1988 Quality of Salmonid Water Regulations, with artificial variations not in excess of ± 0.5 of a pH unit. Entry of cement based products into the site drainage system, into surface water runoff, and hence to surface watercourses or directly into watercourses represents a risk to the aquatic environment.

Pathway: Site drainage network.

Receptor: Surface water and transitional water hydrochemistry.

Pre-Mitigation Impact

Indirect, negative, moderate, short term, likely impact to surface water.

Proposed Mitigation Measures

Mitigation by Avoidance:

- No batching of wet-cement products will occur on site. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will take place;
- No washing out of any plant used in concrete transport or concreting operations will be allowed on-site;
- Where concrete is delivered on site, only the chute need be cleaned, using the smallest volume of water possible. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water is to be tanked and removed from the site to a suitable, non-polluting, discharge location;
- Use weather forecasting to plan dry days for pouring concrete; and,
- Ensure pour site is free of standing water and plastic covers will be ready in case of sudden rainfall event.

Residual Impact

Negative, Indirect, imperceptible, short term, likely impact. The pathway between the cement works and receptors are broken by the nature of the site which does not have open water courses combined with the proposed mitigation.

Significance of Effects

No significant effects on surface water quality are anticipated.

7.4.2.6 Potential Impacts on Hydrologically Connected Designated Sites

The Galway Bay Complex SAC (Code: 000268) and Inner Galway Bay SPA (Code: 004031) are located less than 1.5 kilometres to the southwest of the site. The culverted Knocknacarra Stream has been incorporated into the storm sewer system and flows adjacent to the site. Discharges from the site could conceivably enter the culverted stream which discharges into the Galway Bay Complex SAC and Inner Galway Bay SPA at Rusheen Bay. The construction of the development will involve earth moving and levelling operations which create the potential for pollution in various forms to run off the site, i.e. the generation of suspended solids and the potential for spillage of fuels associated with the refuelling of excavation machinery. Taking a precautionary approach the construction works have potential, in the absence of mitigation, to impact on groundwater and surface water quality. Pollutants may run off the site into the public stormwater system outside the site, which ultimately discharges to Rusheen Bay, thus having connectivity to Inner Galway Bay SPA and Galway Bay Complex SAC. There is also the possibility that pollutants may percolate through the ground ultimately discharge to the SAC/SPA via this diffuse pathway.

Possible effects include water quality impacts which could be significant if mitigation is not put in place.

Pathway: Surface water and groundwater flowpaths.

Receptor: Down-gradient water quality and designated sites.

Pre-Mitigation Impact

Indirect, negative, moderate, short term, likely impact to surface water quality.

Proposed Mitigation Measures

Standard best practice environmental control measures will be implemented during the construction phase of the development. The pathway that would allow potential impacts to occur was considered in the design of the project. Section 2.2.3 of this report sets out the environmental management framework to be adhered to during the construction phase of the development and it incorporates the mitigating principles to ensure no adverse impact on the integrity of European Sites. Section 2.2.3 includes comprehensive detail regarding site set up, pollution prevention, hydrocarbon management, disturbance limitation, construction monitoring and biosecurity. Standard best practice environmental control measures have been incorporated in the design of the development and are outlined in the following subsections. In addition, the 'Infrastructure Design Report '(DBFL Consulting Engineers, 2019) and the Construction and Environmental Management Plan (DBFL Consulting Engineers, 2019), (see Appendices 3-4 and 3-3)), include measures for the avoidance of impact on groundwater and surface water during construction. The following pollution control measures will be put in place:

- Sediment and Erosion – Adjacent drainage systems/groundwater need to be protected from sedimentation and erosion due to direct surface water runoff generated onsite during the construction phase. To prevent this from occurring surface water discharge from site will be managed and controlled for the duration of the construction works until the permanently surface water drainage system of the proposed site is complete. A

temporary drainage system shall be installed prior to the commencement of the construction works to collect surface water runoff by the site during construction.

- Accidental Spills and Leaks – All oils, fuels, paints and other chemicals will be stored in a secure bunded construction hardstand area. Refuelling and servicing of construction machinery will take place in a designated hardstand area which is also remote from any drainage systems. A response procedure will be put in place to deal with any accidental pollution events and spillage kits will be available and construction staff will be familiar with the emergency procedures and use of the equipment.
- Concrete – Concrete batching will take place off site, wash down and wash out of concrete trucks will take place off site and any excess concrete is not to be disposed of on site. Pumped concrete will be monitored to ensure there is no accidental discharge. Mixer washings are not to be discharged into surface water drains.
- Disposal of Wastewater from Site – Discharge from any vehicle wheel wash areas is to be directed to on-site settlement tanks/ponds, debris and sediment captured by vehicle wheel washes are to be disposed off-site at a licensed facility.
- Foul drainage discharge from the construction compound will be tankered off site to a licensed facility until a connection to the public foul drainage network has been established.

