5.0 LAND, SOILS, GEOLOGY AND HYDROGEOLOGY

5.1 INTRODUCTION

This chapter assesses and evaluates the potential impacts of the development on the land, soil, geological and hydrogeological aspects of the proposed development site and the surrounding area. In assessing likely potential and predicted effects, account is taken of both the importance of the attributes and the predicted scale and duration of the likely environmental effects.

5.2 METHODOLOGY

5.2.1 Criteria for rating of effects

This chapter evaluates the effects, if any, which the development will have on Land, Soils, Geology and Hydrogeology as defined in the Environmental Protection Agency (EPA) '*Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports'* (EPA, 2017) as well as in line with Article 94 and Schedule 6 of the Planning and Development Regulations 2001 (as amended) and Article 5 and Annex IV of the EIA Directive (2011/92/EU, as amended). The Draft EPA document entitled '*Advice Notes for Preparing Environmental Impact Statements'* (EPA, 2015) is also followed in this geological and hydrogeological assessment and classification of environmental effects. Due consideration is also given to the guidelines provided by the Institute of Geologists of Ireland (IGI) in the document entitled '*Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements'* (IGI 2013). Finally, the document entitled 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' by the Transport Infrastructure Ireland (TII) formerly National Roads Authority (NRA) (TII, 2009) is referenced where the methodology for assessment of impact is appropriate.

The rating of potential environmental effects on the land, soil, geological and hydrogeological environment is based on the standard EIAR impact predictions table included in Chapter 1 which takes account of the quality, significance, duration and type of effect characteristic identified (in accordance with impact assessment criteria provided in the Draft EPA Guidelines (2017) publication).

The duration of each effect is considered to be either momentary, brief, temporary, short-term, medium term, long-term, or permanent. Momentary effects are considered to be those that last from seconds to minutes. Brief effects are those that last less than a day. Temporary effects are considered to be those which are construction related and last less than one year. Short term effects are seen as effects lasting one to seven years; medium-term effects lasting seven to fifteen years; long-term effects lasting fifteen to sixty years; and permanent effects lasting over sixty years.

The TII (2009) criteria for rating the magnitude and significance of impacts on the geological related attributes and the importance of hydrogeological attributes at the site during the EIA stage are also relevant in assessing the impact and are presented in Tables 1-5 in Appendix 5.1.

The principal attributes (and effects) to be assessed include the following:

- Geological heritage sites within the vicinity of/ within the perimeter of the proposed development site;
- Landfills, industrial sites in the vicinity of the site and the potential risk of encountering contaminated ground;
- The quality, drainage characteristics and range of agricultural use(s) of subsoil around the site;
- Quarries or mines in the vicinity and the potential implications (if any) for existing activities and extractable reserves;
- The extent of topsoil and subsoil cover and the potential use of this material on site as well as any requirement to remove it off-site as waste for disposal (D) or recovery (R) options;
- High-yielding water supply wells/ springs in the vicinity of/ within the site boundary to within a 2km radius and the potential for increased risk presented by the proposed development;
- Classification (regionally important, locally important etc.) and extent of aquifers underlying the site boundary area;
- Increased risks presented to the groundwater bodies by the proposed development associated with aspects such as, for example, the removal of subsoil cover, removal of aquifer (in whole or part thereof), spatial drawdown in water levels, alteration in established flow regimes, and changes in local/ regional groundwater quality;
- Natural hydrogeological/ karst features in the area and potential for increased risk presented by the activities at the site; and
- Groundwater-fed ecosystems and the increased risk presented by operations both spatially and temporally.

5.2.2 Sources of Information

Desk-based geological information on the substrata (both Quaternary deposits and bedrock geology) underlying the extent of the site was obtained through accessing databases and other public archives where available. Data was sourced from the following:

- Geological Survey of Ireland (GSI) - on-line mapping, Geo-hazard Database, Geological Heritage Sites & Sites of Special Scientific Interest, Bedrock Memoirs and 1: 100,000 mapping;
- Teagasc soil and subsoil database;
- Ordnance Survey Ireland - aerial photographs and historical mapping;
- Environmental Protection Agency (EPA) – website mapping and database information;
- National Parks and Wildlife Services (NPWS) – Protected Site Register; and
- Clare County Council - illegal landfill information.

Site-specific data was derived from the following sources:

- *Ground Investigation Report, Art Datacentre, Lands East of Ennis Town Co. Clare*. Ground Investigation Ireland (GII) (May 2021);
- *Engineering Planning Report – Drainage and Water Services* - Art Data Centre. Clifton Scannell Emerson Associates, CSEA (May 2021);
- *Flood Risk Assessment -Art Data Centre*, CSEA (May 2021);
- *Construction Environmental Management Plan* - Art Data Centre, CSEA (May 2021);
- Various design site plans and drawings; and
- Consultation with site engineers/ planners/ architects.

5.2.2.1 Site Investigation Works

Site investigations were carried out by Ground Investigations Ireland (GII) during April-May 2021. These investigations included the following:

- Excavation of thirty-one (31) no. trial pits (TPs) across the proposed development area to examine existing soil conditions and whether any infill or imported material is present on site (maximum depths up to 3.30 metres below ground level (mbgl) with refusals on boulders or rockhead).
- Drilling of twenty-one (21) no. bedrock boreholes; (PBH periphery boreholes and BH geotechnical boreholes; 80 mm diameter, depths up to 25 mbgl to characterise the site in terms of subsoil cover, depth to bedrock, and prevalence of weathered and/ or competent bedrock spatially).
- Logging of the arisings from each trial pit in accordance with BS5930:2015, noting any field evidence of potential impact by hazardous substances.
- Collection of soil samples from each of the trial pit arisings including samples selected for laboratory analysis focusing on potential contamination and the classification of the materials for waste disposal options. Other soil testing included 47 no. soil samples selected for laboratory analysis for pH and sulphate as part of characterising the subsoil aggressivity to concrete, spatially.
- Waste Acceptance Criteria (WAC) sampling with an asbestos fibre survey of samples collected at selected trial pit locations.
- Collection of 4 no. groundwater samples for laboratory analysis -including for hydraulically up-gradient [control] sampling points (eastern site boundary) and down-gradient sampling points at the southwestern site boundary line.

The location of all completed trial pits and boreholes at which representative samples were collected is presented in Figure 5-1 Site Investigation Exploratory Hole Map (GII, 2021) below.

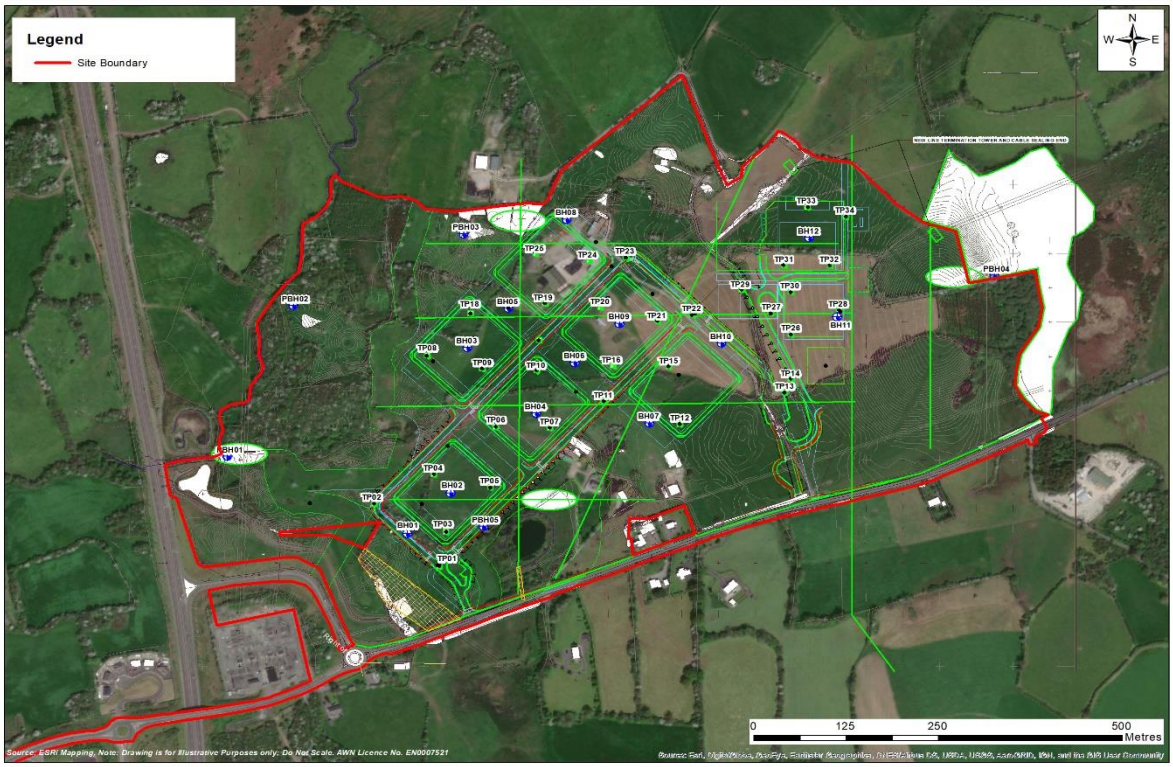

Figure 5-1 *Site Investigation Exploratory Hole Map (GII, 2021)*

Trial pit and borehole logs are included in the GII site investigation report which include a description of the lithologies observed in each excavation, depth to bedrock, refusals, type of bedrock and rock quality distribution (RQD) to borehole termination depth.

Representative samples were collected from arisings at trial pits and transferred directly into laboratory-supplied containers which were then clearly labelled to identify the sample location and depth (metres below ground level). Standard sampling techniques were used to collect the samples and designed to reduce the risk of any cross contamination between sampling events. Appendix 5.2 presents tables with the soil and groundwater analytical test results.

5.2.2.2 Geophysical Survey

APEX Geophysics Limited (AGL) carried out a geophysical survey in May-June 2021 as part of the ground investigation for the proposed development. The underlying objectives of the geophysical survey were to identify any potential underground karst conduits/ water-bearing strata within the overall study area including features which could potentially be discharging to Tooreen Lough and/ or to pond features located to the north, south and east of the site. In addition, the aims of the survey were to provide information on the subsurface conditions across the site. A summary of the geophysical interpretation is presented in Figure 5.15 below.

The geophysical findings along with the borehole data provides key information with regard to the interpretation of subsurface anomalies present across the site and how these may potentially interact with interpreted groundwater movement patterns. The geology identified provide input to the hydrogeological conceptual site model (CSM) cross sections presented in Figures 5.16-5.21.

5.3 RECEIVING ENVIRONMENT

The receiving environment is discussed in terms of land geology, soils, hydrogeology and site history including potential for existing and historical contamination.

5.3.1 General Description of the Site

5.3.1.1 Site Setting

The site comprises approx. 58 hectares (ha) and is located to the east of Ennis in the townland of Tooreen and Cahernalough, Co Clare. The lands are bordered to the south by the R352 (Tulla Road) and to the west by the M18 national route. The lands are traversed by a [Gas Networks Ireland, GNI] transmission gas pipeline and overhead powerlines connecting to the existing Ennis 110kv Substation that adjoins the western boundary.

The site location map for the proposed development is presented in Figure 5.2 below.

Figure 5-2 *Site Location with site layout (AWN, 2021)*

5.3.1.2 Land Use

The site is predominantly in agricultural use currently with the exception of a few residential properties. The site comprises of a series of irregularly shaped fields divided by hedgerows and ditches typical of an agricultural setting. The site contains a number of existing dwellings and farm outbuildings. A number of these will be retained and some demolished as part of the proposed site development.

Immediately beyond the southwest corner of the site boundary lies an existing ESB substation. The town of Ennis is located approx. 3.5 Km farther to the southwest. The western proposed development boundary is bounded by the M18 national route and the southern site boundary is bounded by the R352 road.

According to the EPA (2021) there are no licensed activities within the site boundary of the proposed development or directly adjacent to it. There are two licensed activities listed by the EPA as 'currently active' (i.e. west of the proposed development and located in Ennis, Gort Road Industrial Estate) as follows:

- Paclene Limited (P0144-01) -Licence issued in 2017; and
- Essidev S.A. (P0061-03) -Licence issued in 2015.

Both of these premises are licensed units and are located >3 Km downgradient (i.e. west) of the proposed development; there are no licensed activities located upgradient (i.e. east) of the proposed site.

Consultation with Clare County Council has confirmed that there are no known illegal/ historic landfills within 500 metres of the proposed site boundary.

Historical Ordnance Survey Ireland (OSi) maps (https://geohive.ie/) were examined for the purpose of an environmental due diligence. O.S. maps are available from 1830s-1930s (the historic 6" maps) and 1900 from the historic 25" maps. The historic maps indicate that the subject site was greenfield up to the present day (refer Figure 5-3 below).

There is no evidence to indicate industrial processes have been undertaken within the subject site boundary which appears to have always been used for agricultural purposes (for example grazing, storing cattle). This land use has not materially changed from the 1830s to 2005 and to present day (refer also Figure 5-4 below).

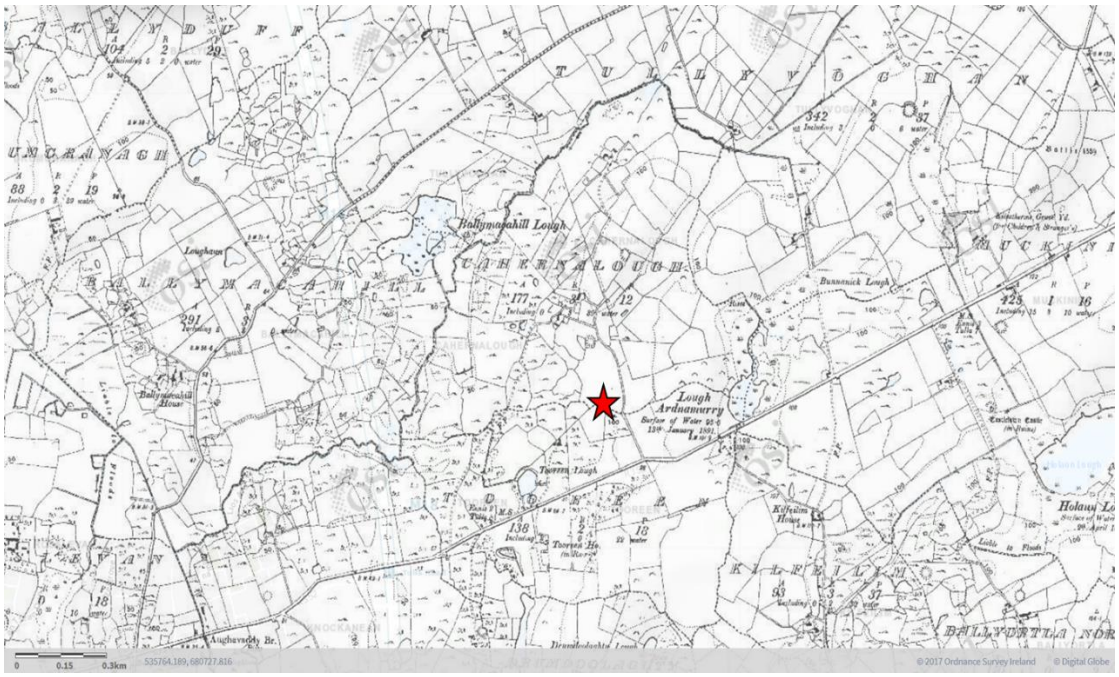

Figure 5-3 *Historic 6" mapping (Note: Site marked with red star; Source: OSi,)*

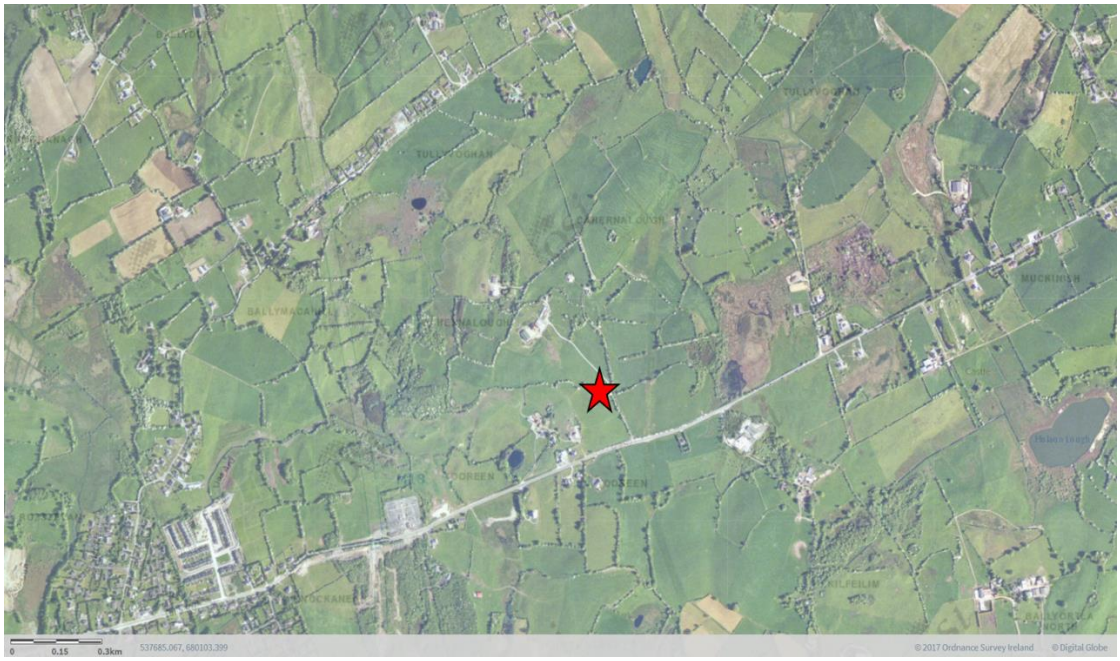

Figure 5-4 *Aerial 2005 Map (Site marked with red star; Source: OSi,)*

5.3.1.3 Topography

The topographical gradient across the development boundary is quite variable mostly due to the drumlin type features present. Overall, the ground level generally falls from east to west/ southwest with an elevation of approx. +15mOD (metres above Ordnance Datum) in the west and +46mOD in the east.

Additional detail on topographical gradients and general terrain elevations across the proposed development is presented in Chapter 6 Hydrology, Section 6.3.2.

5.3.1.4 Regional & Local Hydrology

Regional surface water drainage comprises the Ballymacahill River which runs to the north/ west of the development site boundary and which generally flows in a NE to S/SW direction. The river is also known as the Spancelhill (EPA, 2021) and converges with the River Fergus farther to the SW which in turn ultimately discharges into the Shannon Estuary.

Additional detail on the regional drainage (i.e. Ballymacahill River which converges with the River Fergus c. 3.0Km farther to the SW which subsequently discharges into the Shannon Estuary at the Lower River Shannon Special Area of Conservation (SAC)) and local surface water patterns (which comprise a feature lake, a number of ponds, swallow holes and spring discharges, the latter as streams to the main watercourse, Ballymacahill River) is discussed in Chapter 5 Hydrology, Section 6.3.3.

Regional and local hydrology is intrinsically connected to the hydrogeological setting within the proposed development.

5.3.2 Soils

The GSI/ Tegasc (2021) mapping shows that the soil type beneath the local area is composed of a range of lithologies. The principal soil types are described as follows:

- To the eastern boundary, the site is composed of AminPDPT - Poorly drained mineral soils with peaty topsoil, derived from mainly non-calcareous parent materials. Peaty gleys are included in this category.
- As the site extends to the west, the site is composed of BminDW - Deep well drained mineral soil derived from mainly calcareous parent materials. Grey, brown podzolics and brown earths (medium high base status) are included in this category and BminSW - Shallow well drained mineral soil, derived from mainly calcareous parent material which extends to the western boundary. Renzinas and lithosols are included in this category.
- A section of the southern boundary is composed of BminSRPT.

The following soil groups also occur but are less widespread and found in minor formations:

- FenPeat – which indicates wetland areas with organic material.
- AlluvMin – mineral alluvium.
- BminSP – shallow poorly-drained mineral soil, derived mainly from calcareous parent materials. Surface water gleys and groundwater gleys are included in this category.
- Lac - Lacustrine Deposits (undifferentiated).

Figure 5-5 below presents the soils map indicating the soil lithologies discussed above.

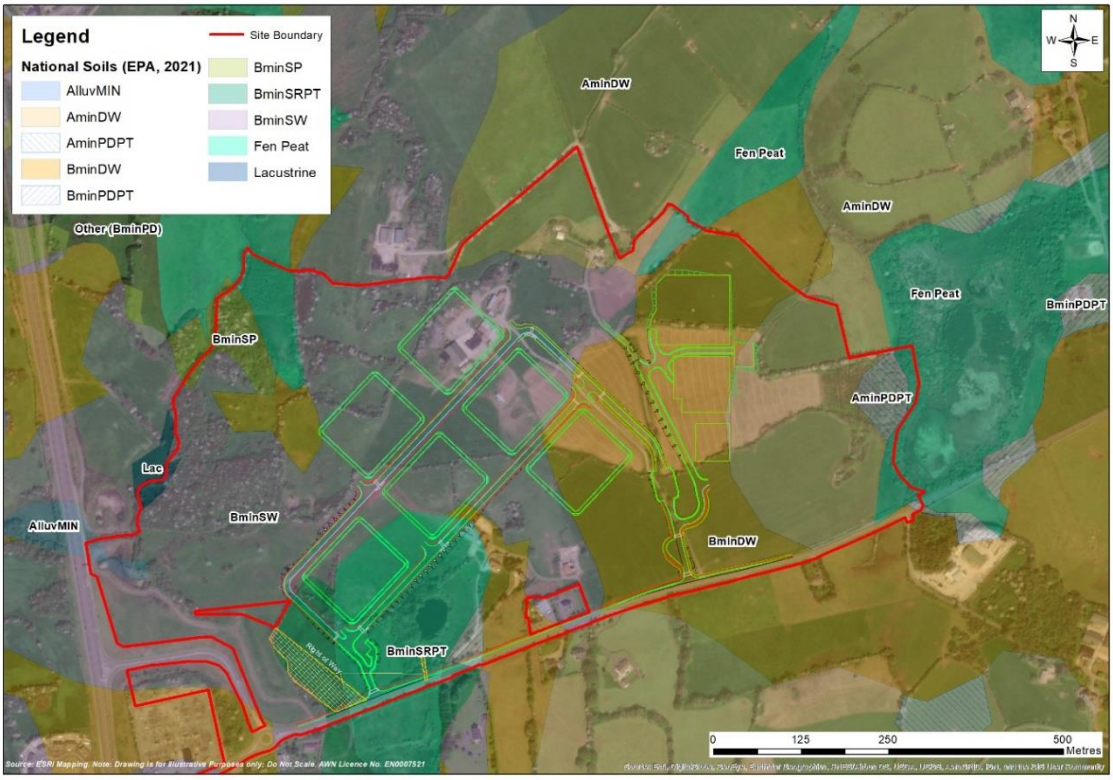

Figure 5-5 *Soils Map with the proposed site layout (Source: EPA/ Teagasc, 2021)*

5.3.3 Subsoils

The Quaternary geological period extends from about 1.5 million years ago to the present day and can be sub-divided into the Pleistocene Epoch, which covers the Ice Age period, and which extended up to 10,000 years ago and the Holocene Epoch, which extends from that time to the present day.

