7 HYDROLOGY AND HYDROGEOLOGY

7.1 Introduction

7.1.1 Background & Objectives

McCarthy Keville O'Sullivan (MKO), on behalf of Crown Square Ltd, has carried out an assessment of the likely significant effects of a proposed mixed use development at the Crown Square site in Mervue, Galway City 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 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 John Staunton.

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. John Staunton holds both a BSc (1st class Hons) and a PhD in Environmental Science. Prior to taking up his position with McCarthy Keville O'Sullivan in October 2014, John worked as a research assistant for several soil and hydrogeological contamination research projects being undertaken by the Earth and Ocean Sciences department in NUI Galway.

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 Engineering Report and Site-Specific Flood Risk Assessment compiled by Punch 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, 2004);
- 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 (Punchs 2018)
- Engineering Report (Punch 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. PUNCH Consulting Engineers visited the site on the 22nd of June 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); and,
- Collection of a surface water sample for chemical analysis`

In 2007, immediately prior to construction works commencing, Irish Drilling Ltd carried out a detailed intrusive site investigation which was described in Chapter 6 comprising the following,

- 16 no. Shell & Auger boreholes and associated sampling

- 7 no. Rotory Core Boreholes to a depth of between 5-14m below ground levels.
- 11 no. Trial Pits

The Irish Drilling Report is included in Appendix 6-1 of this EIAR.

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 9.1 are then used to assess the potential effect that the Proposed Development may have on them.

Table 9.1 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 Mervue, in Galway City. The total above ground site area for the current planning application (Phase 2) measures approximately 2.0 ha while the ground and basement works area extends to approximately 5.1 ha in total.

Development permitted under a previous planning permission was previously commenced and substantial works were completed in 2008. Soils and subsoils were stripped and bedrock excavated with between approximately 6-7m of excavations across the site footprint. The excavation was partially infilled with a two-story concrete frame adjacent Monivea Road as well as some sections of basement slabs and foundations. Following the onset of the economic recession, development was put on hold and the site is currently hoarded up.

The general topography of the site excluding the excavation is largely flat. Levels vary on Joyce's Rd from 28-29m AOD (above ordnance datum) and rise to approximately 30.5m AOD on Monivea Road at the eastern extremity of the site. The excavated site area has been reduced to formation level for the original basement which was at an FFL of 23.3m AOD.

The proposed development site does not contain field drains or natural watercourses and rainfall that falls on the site percolates through the soils and exposed bedrock to ground. After periods of heavy rainfall, surface water drains towards the lowest point of the site at the eastern boundary and is directed to a concrete 'sump' which was installed during the 2008 construction phase. The sump is relatively small, approximately 2m wide x 2m long x 2m deep and during periods of heavy rainfall, water is periodically pumped off-site to the municipal storm sewer.

The Terryland/Sandy River is located approximately 750m North West of the Site and flows in from the River Corrib and discharges to ground. There are no direct discharges to the Terryland/Sandy River from the proposed project.

7.3.2 Water Balance

Greenfield runoff rates for the site have been calculated from the HR Wallingford calculation tool and are included in Appendix 7-1. The Standard Average Annual Rainfall has been calculated at 1,281mm and the Qbar (mean annual flow from the site catchment) 1 in 1 year is 1.56 l/s.

7.3.3 Regional & Local Hydrology

On a regional scale, the site is located within Hydrometric Area 29 on the boarder between the Galway Bay South East catchment and the Corrib catchment, in both the Carrowmoneash (Oranmore)_SC_010 sub-catchment and the Corrib_SC_010 sub-catchment respectively under the Water Framework Directive (WFD). A regional hydrology map is shown as Figure 7.1.

The proposed development site does not contain any mapped watercourses and none were shown to exist during site walkovers. The Terryland/Sandy River is located approximately 750m North West of the Site and flows in from the River Corrib and discharges to ground.

A local hydrology map is shown as Figure 7.2.