The proposed mitigation measures for protection of surface water quality which will include on site drainage control measures (i.e. silt fences, silt bags etc) will ensure that the quality of runoff from proposed development areas will be very high. Connections to the public foul and surface water sewers will not be completed until approval has been received from the local authority and Irish Water. All drainage works will be constructed and tested in accordance with the local authority/ Irish Water requirements. As outlined above, controls will also be put in place to manage risks associated with hydrocarbons/chemicals and cement based products used during construction phase.

Residual Impact

No impacts on water quality or downstream designated sites are anticipated. The potential pathway between the site works area and receptors has been broken to ensure no impacts on designated sites.

Significance of Effects

No significant impacts on groundwater or surface water quality and downstream designated sites are anticipated.

7.4.3 Operational Phase Impacts

7.4.3.1 Potential Increased Downstream Flood Risk due to Increased Hardstanding Area.

Replacement of the greenfield surface with hardstand surfaces will result in an increased risk of pluvial flooding due to low permeability surfaces which will inhibit any downward percolation of rainwater.

The management of surface water for the proposed development has been designed to comply with the policies and guidelines outlined in the Greater Dublin Strategic Drainage Study (GDSDS) and with the requirements of Galway City Council.

It is proposed to divert the existing surface water sewers within the site to align the drainage layout with the proposed diversion of the existing access road to the Gateway Retail Park. The proposed development will be provided with a surface water drainage network to collect surface water flows from the apartment blocks and commercial units. Attenuated outflows from the northern portion of the site will connect with the existing 375mm diameter sewer to the north-west of the site. Storm drainage from

the southern potion of the site will discharge attenuated outflows to the existing 450mm diameter sewer to the south-west of the site.

The surface water strategy incorporates attenuation of storm water to limit discharge from the site, although storage facilities and SUDs elements will be designed to allow infiltration or reduction of run-off volumes and rates where possible.

Run-off from roofs and any additional run-off from the landscaped courtyard podium slab is designed to be conveyed to the surface water drainage network at ground floor level. Two underground surface water attenuation tanks will be provided for the development to attenuate surface water flows for the 100 year critical storm + 10% allowance for climate change in accordance with GDSDS. One concrete attenuation tank will be located beneath the ground floor car park in Site 2, and one Stormtech attenuation system will be located beneath the civic plaza in Site 1.

The podium (landscaped courtyard) consists mainly of green areas, soft landscaped areas and raised planters providing interception storage and treatment. A number of gullies at podium slab level will drain any residual runoff from the landscaped courtyard to the surface water network at ground level.

Surface water run-off from the overall development will be attenuated to greenfield runoff rates.

Pathway: Site surface water drainage network.

Receptor: Surface watercourses.

Pre-Mitigation Impact

Direct, negative, slight, long term, low probability impact.

Proposed Mitigation Measures

The risk of pluvial flooding is minimised by using an attenuated surface water drainage network. Surface water run-off from the overall development will be attenuated to greenfield run-off rates.

Residual Impact

Direct, negative, imperceptible, long term, low probability impact in relation to flood risk.

Significance of Effects

No significant impacts in terms of flooding are expected due to the proposed development.

7.4.3.2 Potential Downstream Water Quality Impacts from Surface Water Drainage.

The operational phase of the proposed project will result in the production of surface water. If not adequately treated, there is potential for indirect impacts on ground water and surface water quality. To prevent pollutants or sediments discharging into water courses from surface drainage the GDSDS requires “interception storage” to be incorporated into the development. This interception storage is designed to receive the run-off for rainfall depths of 5mm up to 10mm. A Class 1 Bypass Separator will be provided on each outfall from from the surface water drainage network.

Pathway: Site surface water drainage network.

Receptor: Groundwater aquifer and/or surface watercourses.

Pre-Mitigation Impact

Direct, negative, slight, long term, low probability impact.

Proposed Mitigation Measures

Water quality risks are reduced by use of interception storage, silt traps, and Class 1 Bypass Separators

Residual Impact

Direct, negative, imperceptible, long term, low probability impact in relation to water quality.