The GSI/ Teagasc mapping database of the subsoils in the area of the proposed development site indicates four (4) no. principal soil types, as shown in Figure 5-6 below. The subsoil types present across the site are:

- LIMESTONE till Carboniferous (TLs). A large section of the eastern boundary of the site is composed of limestone TILL. This till is made up of glacial CLAYs which are less permeable than alluvium subsoils.
- SANDSTONE till Devonian (TLs). A large section of the eastern and northern boundaries of the site are composed of sandstone TILL. This till is made up of glacial CLAYs which are less permeable than alluvium subsoils.
- Karstified bedrock outcrop or subcrop (KaRck). The majority of the western section of the subject site is composed of karstified bedrock. This indicates that the limestone bedrock is heavily karstified in this area and is close to the surface. Refer to Sections 5.3.4 & 5.3.6 below which describes the bedrock geology and aquifer vulnerability for the site and surrounding area.
- Fen Peat – which indicates wetland areas comprising organic material.

The EPA (2021) has classified this area as agricultural land used primarily for pasture farming activities.

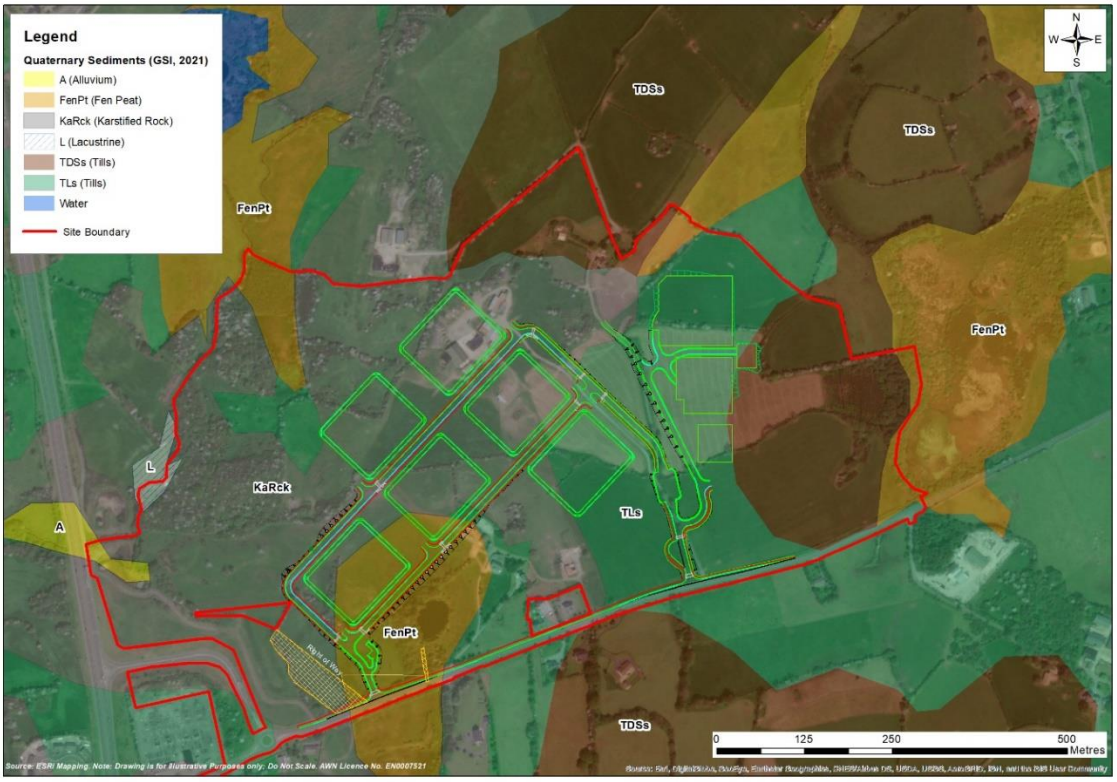

Figure 5-6 *Subsoils Map with the proposed site layout (Source: GSI, 2021)*

Recent investigations undertaken by GII confirm rockhead close to the surface within the west of the site and at local highs across the site. Generally, recorded depth to bedrock (dtb) increases towards the east. The depth of overburden varies to match this with sandy clayey GRAVELS reported to a depth of 2.00 metres below ground level (mbgl) noted along the western section; similar GRAVEL material is noted to 5.00 mbgl to the eastern section of the site (GII, 2021).

The geotechnical/ environmental site investigations were completed in April and May 2021 within the proposed development boundary in order to better characterise the subsoils, nature of the bedrock and where feasible local groundwater conditions. The thirty-four (34) no. trial pits (referenced as TP01 to TP34) were excavated using a 14-ton tracked excavator. The twenty-one (21) no. boreholes (referenced PBH01 to PBH05 & BH01 to BH13) were drilled using a rotary core rig to a depth between 5.0 mbgl to 25.0 mbgl. Water strikes are detailed in the trial pit logs, however due to the water flush drilling method used for the rotary coring there is no detail on groundwater strikes recorded on the borehole logs. The trial pit and borehole logs are available in the GII site investigation report. The soil profile is highly variable across the site and can generally be summarised as follows:

- Topsoil 0.0 m to >0.3 mbgl
- Subsoil 0.3 m to >11.5 mbgl
- Weathered Limestone Bedrock/ Bedrock 1.00 m to >25.0 mbgl

Figure 5-1 above presents the locations of completed trial pits and borehole. Trial pit and borehole logs (GII, 2021) are presented in the site investigation report. Furthermore, a detailed hydrogeological CSM is provided under Section 5.3.18 below.

5.3.4 Bedrock Geology

Inspection of the available GSI (2021) records (Data Sheet 14 and on-line mapping database) shows that the bedrock geology of the site and the surrounding area is dominated by rocks from the Tournaisian to Chadian – Arundian stage which is part of the Dinantian Series of the Carboniferous Era. The site is located over crinoidal & cherty limestone & dolomite referred to as the Tubber Formation (Rock Unit code: CDTUBB) (refer to Figure 5-7 below).

The regional area is highly geologically variable with mainly limestone bedrock. GSI maps do show the site as overlying the Tubber formation which is bordered to the east by a thin formation called Cregmahon Member. This unit is bounded by Waulsortian Limestones. The Tubber Formation is bounded by the Burren Formation to the west. The Burren Formation is made up of pale grey clean skeletal limestone.

The GSI (2021) bedrock geology map (100K structural database) indicates no structural faults in the study area.

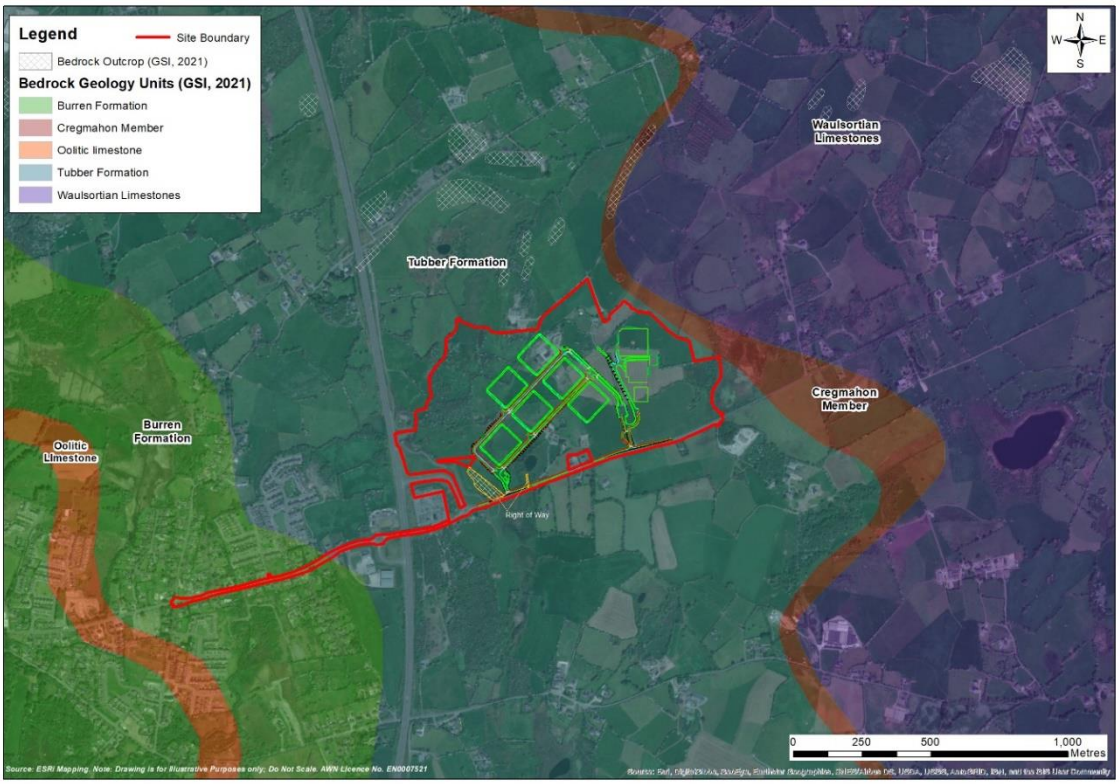

Figure 5-7 *Bedrock Geology Map with the proposed site layout (Source: GSI, 2021)*

Site investigations (GII, 2021) indicate bedrock depth is highly varied throughout the site with rockhead recorded at 0.60 mbgl at BH06 (western section of the site), 2.30 mbgl at BH08 (centre of the site) and 6.20 mbgl at PBH04 (eastern section of the site). The depth to bedrock is shallow across the site especially in the western and centre sections while bedrock is deeper along the eastern boundary owing to the thicker subsoils present. However, the bedrock surface is observed as undulating across the site and there are localised points with shallow bedrock for example within the eastern section of the site. Section 5.3.18 presents the CSM for the subject site. Bedrock was not encountered at any of the trial pits (with refusal also noted).

5.3.5 Regional Hydrogeology

The GSI has devised a system for classifying the bedrock aquifers in Ireland. The aquifer classification for bedrock depends on a number of parameters including, the area extent of the aquifer (km^2), well yield (m^3/d), specific capacity ($m^3/d/m$) and groundwater transmissivity (mm^3/d). There are three main classifications: regionally important, locally important and poor aquifers. Where an aquifer has been classified as regionally important, it is further subdivided according to the main groundwater flow regime within it. This sub-division includes regionally important fissured aquifers (Rf) and regionally important karstified aquifers (Rk). Locally important aquifers are sub-divided into those that are generally moderately productive (Lm) and those that are generally moderately productive only in local zones (Ll). Similarly, poor aquifers are classed as either generally unproductive except for local zones (Pl) or generally unproductive (Pu).

The bedrock aquifers underlying the subject site according to the GSI National Draft Bedrock Aquifer Map are classified crinoidal & cherty limestone & dolomite. GSI mapping has shown the site overlies one aquifer class which is Regionally Important Aquifer (Rkc) which indicates that the aquifer bedrock is dominated by karst environment with conduit flow (refer to Figure 5-8 below).

'Karstification' is the process whereby limestone is slowly dissolved away by percolating waters. It most often occurs in the upper bedrock layers and along certain fractures, fissures and joints, at the expense of others. Karstification frequently results in the uneven distribution of permeability through the rock, and the development of distinctive karst landforms at the surface (e.g., swallow holes, caves, dry valleys), some of which provide direct access for recharge/surface water to enter the aquifer. The landscape is characterised by largely underground drainage, with most flow occurring through the more permeable, solutionally-enlarged, interconnected fissure/conduit zones, which may be several kilometres long. Groundwater velocities through fissures/conduits may be high and aquifer storage is frequently low. Groundwater often discharges as large springs (>2,000 m^3/d), which range from regular and dependable to highly variable ('flashy'). There is strong interconnection between surface water and groundwater. The degree of karstification ranges from slight to intense.

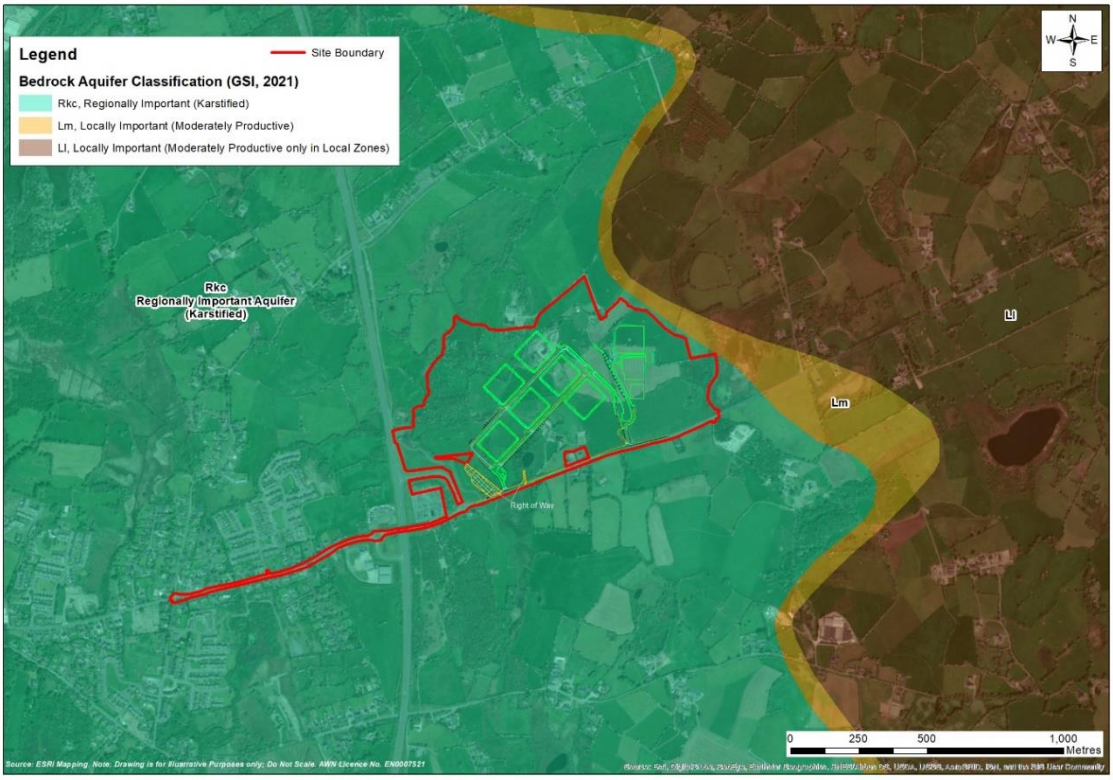

Figure 5-8 *Aquifer Classification Map with the proposed site layout (Source: GSI, reviewed 2021)*

5.3.6 Aquifer Vulnerability

Aquifer vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated generally by human activities. Due to the nature of the flow of groundwater through bedrock in Ireland, which is almost completely through fissures, the main feature that protects groundwater from contamination, and therefore the most important feature in protection of groundwater, is the subsoil (which can consist solely or of mixtures of peat, sand, gravel, glacial till, clays or silts).

The GSI currently classifies the aquifer vulnerability in the region as Extreme (E) to the south-western and western boundary. Aquifer vulnerability decreases to the east of the proposed development site. The eastern section of the site is classified as High (H) to Moderate (M). As can be seen from Table 5. 1 below an Extreme vulnerability with clayey subsoil denotes a depth to bedrock of 0-3 mbgl with High vulnerability categorised as 3-5 mbgl while subsoil thickness increases under the Moderate category.

The aquifer vulnerability class in the region of the site is presented below as Figure 5-9.

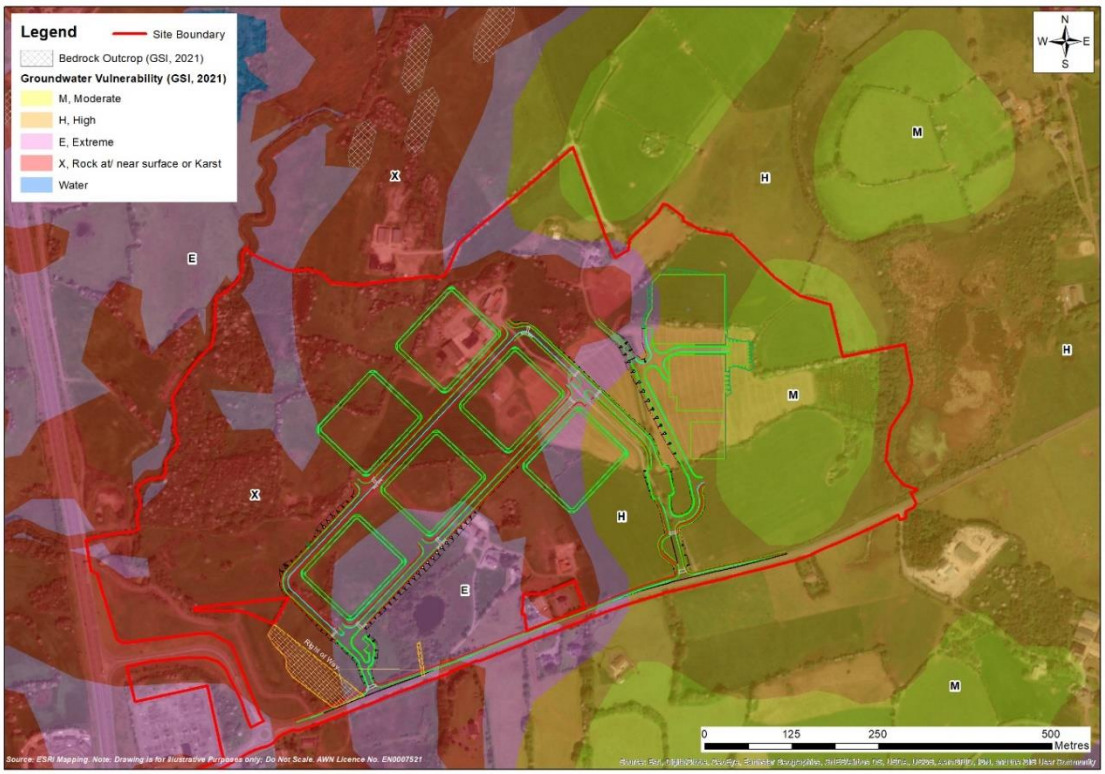

Figure 5-9 *Aquifer Vulnerability Map with the proposed site layout (Source: GSI, 2021)*

Table 5.1 below presents the GSI vulnerability mapping guidelines with specific reference to subsoil thickness and characteristics.

Table 5. 1 *Vulnerability Mapping Guidelines (Source: GSI, 2021)*

Vulnerability Rating	Hydrogeological Condition				
	Subsoil Permeability (type) and Thickness			Unsaturated Zone	Karst Features
	High Permeability (sand/gravel)	Moderate Permeability (e.g. sandy subsoil)	Low Permeability (e.g. clayey subsoil, clay, peat)	(Sand/ gravel aquifers only)	(<30 m radius)
Extreme (E)	0 - 3 m	0 - 3 m	0 - 3 m	0 - 3 m	-
High (H)	> 3 m	3 - 10 m	3 - 5 m	> 3 m	n/a
Moderate (M)	n/a	> 10 m	5 - 10 m	n/a	n/a
Low (L)	n/a	n/a	> 10 m	n/a	n/a

Notes: (1) n/a: Not applicable

(2) Precise permeability values cannot be given at present

(3) Release point of contaminants is assumed to be 1-2 below ground surface

The site investigations carried out by GII (2021) confirmed that the depth to bedrock throughout the site ranges from 0.6 m bgl at BH06 (western section section)), 2.30 mbgl at BH08 (centre of the site) and 6.20 mbgl at PBH04 (eastern section of the site), overlaid with low to medium permeability GRAVELS; therefore, the site-specific vulnerability can be more accurately described as generally ‘Extreme’ at the western

section and ‘High’ to ‘Moderate’ throughout the rest of the site expect for localised topographic highs where rock head is close to the surface.

Furthermore, when reviewing recharge map on the GSI web viewer, this confirms that the eastern section of the site is karst environment as there is high volumes of recharge potential located here, refer to Figure 5-10 below. Recharge volumes for the proposed development site and surrounding are range from 175 mm/year to 660 mm/yr.

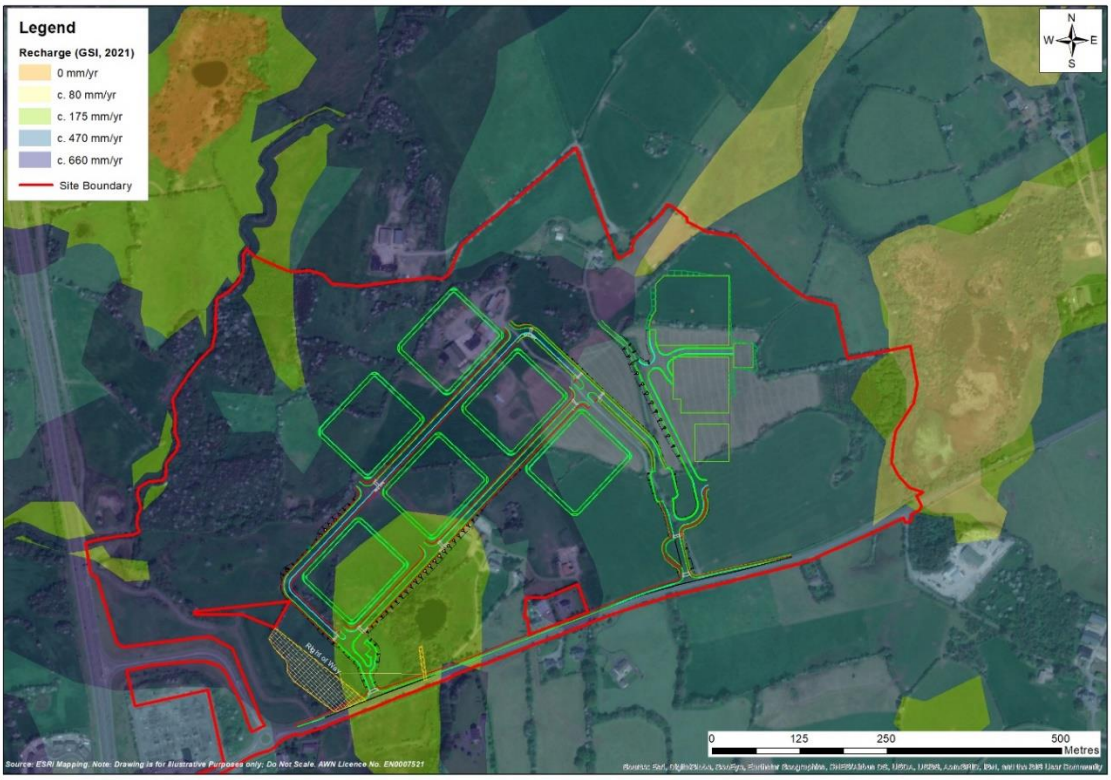

Figure 5-10 *Recharge map with proposed site layout (Source: GSI, 2021)*

5.3.7 Groundwater Flooding

Groundwater flooding occurs when storage in the underground aquifer is full and rainfall (recharge) cannot discharge quick enough, causing the water table to rise above the ground surface. According to the Geological Survey of Ireland (GSI), groundwater flooding in Ireland occurs mainly on the limestone lowlands to the west of the Shannon. The prevalence of groundwater flooding in the western counties is fundamentally linked to bedrock geology. The limestone bedrock in these areas has been dissolved over time in a process known as karstification, creating a subterranean network of water-bearing fractures and conduits with limited storage capacity. Surface drainage systems are frequently absent within well-developed karst landscapes. Instead, the groundwater conduit flow system acts as the main drainage mechanism for the region.