Figure 7.1 Regional Hydrology

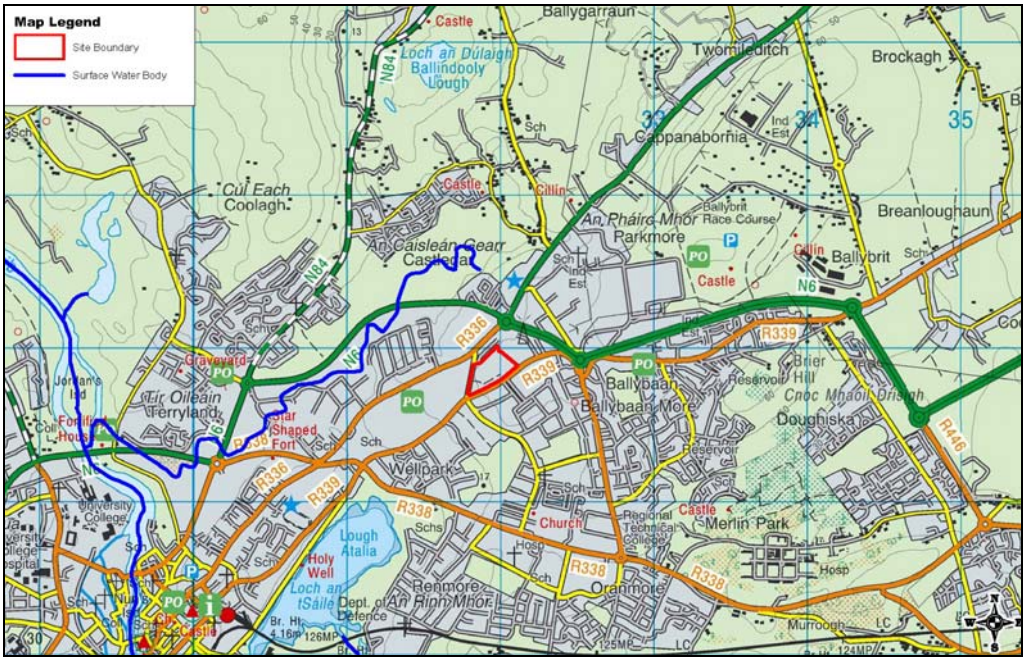


Figure 7.2 Local Hydrology

7.3.4 Site Drainage

The site of the proposed development does not currently have any surface watercourses. As the basement is already excavated only minimal water / rainwater will need to be removed from site. It is planned to let rainwater soak naturally back into the ground in areas not being worked on. In zones under construction it is proposed to run any excess water through an environmental structure such as a settlement tank / silt trap and pump clean water into the combined sewer at an agreed discharge rate during the construction phase (subject to Galway City Council agreement).

A discharge monitoring inspection programme will be put in place and agreed with the

Galway City Council Drainage Engineer. This methodology safeguards water quality and provides a solution for catching suspended solids and sediment prior to discharge into the combined sewer.

In the areas surrounding the proposed development site, the ground has been mainly built upon/made. This hard surfacing combined with extensive storm water sewer systems means that the drainage of the area has been heavily modified and generally directed to the municipal sewer or likely discharges via soakways. Where soil is at the surface, it was relatively dry, firm, and mineral based. Local watercourses, such as the Terryland/Sandy River have minimal influence, if any, on the local hydrological conditions around the site due to the distances.

Some localised and small scale temporary surface water ponding does occur within the site of the proposed development as is to be expected for any large excavation. Staining in the bedrock along the sites boundary indicates that shallow subsurface flows from areas adjacent the site drain into the excavation but the lack of water generally present in the excavated area indicates that this is relatively minor.

There is no evidence of groundwater levels at or above the existing base of the excavations.

7.3.5 Flood Risk Identification

PUNCH Consulting Engineers have completed Site Specific Flood Risk Assessment which is included as Appendix 7-2.

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.

The OPW PFRA map for the area, Map no. 210 (www.cfram.ie/pfra/interactive-mapping/), indicates that there are no areas of the proposed site within any of the indicative coastal, fluvial, or groundwater flood zones for 100-year, 200-year or 1000-year events (Flood Zones A and B). The PFRA flood extents indicate that the site of the proposed development is not located within a flood zone. There is an area to the north of the proposed site noted as being at risk of pluvial flooding.

Where complete the Catchment Flood Risk Assessment and Management (CFRAM) OPW Flood Risk Assessment Maps are now the primary reference for flood risk planning in Ireland and supersede the PFRA maps. CFRAM mapping has been completed for the area of the proposed site.

The CFRAM mapping shows that the proposed development site is outside the 10-year, 100-year and 1000-year Fluvial Flood Extent areas. An area of the land alongside the Terryland River over 750m to the west of the proposed development site is located within these Flood Extents but owing to higher land within the development site, the flood extent does not encompass the land where the proposed development is located.