Significance of Effects

No significant impacts in terms of water quality from surface water drainage are expected due to the proposed development.

7.4.3.3 Potential Water Quality Impacts from Foul Drainage.

The operational phase of the proposed project will result in the production of foul sewage. If not adequately treated, there is potential for impacts on ground water and surface water quality.

All foul water will be discharged to the public sewer and will be treated at the Galway Mutton Island Wastewater Treatment Plant before discharges to Galway Bay. Irish Water have upgraded the Mutton Island Wastewater Treatment facility under the Capital Investment Plan 2014-2016 (Galway Sewerage Scheme Phase 3 – Network Upgrade Contract No.1 Volume D). The upgrade increases the capacity of the plant from 92,000 to 170,000 p.e.

Treatment process includes the following:

- Preliminary Treatment (Screening & Grit Removal)
- Primary Treatment (Upward Flow Settlement Tanks)
- Secondary Treatment (Activated Sludge)

There is full agreement with Irish Water that there is adequate capacity and capability to fully treat all sewage generated by the proposed project in the public sewage treatment system. Given that waste will be appropriately treated to the required standards in the public sewer system; no potential for adverse impact on water quality exists

Pathway: Site surface water drainage network.

Receptor: Groundwater aquifer and/or surface watercourses.

Pre-Mitigation Impact

Direct, negative, significant, long term, likely impact.

Proposed Mitigation Measures

All foul water will be discharged to the public sewer and will be treated at the Galway Mutton Island Wastewater Treatment Plant

Residual Impact

Given that waste will be appropriately treated to the required standards in the public sewer system; no potential for adverse impact on water quality exists.

Significance of Effects

No significant impacts in terms of water quality are expected due to the proposed development.

7.4.4 Assessment of Potential Health Effects

Potential health effects are associated with negative impacts on public and private water supplies and potential flooding. There are no mapped public supply group water scheme groundwater protection zones in the area of the proposed development.

The proposed site design and mitigation measures outlined in the previous subsections ensures that the potential for impacts on the water environment are not significant and so there is no pathway to public or private water supplies which in turn could impact human health.

The flood risk assessment for the development has also shown that the risk of the proposed development contributing to downstream flooding is also very low, and also that the risk of inundation of the development within the site post construction is very low due to the proposed design floor levels and site layout.

7.4.5 Do Nothing Scenario

Current land use (construction compound/scrub) will continue. Surface water drainage and infiltration to ground will continue as is occurring currently with no impact on either surface or groundwater. Potential for illicit dumping to occur at the site resulting in possible contamination of groundwater will continue to exist however the potential impacts associated with this ae imperceptible.

7.4.6 Cumulative Impacts

Potential cumulative effects on hydrology between the proposed development and other developments in the vicinity, including all those listed in Section 2.6.2 of this EIAR, were also considered as part of this assessment.

No significant cumulative impacts on the water environment are anticipated during the construction or operation phases as long as mitigation measures outlined are put in place.

7.4.7 Conclusion

There are no open surface watercourses within or adjacent to the site. As a result, there is limited potential for impact on water quality or the downstream designated sites.

Notwithstanding this, during each phase of the proposed development (construction and operation) a number of activities will take place on the proposed development site which will have the potential to affect the hydrological regime or water quality at the site or its vicinity. These potential impacts generally arise from sediment input from runoff and other pollutants such as hydrocarbons and cement based compounds, with the former having the most potential for impact during the construction phase.

Surface water drainage measures, pollution control and other preventative measures have been incorporated into the project design to minimise significant adverse impacts on water quality and downstream designated sites.

The surface water drainage plan will focus on silt management using silt fences, and silt bags, and to control runoff rates. The key surface water control measure is that there will be no direct discharge of untreated development runoff into local watercourses during either the construction or operational phases of the project. Attenuated surface water drainage will discharge to the municipal storm drainage system during the operational phase of the development.

During the operational stage there will be no impact on water environment. This will be achieved by avoidance methods and design methods including the use of attenuation tanks and pollutant interceptor devices.

Preventative measures during construction include fuel and concrete management and a waste management plan which will all be incorporated into the Construction and Environmental Management Plan (Refer to Appendix 3-3).

Overall the proposal presents no significant impacts to surface water and groundwater quality provided the proposed mitigation measures are implemented.

No significant cumulative impacts on groundwater or designated sites are anticipated.