The following site-specific data was used to determine the potential of groundwater flooding across the site:

1. CFRAM flood maps.
2. Topography.
3. Walk over survey to assess water level marks and review of historical photographs of surface water features, including lakes.

4. Review of contemporary borehole logs drilled through both the overburden and the underlying bedrock.

These data have been used to assess the potential for groundwater flooding.

The topographical gradient is quite variable across the proposed development. Overall, the elevation falls from east to west/ southwest with detailed elevation of approx. +15mOD (meters above Ordnance datum) in the west and +46mOD in the east. The topography (presence of low-lying depressions) and presence of springs and discharge points (sinkholes) is crucial in determining where groundwater flooding occurs within the proposed development boundary.

There are four water features of significance either within the site boundary or along the site boundary where flooding historically occurs (see Figure 5-13, below). These are; Tooreen Lough to the south (within the proposed development area), Ardnamurry Lough farther to the east (outside of the site boundary line), and two pond features located to the north and north-east -both within the proposed development. These features discharge to ground at nearby sink holes also identified on Figure 5-13, below. All four areas are likely to be a combination of groundwater contribution and ponding rainfall. The latter two (i.e. ponds to the north/ northeast) are seen to continue to discharge during dry spells as observed on site (April/ May 2021). All four features are located in [locally] low lying depressions within the landscape.

All of these water features have been observed to expand in terms of lateral extent seasonally with autumn/ winter flooding and this footprint is generally followed by recession during drier conditions in summertime. This filling and emptying/ lowering of water levels is likely based on exceedance of storage capacity of the karst conduit system in wetter months in addition to pluvial components.

In terms of bedrock geology, groundwater flooding is more susceptible in areas where karstification is more prominent than where competent limestone bedrock prevails. Defining the geological setting in which the full site boundary lies is based on a combination of data provided by studies carried out by the GSI as well as based on the site-specific exploratory hole drilling and geophysical studies. Karst limestone with the presence of dolomite as the dominant bedrock geology has been identified in the western and south-western section of the site while more competent limestone rock is interpreted to prevail from the boundary with the karst in the west towards the centre of the site and extending eastwards.

Furthermore, the existing recorded sinkhole/ springs/ seepages/ will be retained as part of the site development proposals -these features are part of the existing groundwater-surface water system here and this controlled natural interaction between both will be maintained. Refer to Figure 5-13 and Conceptual Site Model (CSM) Section 5.3.18 below.

5.3.8 Groundwater Wells and Flow Direction

The GSI Well Card Index is a record of wells drilled in Ireland, water supply and site investigation boreholes. It is noted that this record is not comprehensive as licensing of wells is not currently a requirement in the Republic of Ireland. This current index does not show any wells drilled or springs at the site or surrounding area with the nearest recorded wells located 0.5 km to the east of the site (associated with the Balseskin Reception Centre). None of the wells listed are categorised as domestic use. The site is not located near any public groundwater supplies or group schemes. There are no groundwater source protection zones in the immediate vicinity of the site.

However, there is a private well located to the south of the proposed development site which is currently in use. The closest is c. 3.5 km to the west of the site (Drumcliff Springs PWS) and the proposed site is outside of the zone of contribution of this supply.

Figure 5-11 below presents the GSI well search for the area surrounding the site (note this source does not include all wells) and Table 5.2 below summarises the details of recorded wells present within this search area.

Regional groundwater flow would most likely be to the south – southeast towards the Shannon Estuary. Local groundwater flow has been interpreted as flowing south-southwest (i.e., towards the Ballymacahill River) based on the local topography and drainage pattern.

Table 5.3 below shows the water level in metres above ordinance datum (mAOD) recorded in 2021. Appendix 5.3 presents the logger data collected at selected boreholes and surface water features across the proposed development site.

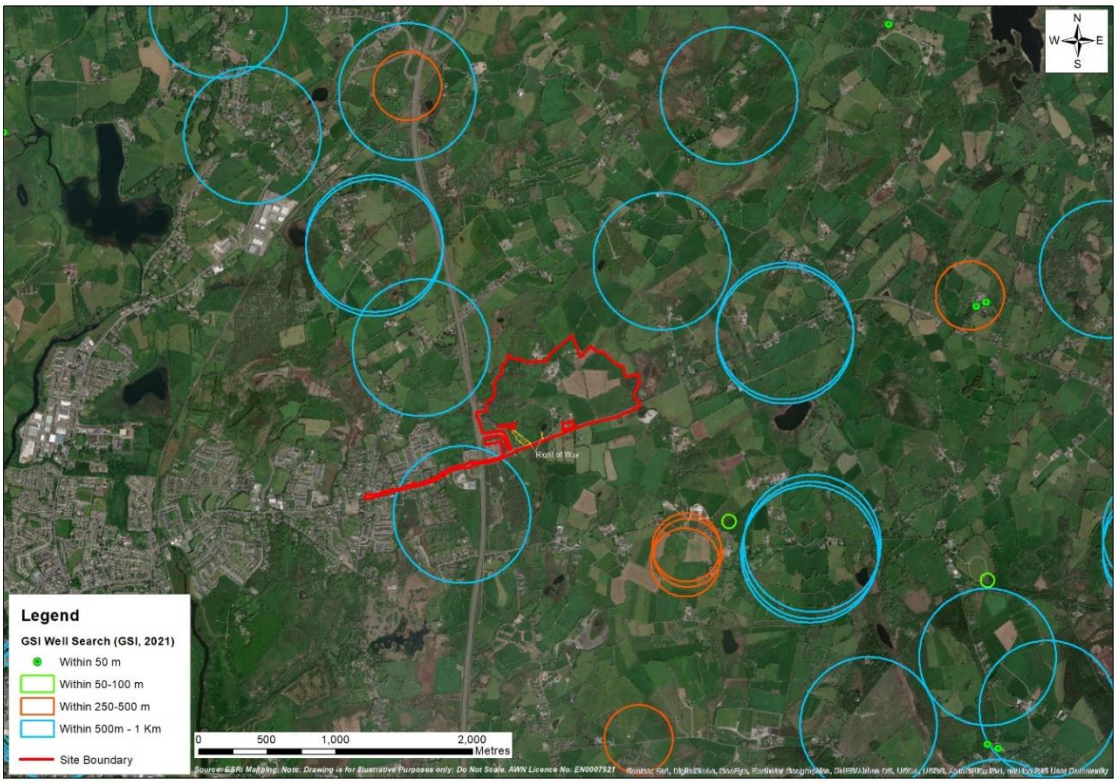

Figure 5-11 *GSI Well Search Map (Source: GSI, 2021)*

Table 5.2 *GSI Well Card Index (Source: GSI, 2021)*

GSI Name	Type	Depth to bedrock (m)	EASTING	NORTHING	TOWNLAND	COUNTY	Use	Yield Class	Yield m3/day
1117NEW077	Borehole	0.9	139900	182290	KILVOYDAN NORTH	Clare	Domestic use only	Failure	38.2
1417NWW020	Borehole		140540	180230	CRANAGHER	Clare	Agri & domestic use	Poor	
1417NWW029	Dug well		140610	180260	CRANAGHER	Clare		Failure	
1417SWW079	Borehole		140700	177000	MOYRIESK	Clare	Agri & domestic use		
1417SWW080	Borehole		140620	177030	MOYRIESK	Clare	Agri & domestic use		
1117SEW011	Borehole	4.9	133620	177170	CLONROAD BEG	Clare	Agri & domestic use	Moderate	
1117SEW123	Unknown		138730	178660	BALLYORTLA NORTH	Clare	Industrial use		
1417SWW085	Unknown		140620	178230	BALLYCRIGHAN	Clare			
1117NEW047	Borehole	6.1	136380	181840	BAREFIELD	Clare	Agri & domestic use	Poor	27.3
1117SEW003	Borehole		138420	178470	CREGGAUN	Clare	Agri & domestic use	Poor	
1117SEW004	Borehole	5.8	138430	178430	CREGGAUN	Clare	Agri & domestic use	Poor	
1117SEW007	Borehole	3.4	138410	178360	CREGGAUN	Clare	Agri & domestic use	Poor	136.2
1117SEW027	Borehole	3.4	138070	177070	KNOCKHOGAN	Clare	Agri & domestic use	Poor	86.4
1417NWW001	Borehole	2.4	140490	180310	CRANAGHER	Clare	Agri & domestic use		
1117NEW011	Borehole	15.2	138730	181770	CLOONKERRY	Clare	Agri & domestic use		
1117NEW012	Borehole	11.9	135000	182400	CLOONTEEN	Clare	Agri & domestic use	Poor	27.3
1117NEW052	Dug well	3.1	136380	181800	BAREFIELD	Clare	Agri & domestic use	Poor	21.8
1117NEW053	Borehole		139140	180050	MUCKINISH	Clare	Agri & domestic use		
1117NEW054	Borehole	0	139140	180020	MUCKINISH	Clare	Agri & domestic use	Poor	11
1117NEW055	Borehole	4.9	136140	180690	BALLYDUFF	Clare	Agri & domestic use	Poor	27.3
1117NEW056	Borehole	3.4	136140	180660	BALLYDUFF	Clare	Agri & domestic use	Poor	21.8
1117NEW057	Borehole	6.1	138240	180560	TULLYVAUGHAN	Clare	Agri & domestic use	Poor	16.4
1117NEW063	Borehole		135250	181480	BALLYMALEY	Clare	Agri & domestic use		38.2
1117SEW001	Borehole		139340	178500	BALLYORTLA	Clare	Agri & domestic use		
1117SEW002	Borehole	1.8	139330	178450	BALLYORTLA	Clare	Agri & domestic use	Poor	
1117SEW005	Dug well	4.3	136780	178710	KNOCKANEAN	Clare	Agri & domestic use	Poor	131
1117SEW006	Borehole	4.9	136480	179930	BALLYMACAHILL	Clare	Agri & domestic use	Poor	
1117SEW008	Borehole	2.7	139320	178420	BALLYORTLA	Clare	Agri & domestic use	Poor	32.7
1117SEW010	Borehole	3.1	133810	177420	CLONROAD BEG	Clare	Agri & domestic use	Moderate	15000
1117SEW014	Borehole	9.1	133800	177380	CLONROAD BEG	Clare	Agri & domestic use	Moderate	28.8
1117SEW015	Borehole	7.8	133810	177340	CLONROAD BEG	Clare	Agri & domestic use	Poor	0.07
1117SEW016	Borehole	6.1	133800	177320	CLONROAD BEG	Clare	Agri & domestic use	Good	28.8
1117SEW017	Borehole	2.1	133810	177270	CLONROAD BEG	Clare	Agri & domestic use	Moderate	8.64
1117SEW029	Borehole	3	139750	177170	FINANAGH	Clare	Agri & domestic use	Poor	
1417NWW065	Borehole	2.1	141500	180500	KNOCKANOURA	Clare	Agri & domestic use	Poor	10.9
1417SWW001	Borehole	5.5	141060	177290	MOYRIESK	Clare	Domestic use only	Moderate	54.5
1417SWW009	Borehole	0.9	140620	177670	MOYRIESK	Clare	Agri & domestic use	Poor	32.7
1417SWW010	Borehole	3	140690	176420	DRIM	Clare	Agri & domestic use	Poor	32.7

Table 5.3 *Site-specific Groundwater Levels. Overburden wells are represented with A after the number i.e. PBH01A. The remaining wells are screened in bedrock.*

Location ID	Ground elevation (mAOD)	Borehole Base of Well Screen Depth (mBGL)	Borehole Base of Well Screen Depth (mAOD)	SWL (mBGL) 05/05/2021	SWL as mAOD 05/05/2021
PBH01	7.97	15.00	-7.03	1.39	+6.58
PBH01A	7.97	5.00	+2.97	1.18	+6.79
PBH02	12.06	10.00	+2.06	3.69	+8.37

PBH03	15.13	12.00	+3.13	1.61	+13.52
PBH04	30.32	15.20	+15.12	2.73	+27.59
PBH04A	30.32	5.00	+25.32	2.30	+28.02
PBH05	14.66	15.30	-0.64	+0.02 (sl. Artesian)	+14.68
PBH05A	14.66	6.50	+8.16	0.6060	+14.11
BH01	11.87	14.00	-2.13	4.66	+7.21
BH02	13.88	14.00	-0.12	N/A	-
BH04	19.46	11.50	+7.96	N/A	-
BH09	21.46	9.90	+11.56	N/A	-

5.3.9 Soil Quality

There are no legislative threshold values for soils in Ireland. As such soil samples were compared to a Generic Assessment Criteria (GAC) derived to be protective of human health, water bodies (including groundwater) and also ecology for a resident and commercial/industrial end use.

Generic Assessment Criteria in the UK has been derived using the Contaminated Land Exposure Assessment (CLEA) model to be protective of human health for a number of different land uses. LQM (Land Quality Management) and the CIEH (Chartered Institute of Environmental Health) developed a document in July 2009 detailing their own research and derivation of their own 'LQM GACs'. A total of 82 substances including many organic substances had LQM GACs derived, for the standard land uses of residential, commercial/industrial and allotments. This was updated in 2015 following further research and the derived results are now called LQM/CIEH Suitable 4 Use Level (S4UL). The LQM/CIEH S4ULs are intended for use in assessing the potential risks posed to human health by contaminants in soil and as transparently derived and cautious "trigger values" above which further assessment of the risks or remedial action may be needed. For each contaminant S4ULs have been derived for six land use scenarios based on assessing exposure pathways in each planning scenario. In this instance the commercial scenario has been considered. Soil type and soil organic matter (SOM) has an influence on the behaviour of contaminants. S4ULs have been derived for three SOM contents (1%, 2.5% and 6%) to cover the likely range in soils. A prudent approach has been taken by considering the lower 1% SOM content.

The UK values do not have any legal standing within the Republic of Ireland and no statutory guidance for assessing the significance of soil contamination currently exists. However, the values do provide a means of placing the data within context when considering magnitude of risk and have been used in that capacity for this assessment.

In total, ten (10) soil samples were collected throughout the trial pitting exercise and sent to Element Environmental Laboratory in the UK for analysis of a range of parameters to examine the soil quality and to investigate any present and/or past contamination occurred across the subject site. Full laboratory result tables for the soil and groundwater samples are presented in Appendix 5.2.

The soil samples were analysed by Element Environmental in Deeside, UK for the following parameters:

- Metals (As, Cd, Cr, Se, Cu, Ni, and Zn);
- Total Petroleum Hydrocarbons Criteria Working Group (TPH CWG);
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Mineral oil;
- A range of Voltaile Organic Compounds (VOC);

- BTEX compounds (benzene, toluene, ethylbenzene and xylenes) and methyl tert-butyl ether (MTBE); and,
- Leachable component of a range of organic and inorganic parameters.
- Waste Acceptance Criteria (WAC) for inert waste landfills in accordance with the 2002 European Landfill Directive (2002/33/EC). This suite of parameters includes the following (carried out on 2 samples).

For this assessment, the soil results were compared to the Generic Assessment Criteria (GAC) concentrations. GACs are soil concentrations that have been derived for a defined set of generic assumptions and are used as trigger values in determining whether further risk management action is required in cases where detailed quantitative risk assessment is not being undertaken. There are no published Generic Assessment Criteria for soils in the Republic of Ireland. Instead, reliance is often placed on criteria from the UK and the Netherlands.

Soil sample analysis are summarised below. Detailed tables are presented in Appendix 5.2. These tables exhibit the soil quality across the site from the ten representative samples taken across the subject site.

Metals

All metal parameter concentrations recorded values below the most conservative threshold value for the LQM/CIEH for HHRA (Human Health Risk Assessment) Residential Threshold at 1% SOM. See Table 1 in Appendix 5.2.

Total Petroleum Hydrocarbon Criteria Working Group (TPH CWG)

All parameters recorded below the laboratory's limit of detection (LOD) for all soil samples collected across the subject site. Therefore, there are no exceedances recorded when these concentrations were compared to the most conservative threshold i.e., LQM/CIEH for HHRA Residential Threshold at 1% SOM.

PAHs

All parameters recorded below the laboratory's LOD for all samples collected across the subject site. Therefore, there are no exceedances recorded when these concentrations were compared to the most conservative threshold i.e., LQM/CIEH for HHRA Residential Threshold at 1% SOM.

Waste Acceptance Criteria (WAC) Analysis

Two (2) no. samples were analysed and compared against Waste Acceptance Criteria (WAC) set out by the adopted EU Council Decision 2003/33/EC which established criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 and Annex II of Directive 1999/31/EC (2002). There was no fill material noted during trial pit excavations with all samples being recorded as original clay subsoil.

The WAC analysis identifies that the representative samples are suitable for classification as Category A – Inert. Based on the laboratory results and parametric concentrations obtained from the site investigation, material from the sample locations would be acceptable at inert waste facilities (Category A). It should be noted that waste facilities develop facility specific criteria also and this should be considered should any soil/ material to be removed from site in the future. The comparison tables for the analysed samples against current WAC criteria can be seen in Table 2 in Appendix 5.2.

Asbestos

There were no asbestos containing materials (ACM) identified in any of the trial pit or soil samples taken.

5.3.10 Groundwater Quality

5.3.10.1 Regional Scale

The Water Framework Directive (WFD) Directive 2000/60/EC, was adopted in 2000 as a single piece of legislation covering rivers, lakes, groundwater and transitional (estuarine) and coastal waters. In addition to protecting said waters, its objectives include the attainment of 'Good Status' in water bodies that are of lesser status at present and retaining 'Good Status' or better where such status exists at present. 'Good Status' was to be achieved in all waters by 2015, as well as maintaining 'high status' where the status already exists. The EPA co-ordinates the activities of the River Basin Districts, local authorities and state agencies in implementing the directive, and operates a groundwater quality monitoring programme undertaking surveys and studies across the Republic of Ireland.

Presently, the groundwater body in the region of the site (Ennis GWB) is classified under the WFD Risk Score system (EPA, 2021) as 'under review" for the WFD cycle (2013-2018). The Ennis GWB was given a classification of "Good" for the last WFD cycle (2013-2018).

5.3.10.2 Local Scale

AWN carried out groundwater monitoring on selected groundwater monitoring wells located along the boundary of the proposed development site. Four (4) no. groundwater samples were taken across the site. 2 no. upgradient groundwater wells (PBH04 & PBH04A) and 2 no. downgradient groundwater wells (PBH01 & PBH01A) were sampled. PBH01 is a deep well which is screened within bedrock, while PBH01A is a shallow well screened in overburden. PBH04 is a deep well which is screened within bedrock, while PBH04A is a shallow well screened in overburden. The groundwater flow is considered to be in a west to southwesterly direction towards the Ballymacahill (also referred to Spancelhill) River which is located along the southwestern boundary of the proposed development. The groundwater wells are screened in the underlying limestone rock to a depth of c. 15 mbgl for the bedrock wells (PBH01 & PBH04) and c. 5.0 mbgl for the overburden wells (PBH01A & PBH04A). Refer to Figure 5-1Er above for borehole locations. Borehole logs and well installation details are presented in the site investigations report (GII, 2021) at the end of this report.

A total of four (4) no. groundwater samples were collected across the site; one groundwater sample from each bedrock borehole. These groundwater samples were sent to Element Environmental Laboratory in the UK for analysis of a range of parameters to examine the groundwater quality and to investigate any present and/or past contamination occurred across the subject site. Appendix 5.2 presents tables with the soil and groundwater analytical test results.

The groundwater samples were analysed for the following parameters;

- TPH CWG,
- Metals (As, Ba, Br, Cd, Cr, Pb, Se, Cu, Ni, Mn, V and Zn,), and

- Chloride, Potassium, Magnesium, Sulphate, Sodium, Orthophosphate, Ammoniacal Nitrogen, Nitrate, Nitrite, Fluoride, Total Suspended Solids, Alkalinity, Total Hardness and Bicarbonate.

Groundwater samples were collected using best practice (BS1995:5930) guidelines for water sampling including sufficient well volume purging (i.e. achieved as a result of the combined pumping tests) prior to sample collection and following adequate aquifer formation recharge to each test well sampled.

Groundwater results were compared with Groundwater Threshold Value (Groundwater Directive S.I. No. 9 of 2010 and amendment; S.I. No. 366 of 2016) and EPA Interim Guidelines for groundwater where available.

The analytical testing was undertaken by Element Environmental (UK) Forensics Limited, a United Kingdom Accreditation Service (UKAS) accredited laboratory located in Deeside, England. The laboratory is accredited under UKAS 4225 as well as to ISO/IEC 17025:2005.

The reported analytical results for the groundwater samples are presented in Appendix 5.2 and compared primarily with the relevant Groundwater Regulations S.I. No. 9 of 2010, SI No. 366 of 2016 and EPA Interim Guideline Values (IGVs), 2003. A brief summary of principal results is presented below.

Field Measurements

Field parameters were measured at PBH01 to PBH05, inclusive. In general, there were no exceedances recorded for field parameters at any of the groundwater monitoring locations. It was noted that two groundwater wells contained elevated pH.

There were slight exceedances recorded at PBH03 & PBH04A monitoring locations of available threshold values for pH. PH concentrations were recorded at 10.90 and 9.60 units, respectively. These concentrations slightly exceed the EPA IGV upper threshold value for pH of 9.5 units (refer to Table 3 in Appendix 5.2).

Metals

Table 4 in Appendix 5.2 summarises the metal parameter concentrations recorded at each of the four (4) no. wells during the groundwater sampling round. These measurements are assessed against the available Groundwater Regulations SI No. 9, 2010 (& 366 of 2016) as well as the EPA's Interim Guideline Values (IGVs) where available also.

The majority of the metal analysis suite recorded a concentration below the laboratory's LOD. There were no exceedances above Groundwater Regulations SI No. 9, 2010 (& 366 of 2016) or EPA's Interim Guideline Values (IGVs) other than a slight exceedance of zinc at PBH04 (Deep). Zinc is naturally occurring in soils and the slightly elevated values recorded are most likely due to sediment in the sample.