Although the site is shown to not be at risk of flooding there is still potential for pluvial flooding on the site. The proposed design includes a reduced podium area with a pumped surface water drainage system. In the event of a pump failure the surface water system in the podium will fill and flooding could occur in the podium depending on the level of rainfall at the time. Details of the measures introduced to the design are outlined in detail in the Site Specific Flood Risk Assessment in Appendix 7-2

7.3.6 Surface Water Hydrochemistry

Q-rating status data is available from 1971 – 2016 for the Terryland River at an EPA monitoring point approximately 720m west of the proposed development site. No watercourses or field drains exist within the Proposed Development site, but a sample was obtained from the standing water at the lowest point in the site to determine surface water hydrochemistry. The Terryland/Sandy River has a poor status under the Water Framework Directive 2010-2015 programme and is 'at risk' of not achieving good status by 2021.

The surface water quality results (Table 9.2) at the site indicates that the water quality is good. The water was shown to have a chemical signature consistent with surface water and showed no evidence of any form of contamination. No hydrocarbons were detected in the sample. The sample results are included in Appendix 7-3.

Table 9.2 Surface water chemistry results (23/10/2018)

Test/ Parameter	Units	Sample result	EQS	AA-EQS	SW Regs A1	SW Regs A2	SW Regs A3
BOD	mg/l	<1				5	5
Suspended Solids	mg/l	<2				50	
COD	mg/l	<10	-	-	-	-	-
pH	pH Units	8.5		4.5<pH< 9.0	4.5<p H<9.0		
Nitrate as N	mg/l	<0.1	-	-	-	50	50
Nitrate as NO3	mg/l	<0.44	-	-	-	50	50
Copper, dissolved	ug/l	1	-	-	-	50	100
Lead, dissolved	ug/l	<0.5	10	-	-	50	50
Chromium, dissolved	ug/l	0.9	30	0.6	32	50	50
Nickel, dissolved	ug/l	1	50	20	-	-	-
Cadmium, dissolved	ug/l	<0.5	5	-	-	5	5
Arsenic, dissolved	ug/l	0.8	25	20		50	50

Test/ Parameter	Units	Sample result	EQS	AA-EQS	SW Regs A1	SW Regs A2	SW Regs A3
Selenium, dissolved	ug/l	1	-	-	-	10	10
Zinc, dissolved	ug/l	<5	-	-	-	3000	5000
Boron, dissolved	ug/l	15	2000	-	-	2000	2000
Petrol Range Organics Water (C5-C12) by GC-FID	ug/l	<10	10*	-	-	-	-
BTEX (Benzene, Toluene, Ethylbenzene, m,p- & o-Xylene)	ug/l	<10	-	-	-	-	-
Beryllium, dissolved	ug/l	<0.5	-	-	-	-	-
Vanadium, dissolved	ug/l	6	-	-	-	-	-
TPH CWG (Aliphatic, Aromatic Fragmentation & Carbon Banding)							
Total Aliphatics and Aromatics C8-C44	ug/l	<133 (Not Detected)	-	-	-	-	-
*Total Hydrocarbons							

7.3.7 Hydrogeology

Visean Limestones (undifferentiated), which are mapped to underlie the proposed development site are classified by the GSI (www.gsi.ie) as a Regionally Important Aquifer – Karstified (conduit). A bedrock aquifer map is shown as Figure 7.3.

This bedrock type has typically high transmissivity and low storativity with lower gradients closer to the coast.

Groundwater flow occurs along fissures, faults, joints and bedding planes. Rapid groundwater flow velocities indicate a large proportion of groundwater flow occurs in enlarged conduit systems (GSI, 2004).

Groundwater flow directions are generally to the west and southwest but as flow pathways are often determined by discrete conduits, actual flow directions will not necessarily be perpendicular to the assumed water table contours (GSI, 2004).

There is a low degree of interaction between surface water and groundwater in the wider area around the site of the proposed development, due to the coverage of built land, and the presence of an extensive drainage system and the lack of water courses.

Some localised and small scale temporary surface water ponding does occur within the site of the proposed development as is to be expected for any large excavation and in the main this ultimately percolates to ground. This occurs mainly along the eastern boundary. Staining in the bedrock along the sites eastern boundary indicates that shallow subsurface flows from areas adjacent the site drain into the excavation but the lack of water generally present in the excavated area indicates that this is relatively minor.