Hydrocarbons

Table 5 in Appendix 5.2 summaries the results of Hydrocarbon testing. In summary, there were no exceedances across the hydrocarbon suite of parameters in any of the four (4) no. groundwater samples.

General Suite

Table 6 in Appendix 5.2 summarises the general suite of parameters analysed at Element Environmental (UK) Limited. The table also included the results for polychlorinated biphenyls (PCBs). There was no exceedance of current regulatory thresholds.

5.3.11 Economic Geology

The GSI (2021) mineral database was consulted to determine whether there were any mineral sites close to the study area. There are no active quarries in a 3 km radium from the proposed development site.

While the origins of the suppliers of general construction materials and data centre components are not known at this stage, in relation to supply of sand, aggregate, stone and cement, which will comprise a significant proportion of HGV traffic generated during the construction phase, 3 quarries have been identified for consideration. These options are further discussed in Chapter 12 Traffic and Transport of this EIA Report.

5.3.12 Geological Heritage

The Geological Survey of Ireland (GSI) Public Viewer (www.gsi.ie/mapping) was reviewed to identify sites of geological heritage for the site and surrounding area. There are no geological heritage sites (audited & unaudited) in a 3 km radius of the proposed development site. The nearest geological site is Kilbreckan (CE0225). This site is located approx. 3.8 km south of the proposed development site. Kilbreckan Mine is situated between Ennis and Quin. It was worked intermittently for silver and lead from 1834 until 1856.

5.3.13 Radon

According to the EPA (now incorporating the Radiological Protection Institute of Ireland), Ennis is a High Radon Area (27.8 %) where is it estimated that more than twenty per cent of the homes in this 10km grid square are estimated to be above the Reference Level. This is the highest of the five radon categories which are assessed by the EPA.

5.3.14 Geohazards

Much of the Earth's surface is covered by unconsolidated sediments which can be especially prone to instability. Water often plays a key role in lubricating slope failure. Instability is often significantly increased by man's activities in building houses, roads, drainage and agricultural changes. Landslides, mud flows, bog bursts (in Ireland) and debris flows are a result. In general, Ireland suffers few landslides. Landslides are more common in unconsolidated material than in bedrock, and where the sea constantly erodes the material at the base of a cliff and leads to recession of the cliffs. Landslides have also occurred in Ireland in recent years in upland peat areas due to disturbance of peat associated with construction activities. The GSI landslide database was consulted and the nearest landslide to the proposed development was approx. 7.6 km to the southeast of the site, referred to as the Ayleacotty 2009 (event ID - GSI_LS09-0004) which occurred on 23rd August 2009 where a steep railway bank collapsed. There have been no recorded landslide events at the site. Due to the local topography and the underlying strata, there is a negligible risk of a landslide event occurring at the site.

In Ireland, seismic activity is recorded by the Irish National Seismic Network. The Geophysics Section of the School of Cosmic Physics at the Dublin Institute for Advanced Studies (DIAS) has been recording seismic events in Ireland since 1978. The station configuration has varied over the years. Currently there are five permanent broadband seismic recording stations in Ireland and operated by DIAS. The seismic data from the stations comes into DIAS in real-time and are studied for local and regional events. Records since 1980 show that the nearest seismic activity to the proposed location was in the Irish sea (1.0 – 2.0 Ml magnitude) and ~55km to the south in the Wicklow Mountains. There is a very low risk of seismic activity to the proposed development site. There are no active volcanoes in Ireland so there is no risk from volcanic activity.

5.3.15 Areas of Conservation

According to the NPWS (2021) on-line database there are no special protected area on or in the vicinity of the subject site. The closest European listed sites are as follows;

- Lower River Shannon Special Area of Conservation (SAC) (site code 002165) - circa. 2.1 km to the southwest of the site.
- Ballyallia Lake SAC and proposed National Hertiage Area (pNHA) (site code: 000014) - circa. 2.3 km to the west of the subject site.
- Ballyallia Lake Special Protection Area (SPA) (site code: 004041) - circa. 2.8 km to the northwest of the subject site.
- Newpark House (Ennis) pNHA (site code: 000061) - circa. 1.6 km to the southwest of the site.

The site would have direct hydrological connection with the Lower River Shannon (SAC) (site code 002165) - circa. 2.1 km to the southwest of the site through the local drainage network and the Ballymacahill (also referred to Spancelhill) River. This waterbody is located along the western boundary of the site. This waterbody is further discussed in Chapter 6 Hydrology of this EIA Report.

Figure 5-12 below presents the location of these protected areas in the context of the subject site.

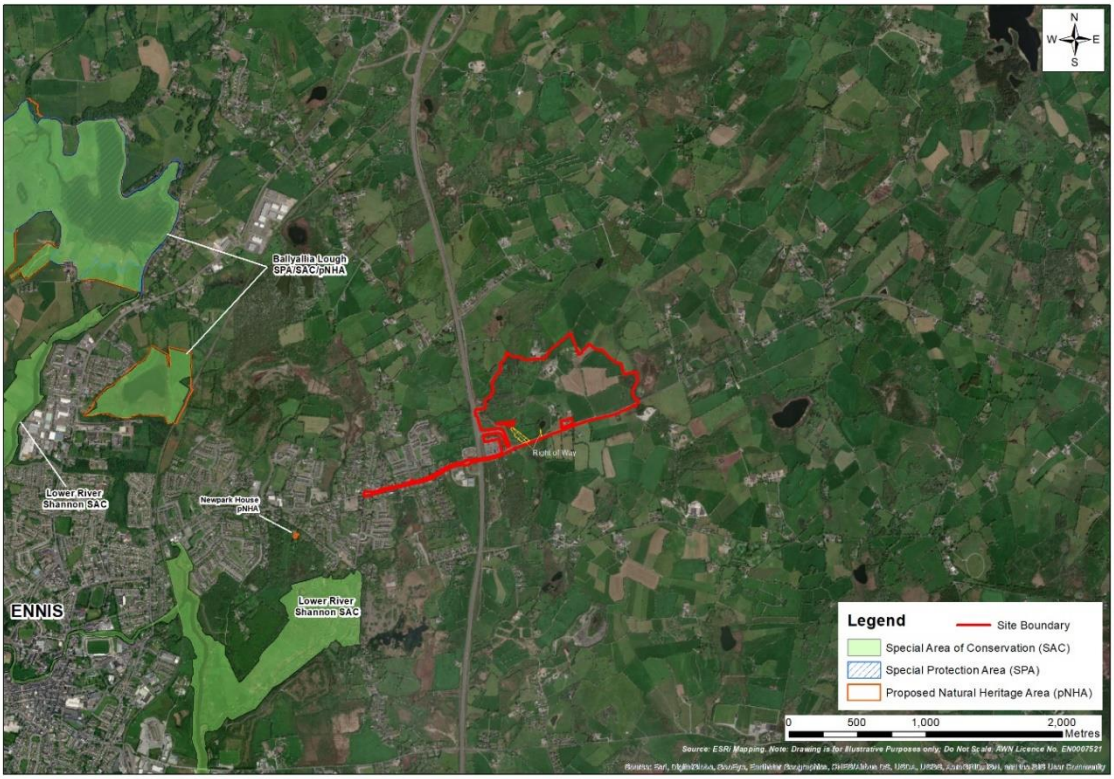

Figure 5-12 *Natura Sites in the Context of the Subject Site (Source: NPWS, 2021)*

5.3.16 Karst Features

According to the GSI (GSI, 2021) website, there are no recorded karst features within the site boundary. However, based on the initial site walkover carried out by AWN in April 2021 it was established that there are a number of karst features within the site boundary and in adjacent lands which transports water into the site. These are described below:

1. Ardnamurray Lough and the southern sinkhole which are located adjacent to the site. The lough drains along the Tulla Road and into lands south of this road. A sinkhole is located within this land. It is assumed that this karst feature is connected to underground conduits which directs water towards the proposed development site and Toureen Lough. There is a spring located directly east to the Toureen Lough which provides water to Toureen Lough.
2. There are two (2) no. pond features which could be attributed to groundwater water levels with some surface water influence. These extend and recede based on the seasonal rainfall changes through the year.
3. There are two (2) no. springs located across the proposed development site – one is located to the north-western section of the site and the second is located in the western section of the site (southwest of the proposed DC 6 building). Refer to Figure 5-13 below. These springs are dependent on water levels across the site and seasonal changes.
4. There is one (1) no. sinkhole located west from Toureen Lough. There is a small overland stream from Toureen Lough to this sinkhole. It is believed that this sinkhole discharges through a spring located along the Ballymacahill (also referred to Spancelhill) River.

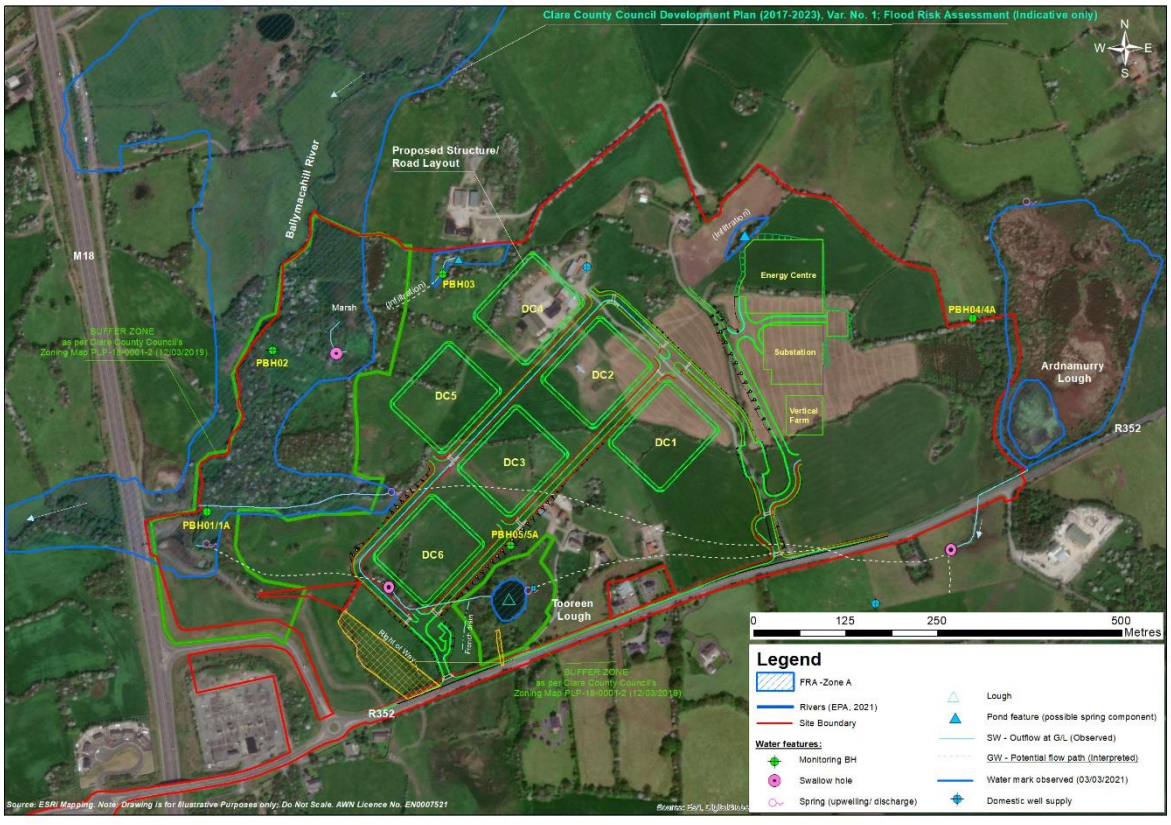

Figure 5-13 *Internal and local karst features across the site with the proposed Site Layout.*

Inserts 5.1 to 5.8 below show karst/ drainage features on site.

Insert 5.1 *Toureen Lough – view is N-W*

Insert 5.2 *Ardnamurry Lough -View is to E (discharge is to south crossing beneath the R352 road to Right Hand Side)*

Insert 5.3 *Pond to north-east (view is W-E) with existing wall to the Right Hand Side*

Insert 5.4 *Ponds to the north -saturated (03/03/2021) -view is to North.*

Insert 5.5 *Spring discharge (main) which flows directly to Ballymacahill River.*

Insert 5.*6* *Spring discharge (main, second view) and flows directly to Ballymacahill River.*

Insert 5.*7* *Swallow hole located to south of R352 (i.e discharge from Ardnamurry Lough)*

Insert 5.*8* *Swallow hole located to south of proposed DC6 building and connected to Toureen Lough stream flow.*

5.3.17 Ecological Receptors

As outlined in Chapter 7 (Biodiversity), there are a number of water habitats which are water fed/ maintained. These are described in Section 7.3.2.1. International and national habitats which are dependent on '*no measurable change in the natural water environment'* are summarised as follows:

Table 6. 1 *Ecological attributes within the site boundary*

Alluvial woodland [*91E0] (WN5 Riparian Woodland and WN6 Wet Willow-Alder-Ash Woodland) GW fed	International
Cladium Fen [*7210] (FS1) GW fed	International
Alkaline fen [7230] (PF1 – Rich Fen and Flush)	National
Molinia Meadows [6410] (GS4 Wet Grassland) GW fed	National

The above habitats are presented in Figure 5-14 below and Figure 7.8 of Chapter 7 (Biodiversity) of this EIA Report which shows the level of ecological importance of habitats at the development site. It is noted that an area of International Importance (alluvial woodland) is present at the edge of Fen habitat at Tooreen Lough and along the eastern boundary. Furthermore, the Reed and Large Sedge swamp (Cladium Fen) area is located along the eastern boundary of the proposed development site. Further information on the habitats is discussed in Chapter 7 (Biodiversity) of this EIA Report. There are no specific groundwater dependent species identified i.e. the habitats present requiring flooding only.

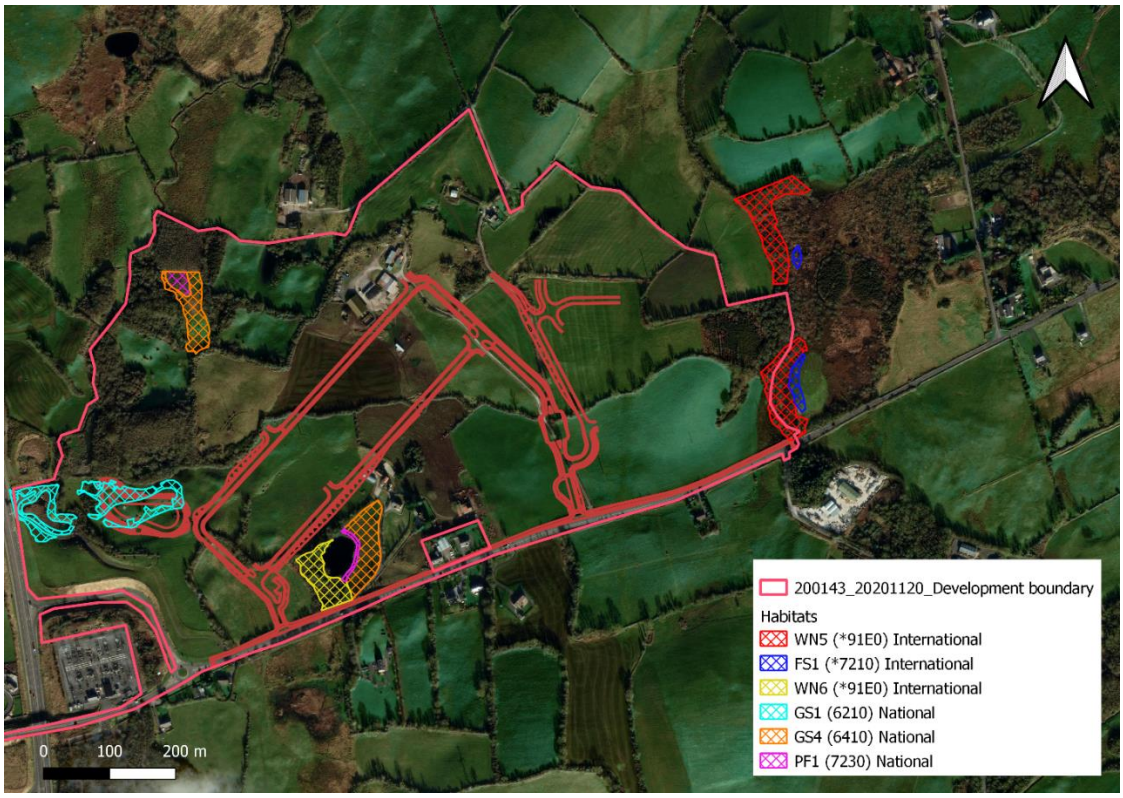

Figure 5-14 *Ecological features location within the site boundary.*

Fen type habitat was located in two different areas. These are considered of National Importance according to their species composition and structure.

The small area of rich fen and flush, located in the far northwest of the proposed development site, described as a wetland/pond feature, corresponded to a depression between wooded areas, and are naturally relatively species-rich vegetation communities. It is likely to have formed as a consequence of a lake infilling and can be described as a topogenous fen (i.e. forming in a valley or depression). A more-species-poor fen community occurs bordering on the landward side of reed and tall sedge swamp vegetation at Tooreen Lough.

Fen habitats located within these two particular areas corresponded to the description of the Annex I habitat Alkaline fen [7230], which are described as '*Wetlands mostly or largely occupied by peat- or tufa-producing small sedge and brown moss communities developed on soils permanently waterlogged, with a soligenous or topogenous base-rich, often calcareous water supply, and with the water table at, or slightly above or below, the substratum…*' within the Interpretation Manual of European Union Habitats (European Commission, 2013). The examples of rich fen and flush habitats within these two areas are considered to be of National Importance.

The areas of oak-ash-hazel woodland and immature woodland in the northwest, Tooreen Lough, the alluvial woodland (*91E0), Molinea meadows (6410) and alkaline fen (7230) surrounding Tooreen Lough and in the north-west, and calcareous grassland (6210) adjacent to the attenuation pond by the M18 Motorway, will be protected under the 'Ecological Buffer Space' as designated by Clare County Development Plan Variation No. 1. These areas will be retained, protected from development and will not be directly impacted from the development.

The wetland in the north of the site will also not be impacted by the proposed hardstand footprint of the development.

5.3.18 Conceptual Site Model (CSM)

The subsoil underlying the site is classified as clayey GRAVELS (generally low to moderate permeability) and the underlying varied limestone aquifer which is classified as a Regionally Important Aquifer. The aquifer vulnerability is considered to be 'Extreme' to 'High' vulnerability across the majority of the site while a section of the eastern boundary is classed as 'Moderate' aquifer vulnerability. This was confirmed during the site investigations.

The geology of the site can be described into two sections – the western and eastern section:

Western Section of the Site

- The underlying geology of this section is made up of weathered / fissured DOLOMITE underlain by competent LIMESTONE at greater depth (generally greater than 7 metres below ground level). Refer to Figure 5-16, below. This is based on the available data, geophysical data and site investigations carried out across the site.
- This DOLOMITE bedrock is highly weathered and fissured with some silt and clay infilled voids.
- Within this unit, there are areas where there is highly karstified LIMESTONE rock. These features are usually located approx. 7 to 10 metres below ground level (m bgl).
- Competent LIMESTONE rock unit is underlying this dolomitised rock which is presented in Figure 5-16,Figure 5-17 and Figure 5-18.

Eastern Section of the Site

- The underlying geology of the centre and eastern sections of the proposed development site is mainly made up of strong competent LIMESTONE rock. This is presented in Figure 5-19and Figure 5-20 below.
- This bedrock is generally very strong, massive, grey, fine to medium grained LIMESTONE.

The depth of bedrock across the site is generally shallow – 0.90 m bgl to 6.20 m bgl. Site investigations (GII, 2021) indicate bedrock depth is highly varied throughout the site with rockhead recorded at 0.60 mbgl at BH06 (western section of the site), 2.30 mbgl at BH08 (centre of the site) and 6.20 mbgl at PBH04 (eastern section of the site). The depth to bedrock is shallow across the site especially in the western and centre sections while bedrock is deeper along the eastern boundary owing to the thicker subsoils present. However, the bedrock surface is observed as undulating across the site and there are localised points with shallow bedrock for example within the eastern section of the site.

Groundwater levels range from 0.6060 m bgl (PBH05A) to 4.66 m bgl (BH01) while slightly artesian conditions were noted at PBH05 (deep well screened in bedrock) as the static water level was +0.02 metres above ground level (m agl). The regional groundwater flow is in a western to southwestern direction towards the Ballymacahill (also referred to Spancelhill) River and the Shannon Estuary.

Local drainage within the development boundary is less defined. Surface water features within the site boundary comprise a series of ponds to the north with variable seepage to ground, and Toureen Lough to the south near the R352. As mentioned in Section 5.3.17, there are a number of karst features within and adjacent to the proposed development site. Spring discharges have been identified mainly to the west of the site and include a spring to the immediate east of Tooreen Lough discharging to this feature, and a spring to the NW of the lough which may potentially receive groundwater from a swallow hole located farther east and south of the R352 road (this water is discharged from the Ardnamurry Lough wetlands located adjacent to the eastern site boundary line -refer to Figure 5-13 above). It is likely, under increased local water levels [head] at the lake, that Tooreen Lough ultimately discharges into the Ballymacahill River under gradient flow observed in the field as both at surface and possibly through gravelly subsoils located between the lough and the river. Local drainage would also typically follow the topographical decline in gradient recorded from east to west/ southwest (refer also to Figure 5-13 above).

Site walkovers conducted by AWN in March/ April/ May 2021 included a visual inspection of the local drainage network and features across site. These features are encapsulated in Figure 5-13 above and include some seepages/ springs with intermittent or ephemeral characteristics which discharge into what are surface streams that ultimately discharge towards the Ballymacahill River running along the western/ southwestern boundary of the site.

The majority of these hydrological and hydrogeological features are located in the south-western section of the site where the karstified limestone and weathered dolomite is located. According to the geophysical survey (APEX, 2021), there is a zone of karstified rock and dolomitised rock underlying the majority of the south-western section, refer to Figure 5-15 below. Bedrock is close to or at the surface to allow the springs and swallow holes to form across the proposed development site.

Review of the hydrogeology and geology in the immediate surrounding region indicates that there are no sensitive receptors such as groundwater dependent SACS/NHAs, Council Water Supplies/ Group Water Schemes or geological heritage sites which could be impacted by this development. No evidence of disposal of waste material was identified the location area proposed for excavation. Collection and analysis of representative soil and groundwater samples for a wide range of parameters shows no evidence of contamination. The review of the groundwater quality data collected on site found that the groundwater beneath the site is of good quality. Groundwater quality results are presented as Appendix 5.2.

Six (6) no. local geological cross sections can be seen in Figure 5-16 to Figure 5-21 below based on the available data such as geophysical survey report, site investigations borehole logs and supplementary site walkovers. The relevant borehole logs were used to construct the Conceptual Site Model (CSM) for the proposed development. These are presented in the cross-sections below in Figure 5-16 to Figure 5-21.

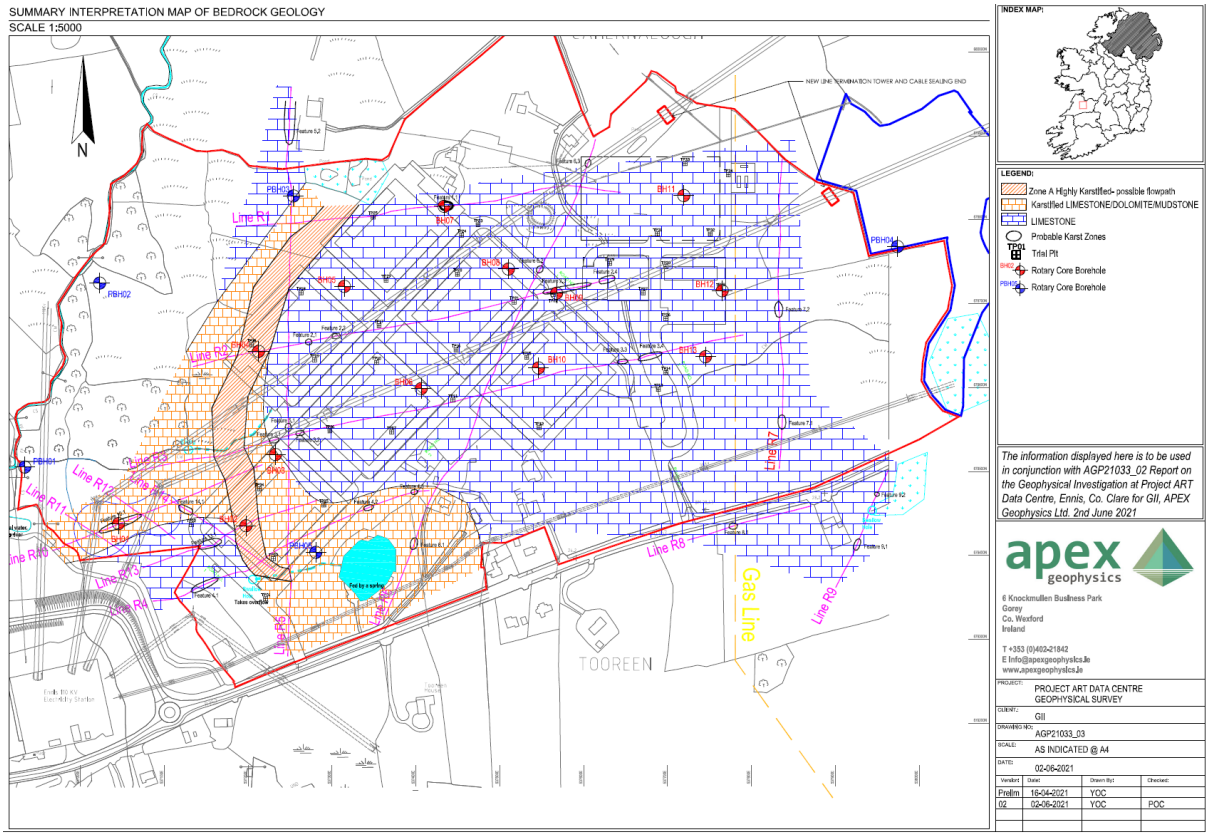

Figure 5-15 *Geophysical survey – interpretation map of the bedrock geology (Apex, 2021).*

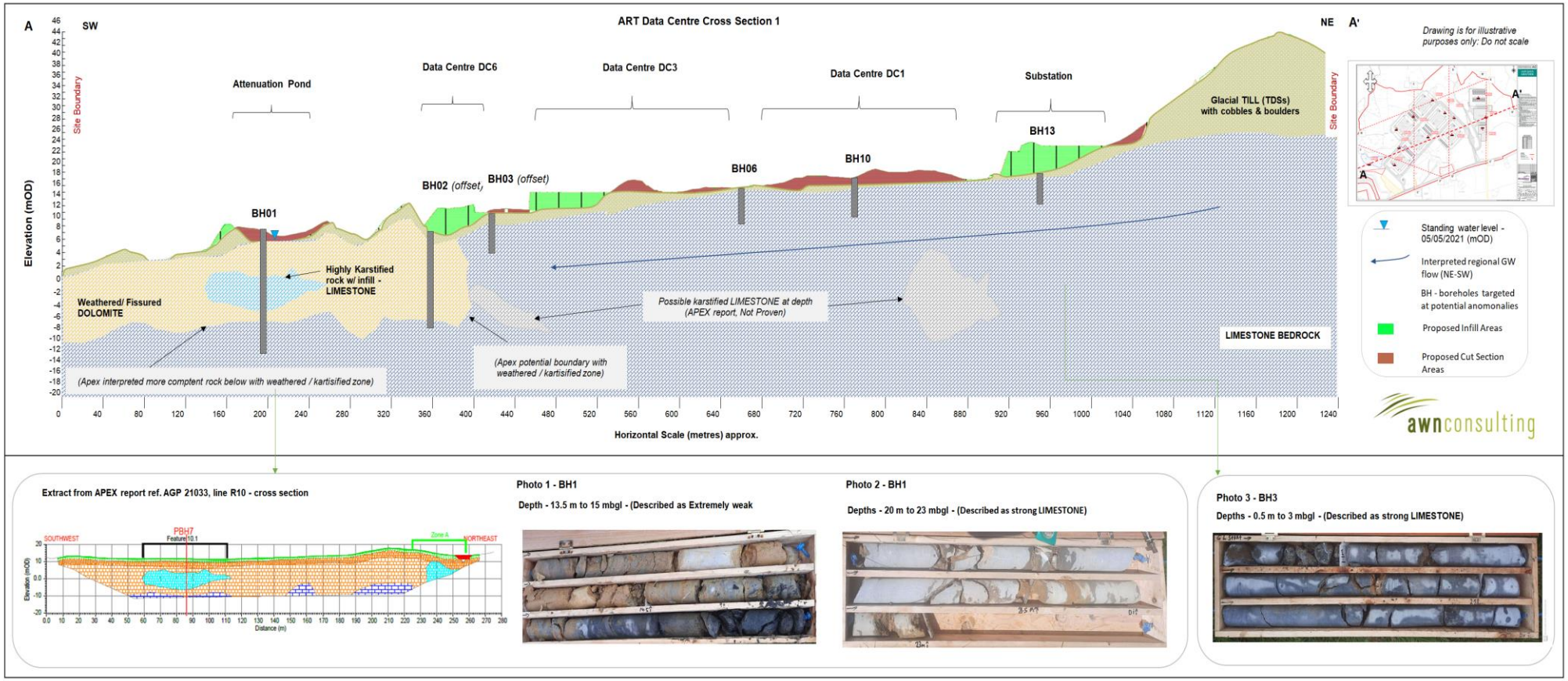

Figure 5-16 *Local Cross Section A-A' with view from SW to NE.*

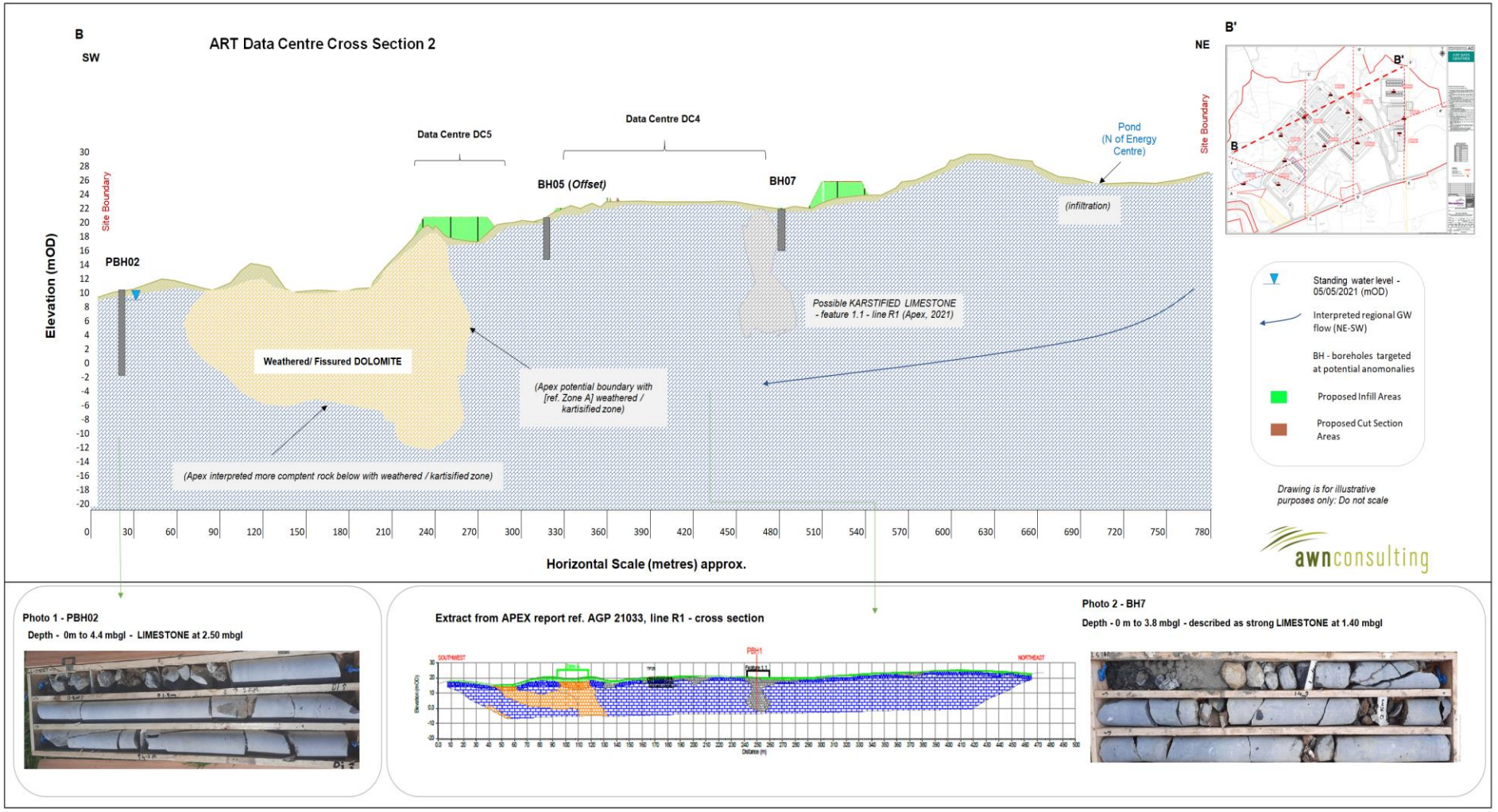

Figure 5-17 *Local Cross Section B-B' with view from SW to NE.*

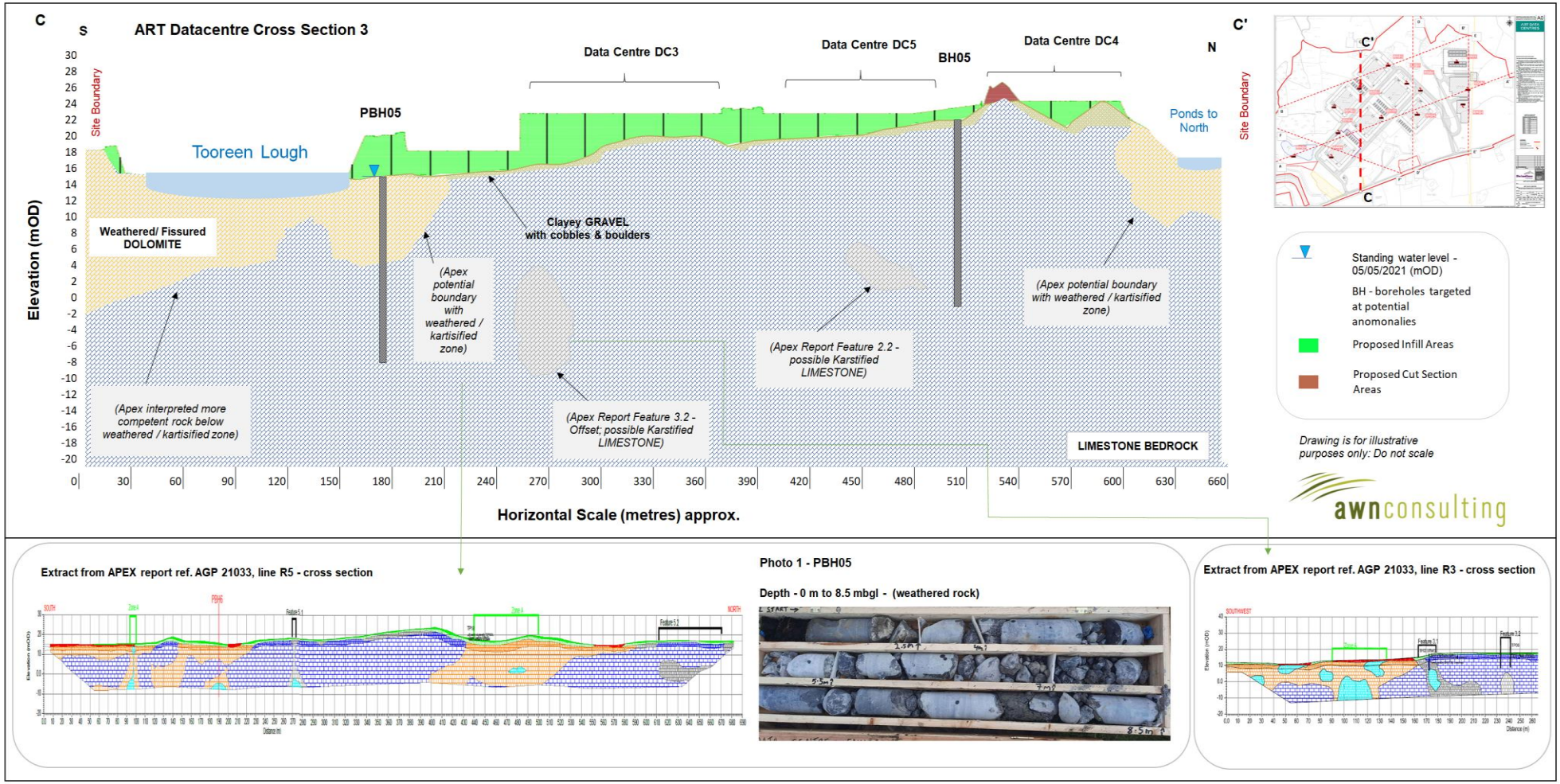

Figure 5-18 *Local Cross Section C-C' with view from S to N.*

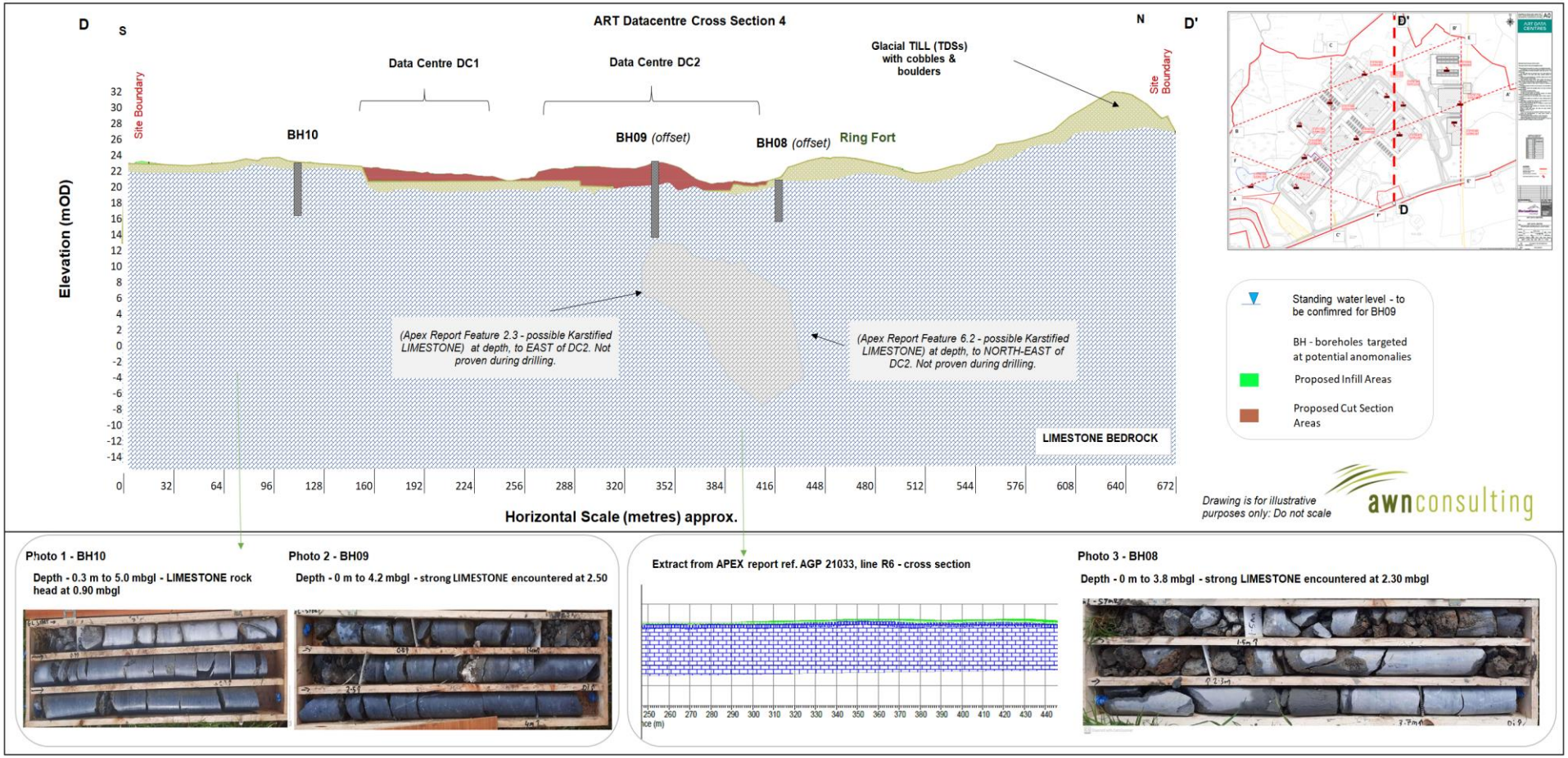

Figure 5-19 *Local Cross Section D-D' with view from S to N.*

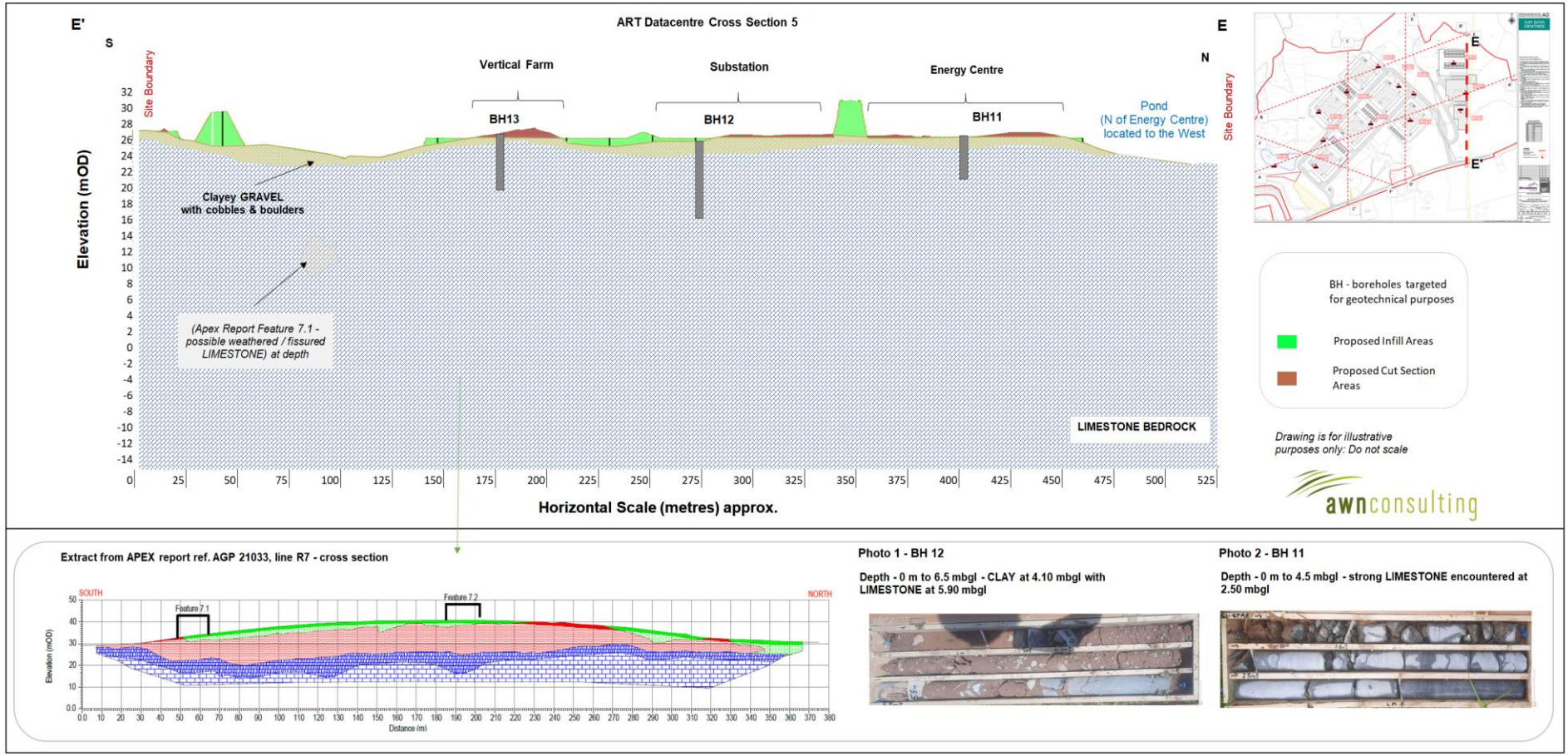

Figure 5-20 *Local Cross Section E-E' with view from S to N.*

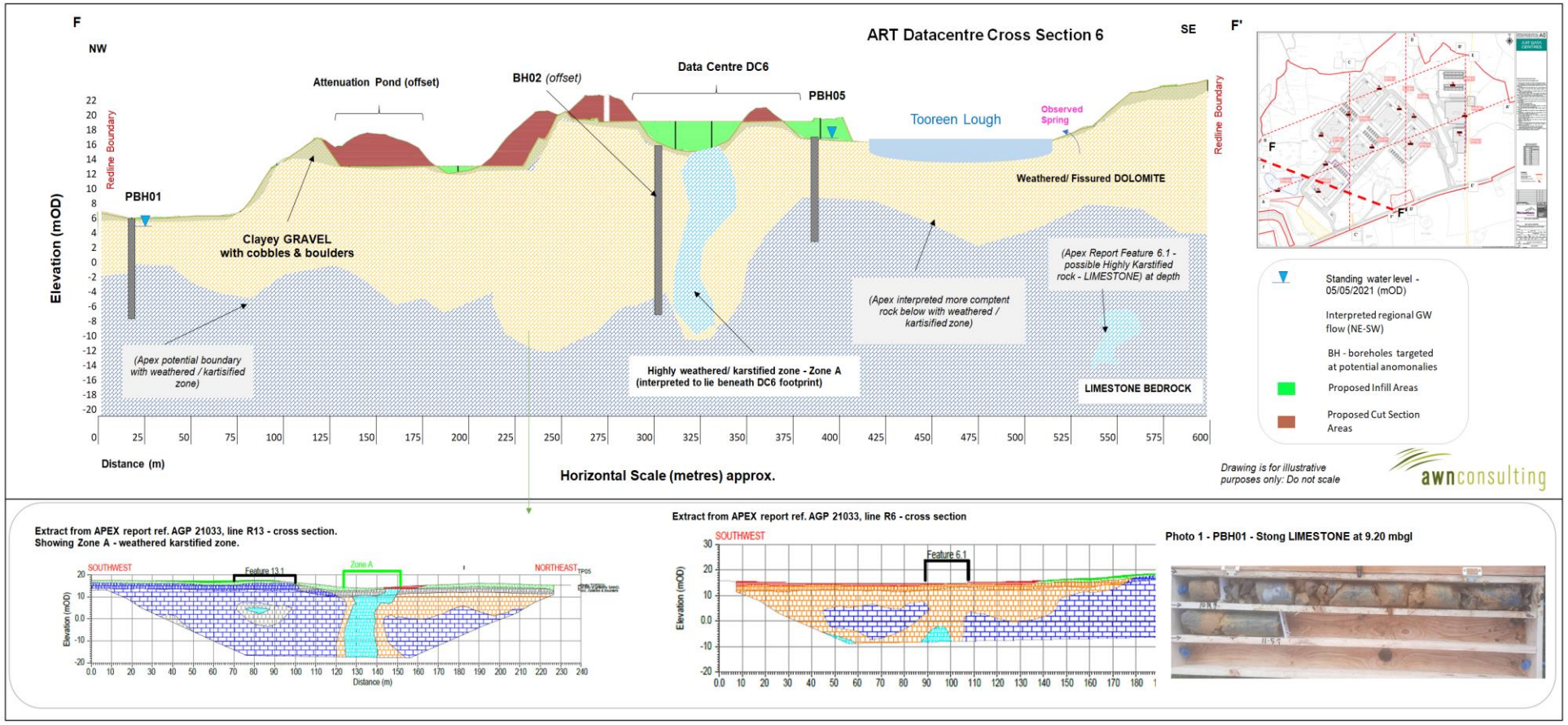

Figure 5-21 *Local Cross Section F-F' with view from NW to SE.*

5.3.19 Rating of Importance of Geological and Hydrogeological Attributes

Based on the TII (previously NRA) methodology (2009) (See Appendix 5.1), criteria for rating site importance of geological features, the importance of the bedrock and soil features at this site is rated as *'Medium Importance'* with medium significance or value on a local scale. This is due to the existence of well drained and/or high fertility soils across the site.