There is no evidence of groundwater levels at or above the existing base of the excavations. The site is located at a slightly higher level to the lands that surround it with ground water flows likely to the west (towards Terryland/Sandy River) and southwest (towards Lough Atalia). The existing excavation base level of approximately 23 mOD is significantly higher than Lough Atalia located 1km to the south west which is tidal and so at sea level. Therefore, the lack of evidence for groundwater being present continually onsite is not considered unusual. The Site Investigation report completed in 2007 included the installation of rotary core boreholes and groundwater levels recorded were on average approximately 7m below ground level across the site.

The location of the existing sump at the eastern site boundary indicates that water naturally accumulates at this location. On a precautionary basis, it is understood that protective measures have been incorporated into the engineering design of the basement at this location to ensure its integrity and allow subsurface water to flow around the basement if required.

Figure 7.3 Bedrock Aquifer Map

7.3.8 Groundwater Vulnerability

The vulnerability rating of the aquifer within the overall site is classified as "Extreme". The site has been excavated and therefore there is no protection afforded to it by soils and subsoils.

Due to the relatively high transmissivity nature of the limestone bedrock aquifer underlying the site and the highly karstified nature of the bedrock, there is a higher

potential for groundwater dispersion and movement within the aquifer and aquifer vulnerability has been considered in the mitigation measures for the site.

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 there are no proposed discharges to ground. The WFD status for the local groundwater body in terms of water quality is Good and therefore this is considered 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 9.6 – 990mg/L while electrical conductivity and hardness were reported to have mean values of 691µS/cm and 339mg/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 proposed development site predominately drains to the underlying subsoil and aquifer. The Terryland/Sandy River drains the land to the west of the site.

The River Water Quality Status (2010 – 2015) for the Terryland River is rated as "Poor" and has a risk result of "At Risk".

7.3.11 Groundwater Body Status

Local Groundwater Body (GWB) status information are available (www.catchments.ie). Refer to Figure 7.4 for the location and extent of local groundwater body.

The Clarinbridge GWB (IE_WE_G_0008) and Clare-Corrib GWB (IE_WE_G_0020) which underlie the proposed development site is assigned an 'At Risk' status based on the quantitative status and chemical status of the GWB.

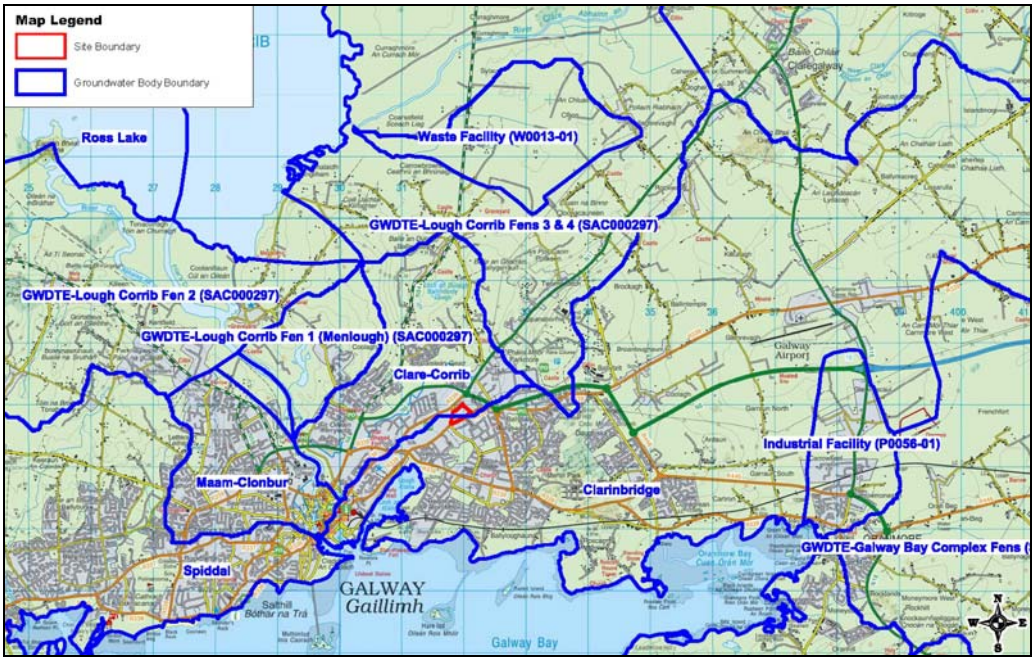


Figure 7.4 Local Groundwater Bodies

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).