Based on the TII methodology (2009) (See Appendix 5.1) the importance of the hydrogeological features at this site is rated as '*Very High Importance'* based on the assessment that the attribute has a high-quality significance or value on a local scale. This assessment is based on the presence of the underlying aquifer which is a Regionally Important Aquifer. In addition, there would be direct or at least an indirect hydrogeological connection between the site and any protected sites (Natura Sites - SAC, SPA, NHA).

5.4 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

The proposed development is c. 60 hectares and comprises:

- Six (6) no. data centres buildings (DC1 to DC6).
- A gas-powered Energy Centre and Above Ground Installation (AGI).
- A new 110kV substation, two drop down masts and underground grid connection.
- Fibre connection.
- Connection and upgrade of foul sewer and mains supply extending along the existing R352.
- Undergrounding of two of the existing overhead 110kv circuits.
- Associated Infrastructure: including roads and an attenuation pond.
- Demolition (one house and a number of farm buildings).

The proposed development occupies c. 60 ha for the total development site. The proposed development represents an overall increase in hardstanding surfaces of approx. 17.3 hectares. The rest of the site comprises landscaping and undeveloped areas. The site layout reserves c. 10 ha of lands as ecological buffer zones. These indicated buffer zones can be seen in Figure 2.1 in Chapter 2 were delineated following assessment undertaken as part of the area assessment within the Clare County Development Plan 2017 – 2023 (Variation No. 1). Further assessment has been undertaken by the project ecologist to protect ecology during construction and operation of the proposed development.

It is noted that a significant proportion of the site is unpaved, and recharge will continue as current. In addition, where there is no storage of bulk fuel i.e., generator yards, SuDS measures have been incorporated in the design to facilitate recharge to ground.

5.4.1.1 Fuel Storage

In the event of a loss of power supply, the emergency generators are designed to automatically activate and provide power to the data storage facility. The generators will be supplied by low sulphur diesel. Fuel oil for the emergency generators is the only required bulk chemical required on site. Located within the services yard of three of the six datacentres, it is proposed to have up to 7 bunded above ground bulk storage tanks for fuel oil (440m^3 for three (3 no.) data storage facilities), distribution pumps, overground delivery pipeline to the belly tanks for diesel fired standby generators within each data storage facility.

The proposed Energy Centre will have back-up fuel storage with up to 20 fully bunded above ground bulk storage tanks for fuel oil (total of 1,440 m^3 of fuel oil). The total fuel store will be 2,900 m^3 (or 2,494 tonnes). All bunds will be capable of containing 110% of the volume of the largest drum/tank within the bund or 25% of the total volume of the substance stored and will designed in accordance with the EPA's guidelines for the storage and transfer of materials for scheduled activities (EPA, 2004).

The site is traversed by a high-pressure Gas Networks Ireland gas pipeline running in a S-N direction to the east of the development site. An AGI will be constructed to facilitate supply for the Energy Centre.

The redline boundary includes c. 2.1 km of the existing Tulla Road for connection to sewer.

Two of the 110kV overhead circuits which currently traverse the site will be brought underground to the [existing] Ennis substation as they come on to the site on the eastern side.

Further details of the proposed development are described in Chapter 2 Description of the Proposed Development. The details of the construction and operation of the development in terms of Land, Soils Geology and Hydrogeology is detailed in the Table 5.4 below.

Table 5.1 *Summary of site activities*

Phase	Activity	Description
Construction	Discharge to Ground	Run-off percolating to ground at the construction site.
	Earthworks: Excavation of Superficial Deposits	Excavations and infilling across the site are required for the site preparation and levelling works, to achieve foundation level and facilitate construction, along with arising from the installation of underground services. The project engineers have estimated that c. 105,703 m^3 of material will require excavation for the Data Centre site. This volume comprises topsoil, subsoils, and (eventually) bedrock. It is envisaged that the majority of this material will be reused on site as part of the site levelling works. This will be used as back fill and to establish the proposed landscaping berms. The estimates will be refined prior to commencement of construction. In addition to this there is a net import of suitable engineering fill up to c. 101,432 m^3 for the Data Centre site. These estimates will be refined prior to commencement of construction. Excavation of the proposed attenuation pond to the southwest of the site (proposed lowest surface water capture point within the main development site). The removal of localised overburden material will be required during preparation of the foundations and platform for the proposed structures. The foundations for the main buildings will be a mix of pad foundations and pile foundations to bedrock as required based on identified ground conditions.
	Storage of soils/aggregates	Aggregate materials such as sands and gravels will be stored in clearly marked receptacles within a secure compound area to prevent contamination. Temporary storage of spoil will be managed to prevent accidental release of dust and uncontrolled surface water run-off which may contain sediment and solid matter. Materials will be sent off site for recycling where possible and, if not suitable for recycling, materials will be disposed of to an appropriate permitted/licensed waste disposal facility.
	Storage of hazardous Material	Temporary storage of fuel required for on site for construction traffic. Liquid materials i.e., fuel storage will be located within temporary bunded areas, doubled skinned tanks or bunded containers (all bunds will conform to standard bunding specifications - BS8007-1987) to prevent spillage. These will be stored within the contractor yard.
	Localised Temporary Dewatering	There is no major dewatering works planned during the construction of the data centre site. According to site investigations, levels of groundwater from the aquifer beneath the site would range from approx. 2.73 mbgl (northeast of the site) to approx. 1.39 mbgl (southeast). Therefore, local groundwater ingress can be expected if excavations below c. 2.0 mbgl into rock are required to the southeast of the site, based on the Section 5.3.18 CSM above. It is also expected during the excavation works that localised dewatering of the subsoils will be required to address perched groundwater.
	Increase in hard standing area	The proposed surface water networks for the development collect runoff from roofs, roads and other hard standing areas in a sealed system of pipes and gullies. The proposed development represents an overall increase in hardstanding surfaces of c. 17.3 hectares.

Phase	Activity	Description
		The proposed surface water drainage service to the development comprises various drainage components including positive stormwater networks, attenuation systems and several Sustainable Drainage Systems (SuDS) elements. The proposed surface water drainage was designed in accordance with the SuDS Manual 2015. The developed area of the site is 17.3 ha and attenuation has been designed on site for the 1:100 yr. flood event including consideration of a 20 % allowance for climate change. An overflow subsurface pipeline will discharge at current discharge rates (greenfield) to the Ballymacahill (also referred to Spancelhill) River. Drainage will be to a single lined attenuation pond with an upgradient oil interceptor. An attenuation volume of 9293 m³ is designed as part of the proposed development.
Operation	Storage of hazardous Material	The site is traversed by a high-pressure Gas Networks Ireland gas pipeline. An AGI will be constructed to facilitate supply for the energy centre. In the event of a loss of power supply, the emergency generators are designed to automatically activate and provide power to the data storage facility. The generators will be supplied by low sulphur diesel. Fuel oil for the emergency generators is the only required bulk chemical required on site. Three of the six datacentres in their service yard, will have up to 7 bunded above ground bulk storage tanks for fuel oil (440 m^3 for three data storage facilities), distribution pumps, overground delivery pipeline to the belly tanks for diesel fired standby generators within each data storage facility. The energy centre will have back up fuel storage with up to 20 bunded above ground bulk storage tanks for fuel oil (total of 1,440 m^3 of fuel oil). The total fuel store will be 2900 m³ or 2,494 tonnes. All bunds will be capable of containing 110% of the volume of the largest drum/tank within the bund or 25% of the total volume of the substance stored and will designed in accordance with the EPA's guidelines for the storage and transfer of materials for scheduled activities (EPA, 2004). As the oil is only for emergency use and testing, refuelling requirement is low and as such the potential for any leak/spill during delivery and offloading is low. A dedicated tanker unloading area will be provided at each of these service yards which will be surrounded by a drainage channel to capture any run-off. A class 1 oil-water full retention separator will be installed to capture any oil in the run-off from the pad. A standard operating procedure for fuel unloading will be in place at the site and tanks will be fitted with high level alarms to prevent overfilling. The risk to the aquifer is considered low due to the design measures in place for containment, delivery and distribution and use of oil interceptors on the stormwater system downgradient of the offloading area and prior to discharge from the site.

The projected volumes of strip, cut and fill are presented in Table 5.5 below:

Table 5.2 *Projected Earthwork Volumes*

	Volume (m^3)
Cut (incl. Utility Trenches)	105,703
Fill	207,136
Net imported material (granular material, concrete, capping, asphalt, topsoil)	101,432

It is predicted that the majority of the spoil generated during site preparation/levelling will be removed from site with some top soil and spoil used in landscaped and bermed areas.

Chapter 14 Waste Management of this EIA Report contains a detailed description of waste management relating to construction of the proposed development. A detailed Construction and Demolition Waste Management Plan will be prepared prior to construction to ensure best practice is followed in the management of waste from the proposed development.

As outlined in Table 5.4 the activities required for the construction phase of the proposed development represents the greatest risk of potential impact on the geological environment. These activities primarily pertain to the site preparation, excavation, levelling and infilling activities required to facilitate construction of the proposed development.

5.4.2 Do Nothing Scenario

The proposed development land is currently agricultural land; the land is zoned 'enterprise' provides for the use and development of land for high end research and development, business science and technology-based industry, financial services, call centres/telemarketing, software development, data centres, enterprise and incubator units, small/medium manufacturing or corporate office in high quality campus/park type development.' It is likely that the land use will change over time even if this development does not go ahead. The associated impact of any such development will be similar to the proposed development for the underlying land soils and hydrogeological regime.

5.5 POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT

An analysis of the potential impacts of the proposed development on the land, soils, geology and hydrogeological environment during the construction and operation is outlined below. Due to the inter-relationship between soils, geology and hydrogeology and surface water (hydrology) the following impacts discussed will be considered applicable to both Chapter 5 and 6 (Hydrology) of the EIAR. Remediation and mitigation measures included in the design of this project to address these potential impacts are presented in Section 5.6 below.

5.5.1 Construction Phase

5.5.1.1 Excavation and Infilling

Due to the lack of previous development at the site and the historical residential and agricultural use at the site, the risk of contaminated soils being present onsite is low and this was confirmed by onsite soil sampling and analysis. Nonetheless material, which is exported from site, if not correctly managed or handled, could impact negatively on human beings (onsite and offsite) as well as water and soil environments.

The levelling of the ground and excavation for foundations for the main buildings will require the excavation of topsoil, subsoil and bedrock (where encountered).

Excavated material will be reused on site for infilling and landscaping works where possible. Import of c. 101,432 m^3 of fill will be required.

Site investigation and laboratory analysis has not identified any existing contamination. However, if contaminated soil/water is encountered, it will be required to be removed by a licensed waste contractor.

Therefore, groundwater ingress is not expected, and localised dewatering will not be required during the construction phase. However, minor groundwater strikes may be encountered but this groundwater volume would be minor given the ground condition and nature of the bedrock. Minor groundwater ingress is expected in the south-western section of the site where the majority of weathered dolomite and karstified limestone bedrock is located. Bedrock is close or at the surface in these areas. Minor dewatering operations will not impact the flow regime of the karst features. It is expected during the excavation works that localised dewatering of the subsoils will be required to address perched groundwater. There will little to no dewatering required in areas of the competent limestone bedrock. Refer to Section 5.3.18 CSM above.

5.5.1.2 Accidental Spills and Leaks

As with all construction projects there is potential for water (rainfall and/or groundwater) to become contaminated with pollutants associated with construction activity. Contaminated water which arises from construction sites can pose a significant short-term risk to groundwater quality for the duration of the construction if contaminated water is allowed percolate to the aquifer. The potential main contaminants include:

- Suspended solids (muddy water with increase turbidity) – arising from excavation and ground disturbance;
- Cement/concrete (increase turbidity and pH) – arising from construction materials;
- Hydrocarbons (ecotoxic) – accidental spillages from construction plant or onsite storage;
- Wastewater (nutrient and microbial rich) – arising from accidental discharge from on-site toilets and washrooms.

Accidental spillages which are not mitigated may result in localised contamination of soils and groundwater underlying the site, should contaminants migrate through the subsoil's and impact the underlying groundwater. Groundwater vulnerability at the site is currently classified as a 'Extreme' to the southwestern section and 'Moderate' to 'High' throughout the rest of the site. Any soil stripping will also further reduce the thickness of subsoil and the natural protection they provide to the underlying aquifer.

5.5.1.3 Potential Blockage of Swallow Holes & Springs

During construction for Data Centre DC6 there is potential for the existing swallow hole that receives water from Tooreen Lough stream flow to become blocked if silt laden run-off is allowed to discharge to it directly.

Similar to the swallow hole at DC6, the main spring located to the immediate north of DC6 may also potentially be impacted from adjacent earthworks (sediment run-off for example) if not protected adequately during construction works.

5.5.1.4 Loss of agricultural land

There will be local loss of agricultural soil however, the area of development is small in the context of the overall agricultural land available in the region. The entire site is also zoned for development. Within the overall context of Ireland's available farmland,

the loss is negligible. There will be no impact to mineral resources in the area as a result of the proposed development.

5.5.1.5 Summary of Construction Phase Impacts

A summary of construction phase impacts for the proposed development (with and without mitigation) following EPA (2017) EIA guidelines is provided below.

The magnitude of the impact for the construction phase without mitigation (design) measures is *Temporary* in duration with a *Significant impact* rating to the underlying aquifer and karst features present across the proposed development site.

However, with the implementation of design measures and mitigation measures (Section 5.6 below) for the proposed development site the impact of the construction phase is *Temporary* in duration with an *Imperceptible impact* rating.

5.5.2 Operational Phase

5.5.2.1 Discharge to Ground

There are no discharges to ground included in the design and no abstractions from the aquifer.

5.5.2.2 Increase in hardstanding

The increase in hardstanding (17.3 ha) will result in an increase in run-off rate and potential downgradient flooding, if not adequately attenuated on site. As described in Section 6.4.2.3 above, the design has incorporated adequate attenuation for a 1: 100-year flood event including correction for climate change effects.

Incorporation of hard stand area on previous greenfield area and the use of SUDs techniques will have a minor effect on local recharge to ground; however, the impact on the overall groundwater regime will be insignificant considering the proportion of the site area in relation to the total aquifer area. It is noted that a significant proportion of the site is unpaved, and recharge will continue as current. In addition, where there is no storage of bulk fuel i.e., generator yards, SuDS measures have been incorporated in the design to facilitate recharge to ground.

5.5.2.3 Accidental Spill and Leaks

The development includes the storage and use of diesel fuel which has the potential to have water quality impacts if a leak/ spill occurs and is not adequately mitigated. The design incorporates containment measures and measures for treatment of any spills/ leaks (described in Section 5.6 below).

Any accidental petrol emissions during storage, transfer, or delivery or leakage in the car parks could cause localised contamination if the emissions enter the soil and groundwater environment without adequate mitigation. However, it is noted that any accidental discharge will more likely impact stormwater drainage due to the hardstand and drainage infrastructure proposed and any releases to drainage will be mitigated through petrol interceptors.

5.5.2.4 Summary of the Operational Phase Impacts

A summary of operational phase impacts for the proposed development (with and without mitigation) following EPA (2017) EIA guidelines is provided below.

The magnitude of the impact for the operational phase without mitigation and design measures is *Temporary* in duration with a *Significant impact* rating to the underlying aquifer and karst features present across the proposed development site.

However, with the implementation of design and mitigation measures for the proposed development site the impact of the operation phase is *Long-term* in duration with an *Imperceptible impact* rating.

5.6 REMEDIAL AND MITIGATION MEASURES

The design has taken account of the potential impacts of the development on the land, soils, geology and hydrogeological environment local to the area where construction is taking place]. Measures (including full containment of oil storage areas) have been incorporated in the design to mitigate the potential effects on the surrounding soils, geology and hydrogeology. These are described below.

Due to the inter-relationship between soils, geology, hydrogeology, ecology and hydrology, the following mitigation measures discussed will be considered applicable to all. Waste Management is also considered an interaction in some sections.

5.6.1 Construction Phase

In order to reduce the potential for any adverse impacts on the existing hydrological environment, a number of mitigation measures will be adopted as part of the construction works on site.

A Construction Environmental Management Plan (CEMP) and Construction Surface Water Management Plan (SWMP) for the site are included with the planning documentation. The contractor will be obliged to work to implement the mitigation measures outlined in the CEMP and SWMP (refer to Chapter 13 of this EIA Report). The CEMP sets out the overarching vision of how the construction of the proposed development will be managed in a safe and organised manner by the Contractor.

The CEMP will be a live document and it will go through a number of iterations before works commence and during the works. It will set out requirements and standards which must be met during the construction stage and will include the relevant mitigation measures outlined in the EIA Report and any subsequent planning conditions relevant to the proposed development.

The SWMP follows best international practice including but not limited to:

- CIRIA, (2001), Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors, (C532) Construction Industry Research and Information Association;
- CIRIA (2002) Control of water pollution from construction sites: guidance for consultants and contractors (SPI56) Construction Industry Research and Information Association
- CIRIA (2005), *Environmental Good Practice on Site* (C650); Construction Industry Research and Information Association

- BPGCS005, Oil Storage Guidelines;
- Eastern Regional Fisheries Board, (2006), Fisheries Protection Guidelines: Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites;
- CIRIA 697, The SUDS Manual, 2007; and
- UK Pollution Prevention Guidelines (PPG) UK Environment Agency, 2004.

5.6.1.1 Control of Soil Excavation

Site preparation, excavations and levelling works required to facilitate construction of foundations, access roads and the installation of services will require c. 101,432 m^3 of imported material. A total of c. 105,703 m^3 will be excavated during the construction phase. Suitable soils will be reused on site as backfill in the grassed areas, where possible. Contractors shall be required to submit and adhere to a method statement indicating the extent of areas likely to be affected and demonstrating that this is the minimum disturbance necessary to achieve the required works.

Topsoil and subsoil will be excavated to facilitate the construction of the proposed data centre buildings, energy centre building, substation, and other ancillary works. It is envisioned that soil/stones (topsoil & subsoil) arising on the site will be removed from the site and disposed of as a waste or, where appropriate, as a by-product by a licensed contractor. Soil tested and classified as hazardous or non-hazardous in accordance with the EPA *Waste Classification – List of Waste & Determining if Waste is Hazardous or Non-Hazardous* publication, HazWasteOnline tool or similar approved method. The material will then need to be classified as inert, non-hazardous, stable non-reactive hazardous or hazardous in accordance with *EC Decision 2003/33/EC*.

According to onsite investigations, the bedrock vulnerability is 'Moderate' to 'High' to the central and north-eastern section and 'Extreme' throughout the rest of the site (e.g., towards the south-western section of the site). Removal and reinstatement of subsoil cover will not alter the vulnerability category of the underlying bedrock. The deposition of infill soil would increase the overburden thickness (refer to Table 5.5 above) and thus may even decrease the groundwater vulnerability.

To facilitate the construction of the proposed sewer connection, it is proposed that approx. 2.1Km of the existing Tulla Road will be excavated. As a conservative measure, it is envisioned that the tarmacadam, concrete, and subsoils will be contaminated. Soil tested and classified as hazardous or non-hazardous in accordance with the EPA *Waste Classification – List of Waste & Determining if Waste is Hazardous or Non-Hazardous* publication, HazWasteOnline tool or similar approved method. The material will then need to be classified as inert, non-hazardous, stable non-reactive hazardous or hazardous in accordance with *EC Decision 2003/33/EC*. The material which is considered hazardous from this alignment for the sewer connection will be removed by a licensed contractor to a registered landfill facility.

Temporary storage of soil will be carefully managed in such a way as to prevent any potential negative impact on the receiving environment and the material will be stored away from any open surface water drains. No soil storing will be allowed within 30 metres of the open water where sufficient working areas are available within the site boundaries, which is in line with Inland Fisheries Ireland guidelines. Movement of material will be minimised in order to reduce degradation of soil structure and generation of dust.

Although there is no evidence of historical contamination in the proposed development area, all excavated materials will be visually assessed for signs of possible

contamination such as staining or strong odours. Site investigations classified the subsoils as 'inert'. Should any unusual staining or odour be noticed, samples of this soil will be analysed for the presence of possible contaminants in order to ensure that historical pollution of the soil has not occurred. Should it be determined that any of the soil excavated is contaminated, this will be disposed of by a licensed waste disposal contractor.

Stockpiles have the potential to cause negative impacts on air and water quality. The effects of soil stripping and stockpiling will be mitigated against through the implementation of appropriate earthworks handling protocols during construction. Stockpiles will be formed within the boundary of the site and there will be no direct link or pathway from storage areas to any surface water body. Overburden material will be protected from exposure to wind by storing the material in sheltered parts of the site, where possible.

5.6.1.2 Sources of Fill and Aggregates

All fill and aggregate for the proposed development will be sourced from reputable suppliers. All suppliers will be vetted for:

- Aggregate compliance certificates/declarations of conformity for the classes of material specified for the proposed development;
- Environmental Management status; and
- Regulatory and Legal Compliance status of the Company.

5.6.1.3 Fuel and Chemical Handling

Any fuels or chemicals (including hydrocarbons or any polluting chemicals) will be stored in a designated, secure bunded area(s) within the designated contractor's compound to prevent any seepage of potential pollutants into the underlying subsoil and bedrock.

All mobile fuel bowsers shall carry a spill kit and operatives must have spill response training. All fuel containing equipment such as portable generators shall be placed on drip trays. All fuels and chemicals required to be stored on-site will be clearly marked. Care and attention will be taken during refuelling and maintenance operations. Particular attention will be paid to gradient and ground conditions, which could increase risk of discharge to waters.

To minimise any impact on the underlying subsurface strata from material spillages, all oils, solvents and paints used during construction will be stored within temporary bunded areas within the contractor's compound. Oil and fuel storage tanks shall be bunded to a volume of 110% of the capacity of the largest tank/container within the bunded area(s) (plus an allowance of 30 mm for rainwater ingress). Drainage from the bunded area(s) shall be diverted for collection and safe disposal.

Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles will take place in a designated area within the contractor's compound which will be away from surface water gullies or drains. In the event of a machine requiring refuelling outside of this area, fuel will be transported in a mobile double skinned tank. An adequate supply of spill kits and hydrocarbon adsorbent packs will be stored in this area. All relevant personnel will be fully trained in the use of this equipment. Guidelines such as '*Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors*' (CIRIA 532, 2001) will be complied with.

Where feasible, all ready-mixed concrete will be brought to site by truck. A suitable risk assessment for wet concreting will be completed prior to works being carried out which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil. Wash down and washout of concrete transporting vehicles will take place at an appropriate facility offsite and no washing of concrete from vehicles will be done on site.

In the case of drummed fuel or other chemical which may be used during construction, containers should be stored in a dedicated internally bunded chemical storage cabinet and labelled clearly to allow appropriate remedial action in the event of a spillage.

Emergency response procedures are required to be outlined in the detailed CEMP. All personnel working on the site will be suitably trained in the implementation of the procedures, and upskilled where necessary.

5.6.1.4 Accidental Spills

A robust and appropriate Spill Response Plan and Environmental Emergency Plan will be prepared prior to works commencing and they will be communicated, resourced and implemented for the duration of the works. Emergency procedures/ precautions and spillage kits will be available and construction staff will be trained and experienced in emergency procedures in the event of accidental fuel spillages.

Machinery activities on site during the construction phase may result in contamination of runoff/ surface water. Potential impacts could arise from accidental spillage of fuels, oils, paints etc. which could impact surface water if allowed to infiltrate to runoff to surface water systems and/or receiving watercourses. However, implementation of the mitigation measures detailed below will ensure that this does not occur.

Concreting operations carried out near surface water drainage points during construction activities could lead to discharges to a watercourse. Concrete (specifically, the cement component) is highly alkaline and any spillage to the underlying subsoil and aquifer bedrock would be detrimental to water quality and local fauna and flora. However, employment of the mitigation measures highlighted above and within the CEMP will ensure that any impact will be mitigated.

5.6.1.5 Protection of Hydrological / Hydrogeological Water Features

This section describes the specific mitigation measures implemented during construction for the protection of the existing identified surface water features and maintaining the existing surface water drainage system. Given the interconnectivity between the identified surface water features and groundwater type features in what is a karst environment then all mitigation measure which apply to hydrogeology will also apply to hydrology (Refer to Chapter 6, Section 6.6).

These measures will be implemented in association with the measures described above to ensure the protection of all hydrological [and hydrogeological] attributes. Mitigation measures are further discussed in the CEMP and SWMP for the development.

Tooreen Lough

There will be no construction works carried out within Tooreen Lough. There will be no oil or subsoil storage in the vicinity of this feature. An ecological buffer of at least 10 metres applies to this feature.

It is proposed that that overland stream discharging from Tooreen Lough will be culverted. The culvert will be designed in accordance with *Section 50 of the Arterial Drainage Act, 1945*, as amended and the overground pipe will be adequately designed for winter flows. This will ensure continued conveyance of existing flows without any upgradient or downgradient impacts on flow or water quality. The culvert will be adequately sized for current and future flow conditions.

Ardnamurry Lough

There are no construction activities planned for this area and this feature is located upgradient and outside of the redline boundary, along the eastern boundary of the proposed development. Therefore, no mitigation measures are needed for this feature.

Swallow Hole (Receiving water from Tooreen Lough) located south of DC6

Prior to commencement of construction works, the discharge stream from Tooreen Lough and swallow hole will be clearly delineated and marked. The swallow hole will be surrounded by a concrete ring with chamber and accessed by a manhole cover to avoid blockage during works on the site. This swallow hole will be monitored daily to ensure it is free flowing. i.e. ensuring no change to the existing flow regime there.

Main Spring located north of DC6

Prior to commencement of construction works, the spring and areas around this feature will be clearly delineated and marked. There are no proposed construction works within this spring area and a buffer zone of at least 10 metres will be implemented to ensure that the integrity of the spring is protected. Therefore, maintaining the flow and water quality of this spring. Daily to weekly monitoring of the spring in terms of flow and water quality will be recorded during construction phase works.

Furthermore, provision of exclusion zones and barriers (e.g. silt fences) between earthworks, stockpiles and temporary surfaces will be provided to prevent sediment washing into the existing drainage systems and hence protecting the integrity of this feature.

Pond located North of the Energy Centre

There are no construction activities proposed within this feature. It is proposed that the Energy Centre will be built up by infill material and a retaining wall will be built to protect the pond feature. An existing [field dividing] wall is in place and will be protected throughout the construction phase works.

Karst Features - conduits/ flow paths

The building foundations will be a combination of pad and piled foundations. The subsurface design is based on the nature of the soils and geology identified in the site investigation undertaken in May-June 2021 and presented in Figures 5.16- 5.21. In areas where karst conduits were interpreted beneath buildings (DC 3 and DC 6), the pile depths and spacing will allow bridging of the existing karst conduits i.e. ensuring no change to the existing groundwater flow regime across the site. Relevant subsurface designs are provided within the planning drawings provided with planning.

Ponds located North of the DC4

There are no construction phase activities proposed within these two (2) no. features. However, the proposed Data Centre building DC4 is located in close proximity. It is proposed that the DC4 structure will be 'built up' using engineered infill material.

As previously discussed, there will be no stockpiling of subsoil/ rock matrix by this feature as well as fuel storage -fuel will be adequately stored in effective bunds located within the contractor compound. Provision of exclusion zones and barriers (e.g. silt fences) between earthworks, stockpiles and temporary surfaces to prevent sediment washing into the existing drainage systems like this feature and hence protecting the integrity of this attribute.

Karst Features - conduits/ flow paths

The building foundations will be a combination of pad and piled foundations. The subsurface design is based on the nature of the soils and geology identified in the site investigation undertaken in May-June 2021 and presented in Figures 5.16- 5.21. In areas where karst conduits were interpreted beneath building, the design of the piling methodology including pile depths/ spacing will allow bridging of the existing karst conduits i.e. ensuring no change to the existing groundwater flow regime across the site. Relevant subsurface designs are provided within the planning drawings provided with planning (Drawing reference ART-CSE-ZZ-XX-DR-C-1800).

5.6.1.6 Control of Water during Construction

Care will be taken to ensure that exposed soil surfaces are stable to minimise erosion. All exposed soil surfaces will be within the main excavation site, which limits the potential for any offsite impacts.

Should any discharge of construction water be required during the construction phase, discharge will be to foul sewer. Pre-treatment and silt reduction measures on site will include a combination of silt fencing, settlement measures (silt traps, 20 m buffer zone between machinery and watercourses, refuelling of machinery off site) and hydrocarbon interceptors.

Any minor ingress of groundwater and collected rainfall in the excavation will be pumped out during construction. It is estimated that the inflow rate of groundwater will be low and limited to the northeast of the site. It is therefore proposed that the water be discharged via the existing stormwater sewer network. Extensive monitoring will be adopted to ensure that the water is of sufficient quality to discharge to the sewer. The use of slit traps and an oil interceptor (if required) will be adopted if the monitoring indicates the requirements for the same with no silt or contaminated water permitted to discharge to the sewer. There may be localised pumping of surface run-off from the excavations during and after heavy rainfall events to ensure that the excavations are kept relatively dry. Due to the very low permeability of the subsoils and the relative shallow nature for excavations, infiltration to the underlying aquifer is not anticipated.

The management of surface water runoff is further discussed in Chapter 6 Section 6.6 and the project-specific Surface Water Management Plan (SWMP) attached to this EIA Report.

5.6.2 Operational Phase

5.6.2.1 Emergency Response Procedures

As normal for a development site of this type, all staff will be suitably trained in emergency response procedures and standard operating procedures (SOPs) to respond to an on-site fuel spillage incident. All employees will be provided with such equipment, information, training and supervision as is necessary to implement the emergency response procedures and SOPs.

5.6.2.2 *Environmental Procedures*

Containment measures are included within the design to reduce potential for environmental impact. There will be comprehensive emergency response procedures and SOPs to respond to chemical/ oil spillage of all types. All employees will be provided with such equipment, information, training and supervision as is necessary to implement the emergency response procedures and SOPs.

5.6.2.3 Fuel Storage

The provision of spill kit facilities and training of operatives in use of same; should be undertaken at the operational stage in order to manage any leaks from fuel storage and vehicles resulting in soil and/or groundwater quality impacts:

All bunds will be capable of containing 110% of the volume of the largest drum/tank within the bund or 25% of the total volume of the substance stored and will designed in accordance with the EPA's guidelines for the storage and transfer of materials for scheduled activities (EPA, 2004). As oil is only required for emergency operation only and testing, refuelling requirement is very low therefore the risk from tanker movement is low. A dedicated tanker unloading area will be provided at each of these service yards which will be surrounded by a drainage channel to capture any run-off. A class 1 oil-water full retention separator will be installed to capture any oil in the run-off from the pad. A standard operating procedure for fuel unloading will be in place at the site and tanks will be fitted with high level alarms to prevent overfilling.

The storage of fuel oil for the emergency generators should be restricted to the generator yard, the bulk fuel tanks, and belly tanks should be bunded, and the over ground delivery pipeline double-lined. The final design for the diesel storage will be contained within a bunded area in line with the requirements of the *Guidance to Storage and Transfer of Materials for Scheduled Activities* (EPA, 2005).

In terms of the risk to the underlying aquifer (with connectivity to surface water features) this is considered low due to the mitigation in place for containment, delivery and distribution and use of oil interceptors on the stormwater system downgradient of the off-loading area and prior to discharge from the site.

5.6.2.4 Management of Surface water during Operation

The proposed development will provide full attenuation for increase in hardstand area in compliance with the requirements of the Greater Dublin Strategic Drainage Study. The proposed surface water drainage service to the development comprises various drainage components including positive stormwater networks, attenuation systems and several Sustainable Drainage Systems (SuDS) elements. The proposed surface water drainage was designed in accordance with the SuDS Manual 2015. This is further detailed in Chapter 6 Hydrology of this EIA Report.

5.6.2.5 Protection of Surface Water Features

Intermittent and on-going inspection and maintenance of the swallow hole south of DC6 discharge from Tooreen lough will be undertaken to ensure free flowing discharge to Ballymacahill River along the western boundary of the proposed development.

5.7 CUMULATIVE IMPACT ASSESSMENT

The cumulative impact of the proposed development with any/all relevant other planned or permitted developments (as described in Chapter 3 Appendix 3.1)) are discussed below.

5.7.1 Construction Phase

The potential for impact on land, soils and groundwater during construction primarily arises from accidental leaks and spills to ground or dewatering. The proposed development does not require dewatering and with the proposed mitigation in place (as outlined in Section 5.6) for management of accidental discharges, the effect due to construction in this area is considered to be a *neutral* on quality and an *imperceptible* significance. Contractors for the proposed development will be contractually required to operate in compliance with the CEMP which includes the mitigation measures outlined in this EIA report. The other developments considered, which are identified in Chapter 3 and Appendix 3.1 will also have to incorporate measures to protect soil and water quality in compliance with legislative standards for receiving water quality. As a result, there will be no cumulative potential for change in soil quality or the natural groundwater regime. The cumulative impact is considered to be *neutral and imperceptible*.

5.7.2 Operation Phase

Overall, there will be a local change in recharge to ground pattern due to the increase in hardstand from these proposed and planned developments. However, based on the overall size of the underlying aquifer and measures to protect soil and water quality there will be no overall change on the groundwater body status. The operation of the proposed development is concluded to have a *long-term, imperceptible* significance *with a neutral* impact on soil and water quality.

The proposed development includes design measures to protect against any accidental discharges to ground e.g. adequate containment measures for oil storage, use of hardstand in loading areas and drainage through oil interceptors. As such the impact will be *neutral* and *imperceptible* in relation to soil and water. The other developments considered, which are identified in Chapter 3 and Appendix 3.1, will be required to manage sites in compliance with legislative standards for receiving water quality. As such the cumulative or in-combination impacts are concluded to be *neutral* and *imperceptible* in relation to soil and water.

Overall, there will be a loss of agricultural land which is in line with the zoning of the area therefore the cumulative impact on land is considered to be *long-term neutral* and *not significant.*

5.8 RESIDUAL IMPACTS OF THE PROPOSED DEVELOPMENT

5.8.1 Construction Phase

The implementation of mitigation measures outlined above (Section 5.6) will ensure that the predicted impacts on the geological and hydrogeological environment do not occur during the construction phase and that the residual impact will be **short-term-imperceptible-neutral**. Following the TII criteria (refer to Appendix 5.1) for rating the magnitude and significance of impacts on the geological and hydrogeological related attributes, the magnitude of impact is considered **negligible**.

5.8.2 Operational Phase

The implementation of the design and mitigation measures highlighted above (Section 5.6) will ensure that the predicted impacts on the geological and hydrogeological environment do not occur during the operational phase and that the residual impact will be **long-term-imperceptible-neutral**. Following the TII criteria (refer to Appendix 5.1) for rating the magnitude and significance of impacts on the geological and hydrogeological related attributes, the magnitude of impact is considered **negligible**.

5.9 MONITORING OR REINSTATEMENT

5.9.1 Construction Phase

During construction phase the contractor will be obliged to undertake monitoring in compliance with the SWMP and CEMP this will include:

- Regular inspection of surface water run-off and sediments controls e.g. silt traps will be carried during the construction phase.
- Weekly checks will be carried out to ensure surface water drains are not blocked by silt, or any other items, and that all soil storage is located at least 10 metres from the nearest surface water receptors. A regular log of inspections will be maintained, and any significant blockage or spill incidents will be recorded for root cause investigation purposes and updating procedures to ensure incidents do not re-occur.
- Regular inspection of construction mitigation measures will be undertaken e.g. concrete pouring, refuelling etc.
- Regular monitoring of the silt traps/ trenches/ fences around established buffer zones to ensure on-going protection of all hydrological and hydrogeological water attributes.
- Soil sampling to confirm disposal options for excavated soils.

5.9.2 Operational Phase

There will be no requirement for groundwater monitoring as there is no likely discharge to ground. Maintenance of the surface water drainage system and foul sewers as per normal urban developments is recommended to minimise any accidental discharges to ground.

6.0 HYDROLOGY

6.1 INTRODUCTION

This chapter assesses and evaluates the potential impacts of the proposed development on the hydrological aspects of the site and surrounding area. In assessing likely potential and predicted effects, account is taken of both the importance of the attributes and the predicted scale and duration of the likely effects.

6.2 METHODOLOGY

6.2.1 Criteria for rating of effects

This chapter evaluates the effects, if any, which the proposed development will have on Hydrology as defined in the Environmental Protection Agency (EPA) 'Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports' (EPA, 2017). The Draft EPA document entitled '*Advice Notes for Preparing Environmental Impact Statements'* (EPA, 2015) is also followed in this hydrological assessment and classification of environmental effects. In addition, the document entitled '*Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes'* by the National Roads Authority' (NRA, 2009) is referenced where the methodology for assessment of impact is appropriate.

The rating of potential environmental effects on the hydrological environment is based on the standard EIAR impact predictions table included in Chapter 1 which takes account of the quality, significance, duration and type of effect characteristic identified (in accordance with impact assessment criteria provided in the Draft EPA Guidelines (2017) publication).

The duration of each effect is considered to be either momentary, brief, temporary, short-term, medium term, long-term, or permanent. Momentary effects are considered to be those that last from seconds to minutes. Brief effects are those that last less than a day. Temporary effects are considered to be those which are construction related and last less than one year. Short term effects are seen as effects lasting one to seven years; medium-term effects lasting seven to fifteen years; long-term effects lasting fifteen to sixty years; and permanent effects lasting over sixty years.

The TII criteria for rating the magnitude and significance of impacts and the importance of hydrological attributes at the site during the EIA stage are also relevant in assessing the impact and are presented in Tables 1-3 in Appendix 6.1.

The principal attributes (and effects) to be assessed include the following:

- River and stream water quality in the vicinity of the site (where available);
- Surface watercourses near the site and potential impact on surface water quality arising from proposed development related works including any discharge of surface water run-off;
- Localised flooding (potential increase or reduction) and floodplains including benefitting lands and drainage districts (if any); and
- Surface water features within the area of the site.

6.2.2 Sources of Information

Desk-based hydrological information in the vicinity of the site was obtained through accessing databases and other archives where available. Data was sourced from the following:

- Environmental Protection Agency (EPA) – website mapping and database information. Envision water quality monitoring data for watercourses in the area;
- River Basin Management Plan for Ireland 2018-2021.
- *The Planning System and Flood Risk Management, Guidelines for Planning Authorities* (Department of the Environment, Heritage and Local Government (DoEHLG) and the Office of Public Works (OPW));
- Office of Public Works (OPW) flood mapping data (www.floodmaps.ie);
- South Dublin City Council (2005), Greater Dublin Strategic Drainage Study: Technical Documents of Regional Drainage Policies. Dublin: Dublin City Council; and
- 'Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors' (CIRIA 532, 2001);
- National Parks and Wildlife Services (NPWS) – Protected Site Register.

Site specific data was derived from the following sources:

- Engineering Planning Report – Drainage and Water Services. Art Data Centre. Clifton Scannell Emerson Associates (CSEA) (May 2021);
- Flood Risk Assessment. Art Datacentre Ennis. Clifton Scannell Emerson (May 2021);
- Construction Environmental Management Plan. Art Data Centre Ennis. AWN Consulting (May 2021) which includes a Surface Water Management Plan for the Construction Phase prepared by (CSEA) (May 2021)
- Various design site plans and drawings; and
- Consultation with design engineers.

6.3 RECEIVING ENVIRONMENT

The following section describes the receiving environment in terms of current land use, local and regional hydrological features and surface water quality, flood risk and areas of ecological importance. A summary of the hydrological attributes and importance rating of same (following TII, 2009 criteria) is presented at the end of the section -this will be used as part of the impact assessment covered in Section 6.5 below.

6.3.1 Site Setting & Land Use

The receiving environment is discussed in terms of surface water hydrology including potential for existing and historical contamination. The proposed development site is c. 55 hectares (ha) in area and is located to the east of Ennis in the townland of Tooreen and Cahernalough, Co. Clare. The lands are bordered to the south by the R352 (Tulla Road) and to the west by the M18 national route. The lands are traversed by a [transmission] gas pipeline running south to north towards the eastern site boundary as well as overhead powerlines running east to west and which connect to the existing Ennis 110kv substation that adjoins the south-western boundary.

The site is used for agricultural purposes currently and comprises a series of irregularly shaped fields divided by hedgerows and ditches typical of a rural setting. A number of

existing dwellings and farm outbuildings are present within the development boundary. A number of these structures will be retained, and some will be demolished as part of the proposed development of the site.

6.3.2 Topography

The topographical gradient across the development boundary is quite variable mostly due to the drumlin type features present. Overall, the ground level generally falls from east to west/ southwest with an elevation of approx. +15mOD (metres above Ordnance Datum) in the west and +46mOD in the east.

The topographical low points are generally to the southwest where the Ballymacahill River crosses the M18 road. Here, elevations within the range of +7.0mOD to +8.0mOD are recorded. Farther to the east, the general [lake edge] elevation of the Tooreen Lough lies at approx. 14.2mOD. Beyond the eastern site boundary, the Ardnamurry Lough to the immediate north of the R352 lies at approx. +27.5mOD to +28.0mOD with the discharge via the swallow hole to the south of the R352 lying at an elevation of approx. +26.5mOD to +26.0mOD.

6.3.3 Regional & Local Hydrology

Regional Hydrology

The subject site is located within the former Shannon Estuary North River Basin District (now the Irish River Basin District), as defined under the European Communities Directive 2000/60/EC, establishing a framework for community action in the field of water policy – this is commonly known as the Water Framework Directive (WFD).

According to the EPA (2021) on-line mapping, the proposed development site lies within the Shannon Estuary North Catchment (Hydrometric Area No. 27) and the River Fergus sub-catchment (refer to Figure 6-1 below).

Regional surface water drainage near the proposed development boundary includes the Ballymacahill (EPA ref: Spancelhill) River to the north/ west of the site boundary. The Ballymacahill River generally aligns with the full western site boundary with only a section of the river (to the immediate east of the M18 road) shown to lie within the south-western boundary of the site. The river flows in a NE to SW direction crossing beneath the M18 road. The river converges with the River Fergus c. 3.0Km farther to the SW and the River Fergus ultimately discharges into the Shannon Estuary at the Lower River Shannon Special Area of Conservation (SAC) located >7.0Km downstream of the site.

Note: The perimeter of the Lower River Shannon SAC extends upstream along the River Fergus towards Ennis and approx. 2.1 km southwest of the site. Therefore, the proposed development has direct connectivity to the Lower River Shannon SAC via the Ballymacahill River feature to the west.