Approximately 1 km to the southwest of the proposed site is the Galway Bay Complex SAC (Code: 000268), and the Terryland River, which is hydraulically downgradient of the site connects the Inner Galway Bay SPA (Code: 004031) approximately 1km downstream of the proposed site.

7.3.13 Water Resources

There are no groundwater protection zones mapped within the proposed development site or study area. A borehole well (GSI database to accuracy of 2km) for the Ballinfoyle Group Scheme water supply is located to the northwest of the site. There are two other mapped private well locations (GSI database to accuracy of 100m) within 1km, which were obtained from the GSI well database (www.gsi.ie).

No groundwater wells would be expected in the area, given the proximity to the municipal supply. 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 the proposed development and the current site topography, construction activities will be near the surface. It is not proposed to carry out extensive excavations at the site and so the potential to affect the local hydrological regime is limited. There are no surface water courses onsite or adjacent the site and there are no proposed discharges direct or indirect to surface water courses. During the operational phase all surface water will directed to the municipal storm sewer and all foul water will be direct to the municipal foul sewer.

Impacts on surface water for this development will generally be negligible and groundwater is generally the main sensitive receptor during the construction phase. Although there will be up to two basement levels below the proposed finished ground level, the excavation work for this development has been almost entirely completed, with only minor excavation required for creating pad foundations and laying pipes. 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 9.1 above, the Regionally Important Karstified Aquifer (*i.e.* Limestone) at the site can be classed as Sensitive to pollution. Also, any contaminants which may be accidently released on-site may also discharge to via groundwater flow paths to the local surface water drainage and either into the storm water sewer or into the Terryland/Sandy River and potentially into the River Corrib.

The Galway Bay Complex SAC (Code: 000268) is located 1km to the southwest of the site which is considered sensitive.

Comprehensive surface water mitigation and controls are outlined 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 groundwater or downstream surface water bodies or the municipal storm sewer.

Any introduced drainage works at the development site will mostly discharge to storm water sewers via attenuation tanks, with a small amount of basement runoff discharging to the foul sewer network via a hydrocarbon interceptor and pumping station. A very small amount of surface water from the soft-surfaced (i.e. grass and landscaped) areas will percolate to the surrounding soils.

7.3.15 Proposed Site infrastructure and Drainage Management

The proposed development has been designed using MicroDrainage software as described fully in the Section 3.3.1 of the Engineering Report which forms Appendix 3-3 of this EIAR. It is proposed that any surface water that enters the basement levels of the proposed development will drain via gravity to an attenuation tank acting as a basement sump, with a hydrocarbon interceptor. From here, water will be pumped to the Monivea foul sewer which runs along the public road on the Monivea Road.

Surface water from the site directed to the sewers will pass firstly through silt traps (sump manholes) and then through attenuation tanks prior to discharging to outfalls on either Connolly Avenue or the Monivea Road. It is proposed that approximately 70% of this surface water discharge will be to Connolly Avenue, while the remaining 30% will be to the Monivea Road. The forward flow from the site will be limited to 2l/ha/ sec in accordance with the Greater Dublin Strategic Drainage Strategy.

As described in the Engineering Report (Section 2.2.2 of Appendix 3-3) a below ground drainage system will be provided for the site. This will deal with foul water from both the residential/commercial developments and the suspended drainage system in the basement. It is proposed to connect this drainage system to the 675mm diameter public foul water sewer located in the Monivea Road. The limited volume of foul water

associated with the -1 & -2 basement is proposed to be collected via an on-site network of pipes in the lower basement and discharged to the Monivea public (Irish Water) foul sewer via two pumping stations. One at the southwestern corner of the site will deal with the foul water from the commercial development, including the hotel, while the residential development on the eastern side of the site will discharge via a pumping station on the southeastern corner. The pumping stations would have expected storage for 24 hours.

Water supply to the site will be via an existing onsite 125mm connection to the adjacent public (Irish Water) watermain.

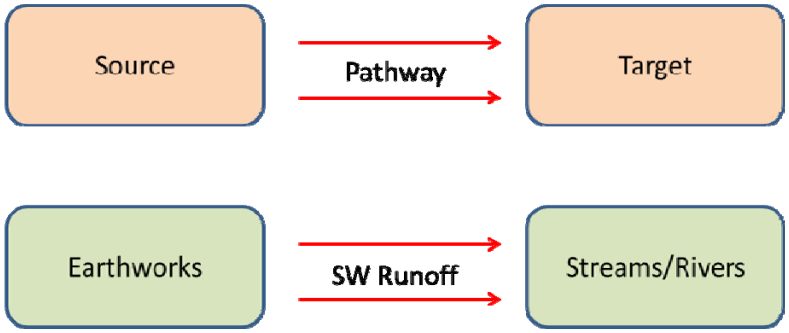
As the basement is already excavated only minimal water / rainwater will need to be removed from site. It is planned to let rainwater soak naturally back into the ground in areas not being worked on. In zones under construction it is proposed to run any excess water through an environmental structure such as a settlement tank / silt trap and pump clean water into the combined sewer at an agreed discharge rate during the construction phase (subject to Galway City Council agreement).

A discharge monitoring inspection programme will be put in place and agreed with the Galway City Council Drainage Engineer. This methodology safeguards water quality and provides a solution for catching suspended solids and sediment prior to discharge into the combined sewer.

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 Mitigation Measures:**	Control measures that will be put in place to prevent or reduce all identified significant adverse 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 (Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Waters – Discharge to Storm Sewer

Construction phase activities including site preparations, service trench construction, levelling/construction, tree removal and pad foundation excavation will require some level of 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.

The site is relatively unique in that there are no adjacent natural or man-made watercourses and surface water generally percolates to ground. Also, the nature of the mineral soils (gravelly clay) at the site and the bedrock (limestone) means that sediments are not easily entrained in surface waters. The water currently present on site is clear however, the construction activities can result in the release of suspended solids. It is planned to let rainwater soak naturally back into the ground in areas not being worked on. In zones under construction it is proposed to run any excess water through an environmental structure such as a settlement tank / silt trap and pump clean water into the combined sewer at an agreed discharge rate during the construction phase (subject to Galway City Council agreement). This could result in an increase in the suspended sediment load, resulting in increased turbidity to the storm sewer. This process will only be required prior to the sub-basement and retaining walls being constructed and at that point the drainage system will be as described for the Operational Stage of the project. There are no open water courses at or adjacent the site which could be affected by sediment release.

Pathways: Intermittent pumping.
Receptors: Down-gradient municipal storm sewer.

Pre-Mitigation Impact
Indirect, negative, moderate, short-term, likely impact.

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

- A Trade Effluent Discharge License which will regulate flow volumes and quality will be applied for to Galway City Council prior to construction commencing
- Prior to the commencement of earthwork silt fencing will be placed down-gradient of the construction areas where drains or drainage pathways are present.
- As construction advances there may be a small requirement to collect surface water within the site. As the basement is already excavated only minimal water / rainwater will need to be removed. It is planned to let rainwater soak naturally back into the ground in areas not being worked on. In zones under construction it is proposed to run any excess water through an environmental structure such as a settlement tank / silt trap and pump clean water into the combined sewer at an agreed discharge rate during the construction phase (subject to Galway City Council agreement).
- A discharge monitoring inspection programme will be put in place and agreed with the Galway City Council Drainage Engineer. This methodology safeguards water quality and provides a solution for

catching suspended solids and sediment prior to discharge into the combined sewer.

- No pumped construction water will be discharged directly into any local watercourse;
- Daily monitoring and inspections of site drainage during construction will be completed;
- 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', CIRlA, 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:
  - Small working areas, covering stockpiles, weathering off stockpiles, cessation of works in certain areas or other similar/equivalent or appropriate measures.
- In-Line controls:
  - 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 the site sump. Silt fences are effective at removing heavy settleable solids. This will act to prevent entry to the sump 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. 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 to the east of the site and the discharge allowed percolate to ground.

Monitoring:
An inspection and maintenance plan for the on-site drainage system will be prepared in advance of commencement of any construction works. Regular inspections of the

sump and holding tank will be undertaken, especially after heavy rainfall, to check for visual evidence of sediment in the water body.

During the construction phase field testing and laboratory analysis of a range of parameters with relevant regulatory limits and EQSs will be undertaken for the holding/settlement tank, and specifically following heavy rainfall events (*i.e.* weekly, monthly, and event-based monitoring is proposed).

Residual Impact

Indirect, negative, slight, short-term, medium probability impact on the municipal sewer.

Significance of Effects

No significant effects on surface water quality are expected due to site excavation work. There is no hydraulic connectivity between the site and open watercourses. Mitigation measures will be employed on a precautionary basis to protect the storm sewer. The potential effects on the storm sewer will be slight as the flow and quality will be controlled for the short-term use of the discharge.

7.4.2.2 Potential Release of Hydrocarbons during Construction Stage

Accidental spillage during refueling of construction plant with petroleum hydrocarbons is a significant pollution risk to groundwater, surface water (via subsurface flows) and associated ecosystems, and to terrestrial ecology. In this case, the most sensitive receptor is groundwater. 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 discharge to the municipal sewer.
Receptor: Groundwater, surface water (via subsurface flows) and surface water sewer.

Pre-Mitigation Impact
Indirect, negative, significant, 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 refuelling will be carried out at designated refuelling stations on site. Drip trays will be used when refuelling all plant. Absorbent material and pads will be available in the event of any accidental spillages. Alternatively, mobile double skinned fuel bowsers may be used. Fuel bowsers will be parked on a level area in the site when not in use.

Only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays, spill kits and fuel absorbent mats will be used during all refuelling operations.

The following mitigation measures are proposed to avoid release of hydrocarbons at the site:

- Minimal maintenance of construction vehicles or plant will take place on site.
- Drip trays will be used to control on-site refuelling at controlled fuelling stations.
- On-site diesel tanks will be double skinned to 110% of their capacity.
- Containment stores will be used for refuelling of small plant such as consaws etc.
- Any fuel bowsers used on site will be custom-built / bunded to 100% of capacity. Fuel bowsers will be parked on a level area in the construction compound when not in use.
- 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 volumes stored on site will be minimised. Any fuel storage areas will be bunded appropriately for the fuel storage volume for the time period of the construction.
- Plant used will be regularly inspected for leaks and fitness for purpose.
- Any Hazardous Materials will be stored in drip trays in secure containment stores.
- Refuelling/containment store signage will be erected at predetermined locations around the site.

An emergency plan for the construction phase to deal with accidental spillages will be contained within Environmental Management Plan. Spill kits will be available to deal with any accidental spillage in and outside the refuelling area

Residual Impact
Indirect, negative, imperceptible, short-term, unlikely impact on groundwater and surface water.

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

7.4.2.3 Groundwater and Surface Water Contamination from Wastewater Disposal (Construction Phase)

Release of effluent from on-site wastewater systems has the potential to impact on groundwater and surface waters.

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.

7.4.2.4 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 ⩾ 6 ⩽ 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 sewer or into watercourses represents a risk to the aquatic environment.

There is no direct hydraulic connection between the site and open water courses.

Pathway: Site drainage network.
Receptor: Surface water sewer system and ground water

Pre-Mitigation Impact
Indirect, negative, moderate, short term, likely impact to surface water and/or sewer.

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.

Significance of Effects

No significant effects on water quality are anticipated.

7.4.2.5 Potential Impacts on Hydrologically Connected Designated Sites

The Galway Bay Complex SAC (Code: 000268) is located 1m to the southwest of the site.

Possible effects include water quality impacts most likely via groundwater flow paths which could be significant if mitigation is not put in place.

Pathway: Groundwater flowpaths.
Receptor: Down-gradient water quality and designated sites.

Pre-Mitigation Impact
Indirect, negative, moderate, long term, likely impact to surface water and groundwater quality.

Proposed Mitigation Measures
The proposed mitigation measures for protection of groundwater quality and surface water quality which will include on site drainage control measures (i.e. sump and settlement/holding tank) will ensure that the quality of runoff from proposed development areas will be very high. 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.

The majority surface water arising on site will drain to ground, with no proposed outfall other than intermittent and temporary pumping of surface water to the municipal foul sewer. Groundwater quality risks are reduced during the construction phase by use of the control measures described above.

Residual Impact

No impacts on water quality or downstream designated sites are anticipated.

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 surface water runoff from the proposed development is to be entirely separate from the development's foul sewerage network development drainage as described in the PUNCH Engineering Report.

All surface water run-off from roof areas and hardstanding areas shall be collected in the gravity pipe network. The surface water from any open deck parking areas or pavements shall be collected via a series of gullies and channels.

Any surface water that is generated within the -1 & -2 basement will run through a bypass interceptor prior to being pumped to the foul water system, this figure is estimated at 0.04l/s based upon approximately 1600 parking bays at 2l/ bay/ day.

New surface water connections will be designed to connect by gravity to the existing public drainage network, with 70% of limited forward flow discharging to the Tuam Road located north of the site and the remainder discharging to the Monivea Road

located south of the development. On-site attenuation is to be provided to restrict flows from the development to greenfield runoff rates of 2 litres per second per hectare across the site in accordance with the Galway City Development Plan.

On the eastern half of the site, a portion of the external podium level drops down to Basement -1 level. Therefore, it will not be possible to discharge surface water from this area by gravity to the public sewer. Surface water from the proposed reduced podium area on site will be collected by gravity and then pumped via rising main to the North of the site where it will connect into the main line of the proposed surface water drainage network. In the event of a pump failure the surface water system in the podium will fill and flooding could occur in the podium depending on the level of rainfall at the time. Details of the measures introduced to the design to protect property are outlined in detail Section 5.2 of the Site Specific Flood Risk Assessment in Appendix 7-2.

Pathway: Site surface water drainage network.
Receptor: Groundwater aquifer and surface water.

Pre-Mitigation Impact
Direct, negative, slight, long term, low probability impact.

Proposed Mitigation Measures
The risk of flooding is minimized by the collection, treatment and discharge of water to the municipal sewers. While there is a risk of flooding to the reduced height podium should the proposed pump system fail however the risk associated with this is mainly to property and people. The mitigation measures described in Section 5.2 of the Site Specific Flood Risk Assessment reduces this risk.

Water quality risks are reduced by use of hydrocarbon interceptors and silt traps.

Residual Impact

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

Significance of Effects

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

7.4.3.2 Potential Emissions to Groundwater and/or Surface water

There are no proposed emissions to ground or surface water courses from the site during the operational phase.

All surface water run-off from roof areas and hardstanding areas shall be collected in the gravity pipe network. The surface water from any open deck parking areas or pavements shall be collected via a series of gullies and channels.

Any surface water that is generated within the -1 & -2 basement will run through a bypass interceptor prior to being pumped to the foul water system.

New surface water connections will be designed to connect by gravity to the existing public drainage network as described above in Section 7.4.3.1.

Pathway: Site surface water drainage network.
Receptor: Groundwater aquifer and surface water.

Pre-Mitigation Impact
Direct, negative, slight, long term, low probability impact.

Proposed Mitigation Measures
The risk of emissions is minimized by the collection, treatment and discharge of water to the municipal sewers.
Water quality risks are reduced by use of hydrocarbon interceptors and silt traps.

Residual Impact

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

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.

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 buildings within the site post construction is very low due to the proposed design floor levels and site layout and measures described in the Site Specific Flood Risk Assessment.

7.4.5 Do Nothing Scenario

The site currently comprises an excavated partially constructed commercial development which is hoarded up. Phase 1 of the development (which includes Commercial Offices (Blocks A-E), Hotel and Site Infrastructure, including all basement structures for the entire site) has received permission, and will be constructed regardless of whether this currently proposed phase 2 is permitted or not. The potential impacts are considered to be permanent direct slight negative on Hydrology.

7.4.6 Cumulative Impacts

Due to the localised and shallow nature of the proposed construction works which will be kept within the proposed project site boundary, there is no potential for significant cumulative effects on the water environment in-combination with other local developments. The construction of the proposed development and all associated site infrastructure will only require relatively localised excavation works the output of

which will be retained onsite and therefore will not contribute to any significant cumulative effects on water.

Water management during the operational phase (including the Phase 1 element of this development) will be highly controlled and so there is no potential for significant cumulative effects.

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

The site is naturally separated from any local watercourses, and this setback distance means that there is limited potential for impact on surface 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, some of 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.

During the construction phase, the surface water drainage plan will focus on silt management to control runoff rates to the municipal sewer. The key surface water control measure is that there will be no direct discharge of development runoff into local watercourses. This will be achieved by avoidance methods and design methods (*i.e.* surface water drainage to sump and holding tank).

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 3-2).

Overall the proposal presents no significant potential for 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.