In terms of regional drainage, generally all identified water courses tend to drain in a northeast to southwest orientation (refer Figure 6-1 below). This would also indicate a general interpreted NE-SW groundwater flow orientation (refer Chapter 6 Land, Soil, Geology & Hydrogeology).

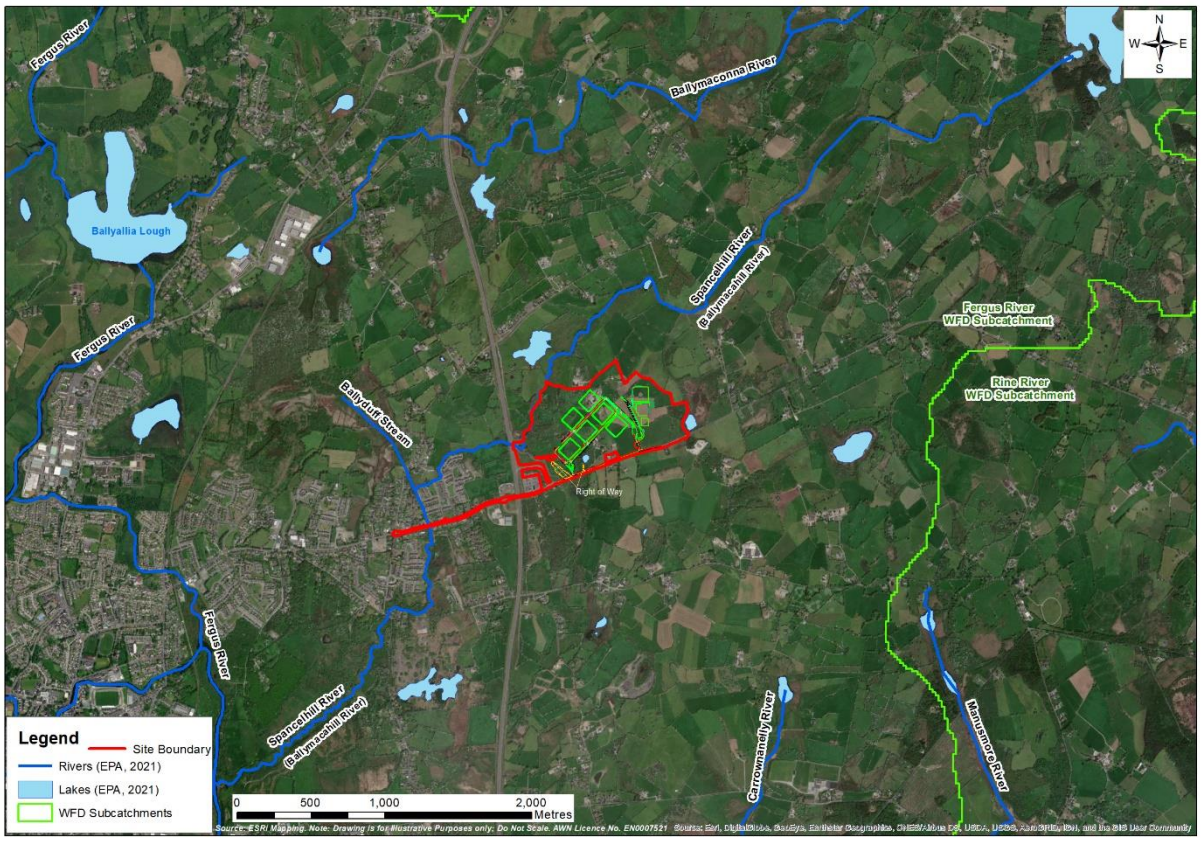

Figure 6-1 *Hydrological Setting and Site Boundary (Source: EPA, 2021)*

Local Hydrology

Drainage within the site boundary comprises a feature lake, a number of ponds, swallow holes and spring discharges, which ultimately discharges to the Ballymacahill River. Local drainage at the proposed development site is typical of a karst environment.

Spring discharges have been identified mainly to the west of the site and include a spring to the immediate east of Tooreen Lough discharging to this feature, and a spring to the NW of the lough which may potentially receive groundwater from a swallow hole located farther east and south of the R352 road (this water is discharged from the Ardnamurry Lough wetlands located adjacent to the eastern site boundary line -refer to Figure 6-2 below). It is likely, under increased local water levels [head] at the lake, that Tooreen Lough ultimately discharges into the Ballymacahill River under gradient flow observed in the field as both at surface and possibly through gravelly subsoils located between the lough and the river. Local drainage would also typically follow the topographical decline in gradient recorded from east to west/ southwest (refer also to Figure 6-2 below).

Site walkovers conducted by AWN in March, April, and May 2021 included a visual inspection of the local drainage network and features across site. These features are encapsulated in Figure 6.2 below and include some seepages/ springs with intermittent or ephemeral characteristics which discharge into what are surface streams that ultimately discharge towards the Ballymacahill River running along the western/ southwestern boundary of the site.

Local drainage within the development boundary is further defined in Section 6.3.4 (Lakes) and Section 6.3.5 (Ponds) below.

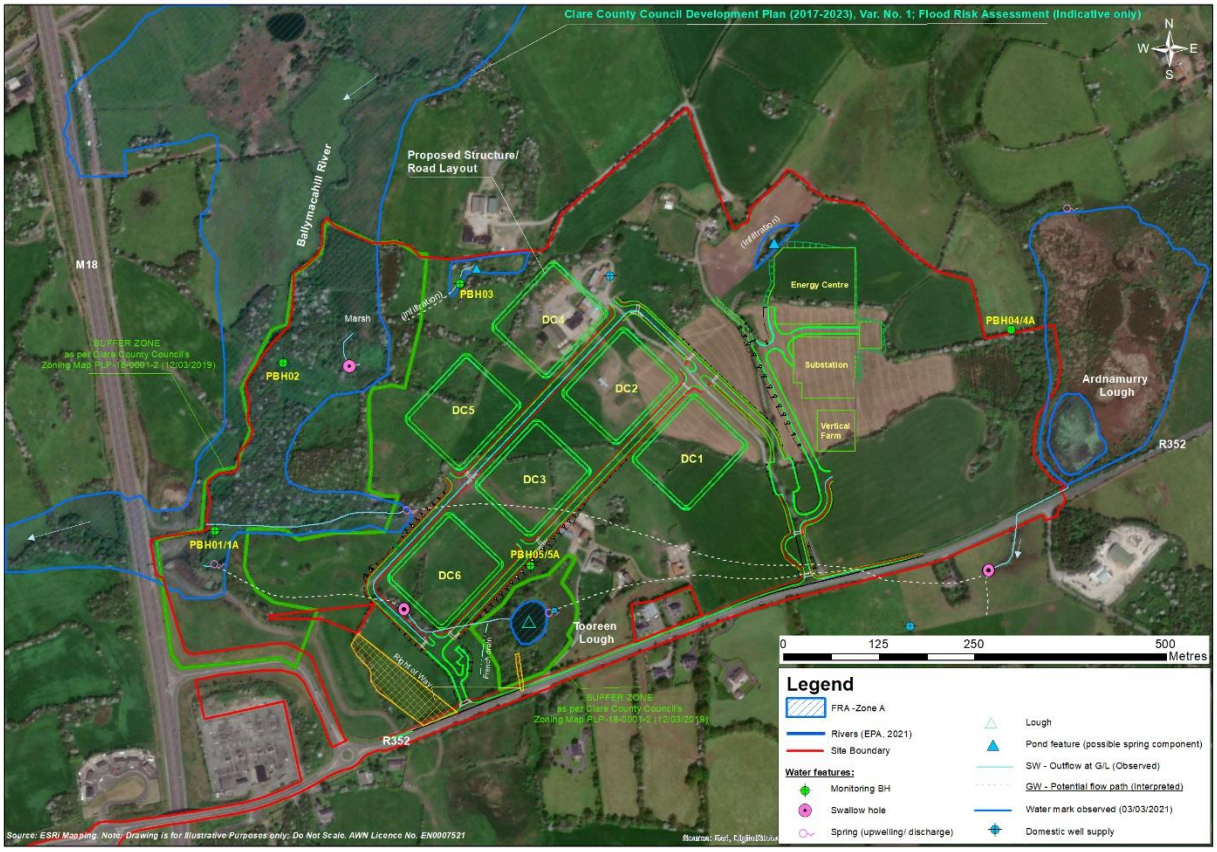

Figure 6-2 *Site Location and Local Drainage*

6.3.4 Lake Features

There are two lake features, refer to Figure 6-2 above. These lakes are called Tooreen Lough and Ardnamurry Lough and are located along the southern boundary with the R352 road and outside the eastern boundary of the site, respectively.

These lakes are primarily collected surface water within low lying depressions but are also fed by groundwater. A spring is located to the immediate east of Tooreen Lough and is likely discharging into this feature. The spring is also a local groundwater supply point for nearby residents and its presence indicates some continuity of upwelling effects in terms of supplying this well point. Farther to the east at Ardnamurry Lough, groundwater seepages (described in [GeoHive] historical 6" mapping for the area (OSi, 2021) as 'Rises') were recorded by AWN (March and May 2021) and are located to the north of the lough feature. It is therefore interpreted that the feature receives a component of groundwater inflow in addition to meteoric recharge in the wider area which drains towards this locally low wetland feature.

Tooreen Lough overflow water is recorded as discharging as stream flow to the immediate northwest/ west with the stream mainly flowing westwards towards an identified swallow hole located two fields across. Surface water discharges to ground at this point with an obvious [acoustically observed] 'drop' in water level below ground. This discharge is interpreted to ultimately drain towards a spring observed with

'overburden outflow' located farther west near the Ballymacahill River into which this outflow water finally discharges.

The swallow hole located farther east and south of the R352 road (this water is sourced from the wetlands at Ardnamurry Lough) is interpreted as possibly discharging in two directions at the point the water reaches the end of the [CCTV recorded] culvert, namely (a) to the immediate south and away from the R352 road, and (b) to the west crossing the R352 at a point where 'possible karstified Limestone' is reported by APEX (2021) as Feature 8.1 through which the transmission gas main also runs. This feature is interpreted as 5-6m in depth and discussion with the landowner indicated significant groundwater in the area during the excavation for the gas main installation. Where (b) represents a potential [groundwater] flow path then this water is interpreted to flow westwards beneath the proposed development and ultimately discharging to either Tooreen Lough spring or the main spring located to the northwest of Tooreen Lough, or both. Discharge to the spring at Tooreen Lough will follow the drainage network described above. Where the discharge [or part thereof] is to the main spring to the northwest of the lough, then this water will feed into the stream flow that ultimately discharges to the Ballymacahill River (refer also Figure 6-2 above). The geophysical survey (APEX, 2021) did not identify these conduits but identified a significant karstic and dolmitised zone which coincides with the swallow holes on the west of the proposed development site. The ecological assessment (Chapter 7) has not identified any specifical groundwater dependent species present.

Insert 6.1 presents [current] imagery of both lake features.

Insert 6. 1 *Tooreen Lough (LHS, April 2021) and Ardnamurry Lough (RHS, March 2021)*

6.3.5 Pond Features

Surface water features within the site boundary comprise a series of ponds to the north/ northeast with interpreted [seasonal/ recharge dependent] infiltration to ground.

There are two (2) no. pond water features of note either within the site boundary or along the site boundary where flooding historically occurs (see Figure 6-2 above). These features are located to the north (northwest of the proposed Data Centre DC4) and northeast (north of the proposed Energy Centre). These features discharge to ground and water fluctuates due to seasonality i.e. with swelling of levels during winter/ wetter months and recession of levels during summer/ drier months as presented in Figure 6-2 above and Insert 6.2 below. These areas are likely to be a combination of groundwater contribution and ponding after rainfall events. All pond features are located in [locally] low lying depressions within the landscape. The ecological

assessment (Chapter 7) has not identified any specific groundwater dependent species present.

The Ballyamachill (Spancelhill) River flows along the north-western boundary of the proposed development site. It flows between two attenuation ponds located within and adjacent to the western section of the proposed development site, before exiting the site through a culvert under the M18 Motorway to Ennis, refer to Insert 6.2 below. Ballyamachill River then flows *c.* 2.1km downstream into the River Fergus, which in turn discharges into the Fergus Estuary *c.* 4.9km downstream. The River Fergus overlaps with the Lower River Shannon SAC where the Ballyamachill River joins the River Fergus, and the Fergus Estuary overlaps with the River Shannon and River Fergus Estuaries SPA *c.* 4.9km downstream.

Insert 6.2 *Culvert under M81 motorway.*

The Dromore Woods and Loughs SAC is located *c.* 4.5km northwest of the proposed development site. A portion of the River Fergus flows through this European site. The River Fergus then flows *c.* 9.3km downstream, via Ballyallia Lough SAC, and combines with the outfall of the River Fergus that connects with the Ballyamachill River, upstream of this.

There is therefore a hydrological link between the proposed development site and European sites therein.

6.3.6 Surface Water Quality

The proposed development is located within the former Shannon Estuary North River Basin District (now the Irish River Basin District), as defined under the European Communities Directive 2000/60/EC, establishing a framework for community action in the field of water policy – this is commonly known as the Water Framework Directive (WFD). lies within the Shannon Estuary North Catchment (Hydrometric Area 27) and the River Fergus sub-catchment (refer to **Error! Reference source not found.** above).

The WFD requires ‘Good Water Status’ for all European waters to be achieved through a system of river basin management planning and extensive monitoring by 2015 or, at the least, by 2027. ‘Good status’ means both ‘Good Ecological (Status’ and ‘Good Chemical Status’. In 2009, the Eastern River Basin District (ERBD) River Basin Management Plan (RBMP) 2009-2015 was published. In the ERBD RBMP, the

impacts of a range of pressures were assessed including diffuse and point pollution, water abstraction and morphological pressures (e.g. water regulation structures). The purpose of this exercise was to identify water bodies at risk of failing to meet the objectives of the WFD by 2015 and include a programme of measures to address and alleviate these pressures by 2015. This was the first River Basin Management planning cycle (2010-2015). The second cycle river basin management plan for Ireland is currently in place and will run between 2018-2021 with the previous management districts now merged into one Ireland River Basin District (Ireland RBD).

This second-cycle RBMP aims to build on the progress made during the first cycle. Key measures during the first cycle included the licensing of urban waste-water discharges (with an associated investment in urban waste-water treatment) and the implementation of the Nitrates Action Programme (Good Agricultural Practice Regulations). In more general terms, three key lessons have emerged from the first cycle and the public consultation processes. These lessons have been firmly integrated into the development of the second cycle RBMP. Firstly, the structure of multiple RBDs did not prove effective, either in terms of developing the plans efficiently or in terms of implementing those plans. Secondly, the governance and delivery structures in place for the first cycle were not as effective as expected. Thirdly, the targets set were too ambitious and were not grounded on a sufficiently developed evidence base. The second cycle RBMP has been developed to address these points.

The proposed development is situated within the administrative area of Clare County Council. The Planning and Development policy framework with which the proposed development complies is defined by the Clare County Development Plan 2017 – 2023 (CCDP) and specifically Variation No.1 (adopted March 2019). Variation No.1 was undertaken to give effect 'to the *Government Policy Statement on the Development of Data Centres* in Ireland by identifying, in a plan led manner, the preferred location of a Data Centre in County Clare.' In terms of water quality, Variation No. 1 states that a development must "*maintain and improve water quality, as well as avoid and minimise effects on natural processes in particular natural flood management and catchment processes*".

The strategies and objectives of the WFD in Ireland have influenced a range of national legislation and regulations. These include the following:

- European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003);
- European Communities (Drinking Water) Regulations 2014 (S.I. 122 of 2014);
- European Communities Environmental Objectives (Surface Waters); Regulations, 2009 (S.I. No. 272 of 2009 as amended SI No. 77 of 2019);
- European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010 S.I. No. 366 of 2016);
- European Communities (Good Agricultural Practice for Protection of Waters) Regulations, 2010 (S.I. No. 610 of 2010);
- European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations, 2011 (S.I. No. 489 of 2011);
- Statutory Instrument (SI) No. 293 of 1988 European Communities (Quality of Salmonid Waters) Regulations 1988;
- Local Government (Water Pollution) Acts 1977-1990; and
- SI No. 258 of 1988 Water Quality Standards for Phosphorus Regulations 1998

Surface water quality is monitored periodically by the EPA at various regional locations along with principal and other smaller watercourses. The EPA assesses the water

quality of rivers and streams across Ireland using a biological assessment method, which is regarded as a representative indicator of the status of such waters and reflects the overall trend in conditions of the watercourse. The biological indicators range from Q5 - Q1. Level Q5 denotes a watercourse with good water quality and high community diversity, whereas Level Q1 denotes very low community diversity and bad water quality.

In relation to the subject site, the nearest active EPA monitoring stations located along the Ballymacahill (Spancelhill) River are:

- Up-gradient monitoring station: 'Bridge NW, near Spancelhill' (EPA Code: RS27S030200): located along the Ballymacahill River c. 1.30Km upstream of the proposed development site. The most recent status recorded by the EPA (2019) is classified as *Q3/ Poor*.
- Down-gradient monitoring station: 'Gaurus Br (Br d/s Aughavaddy Br)' (EPA Code: RS27S030400): located along the Ballymacahill River c. 1.35Km downstream of the proposed development site. The most recent status recorded by the EPA (2019) is classified as *Q3/ Poor*.

Figure 6-3 below presents the location of these EPA quality monitoring points in the context of the proposed development site.

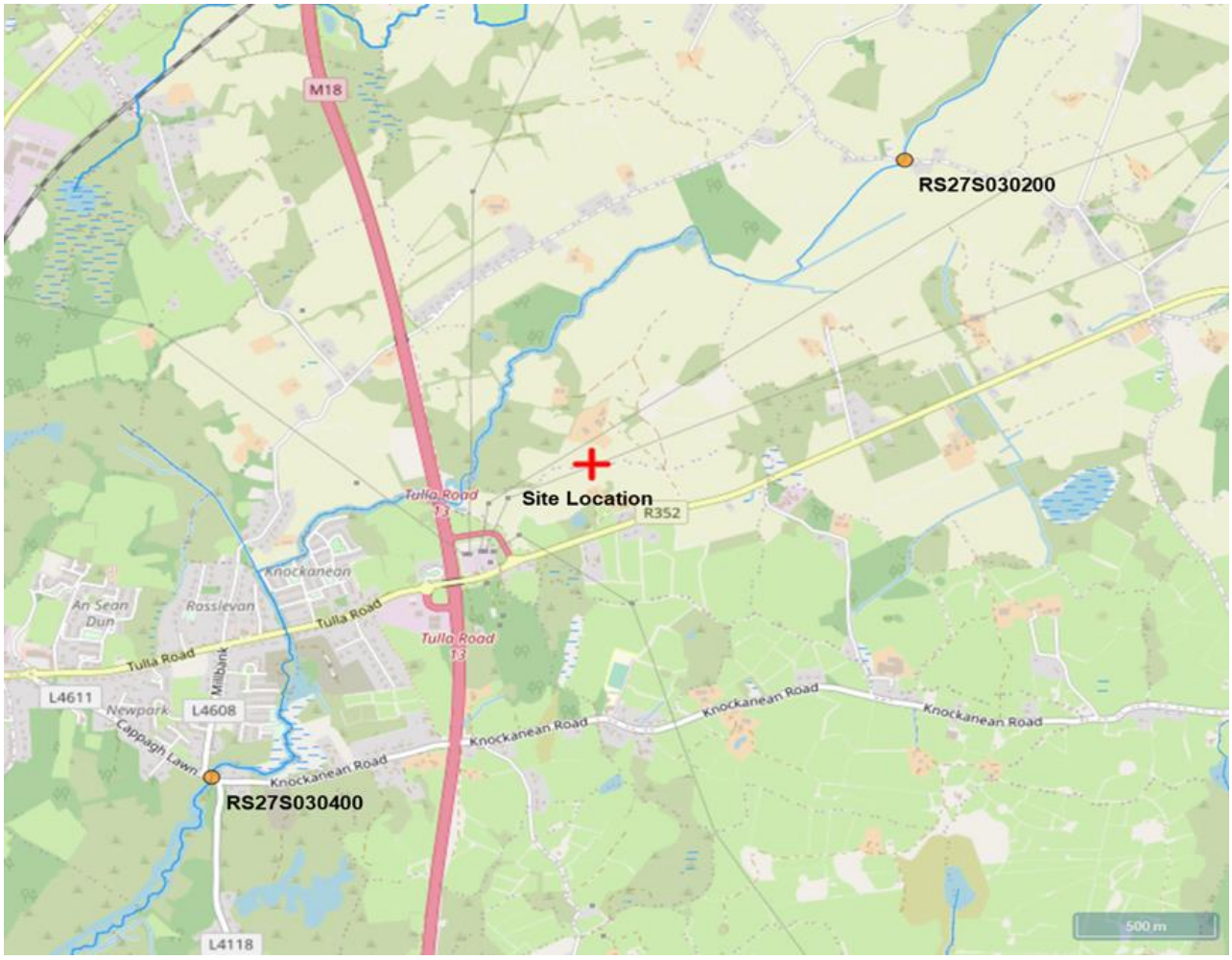

Figure 6-3 *EPA Surface Water Quality Stations (Source: EPA, 2021)*

The Water Framework Directive (WFD) Directive 2000/60/EC was adopted in 2000 as a single piece of legislation covering rivers, lakes, groundwater and transitional (estuarine) and coastal waters. In addition to protecting said waters, its objectives include the attainment of 'Good Status' in water bodies that are of lesser status at present and retaining 'Good Status' or better where such status exists at present. The WFD requires 'Good Water Status' for all European waters to be achieved through a system of river basin management planning and extensive monitoring. 'Good status' means both 'good ecological status' and 'good chemical status'.

The Ballymacahill (Spancelhill) River is currently classified by the EPA as having 'Poor' water status and is '*At risk of not achieving good status*'. This poor status is related to Anthropogenic Pressures along this waterbody.

Site-Specific Water Quality

The following table presents a summary of baseline field parameters collected at points across the proposed development site. Parameters include for pH, EC -electrical conductivity (uS/cm) and temperature (Deg. C) as well as some manual flow measurements on the date shown.

These sampling points are also shown in Figure 6-2 above.

Table 6. 1 *Summary of Field Parameters*

Feature ID	General location	pH	EC (uS/cm)	Temp (Deg. C)	Comments
Tooreen Lough	North of R352	08/04/2021 8.50 05/05/2021 8.10	08/04/2021 654 05/05/2021 661	08/04/2021 11.8 05/05/2021 14.6	08/04/2021 Some recession of water mark observed at lake boundary; clear water. 05/05/2021 No further significant recession in water levels observed; clear water
Swallow hole at Tooreen Lough	West of stream discharge from Tooreen Lough	03/03/2021 - 08/04/2021 8.09 05/05/2021 7.80	03/03/2021 642 08/04/2021 632 05/05/2021 715	03/03/2021 7.1 08/04/2021 9.6 05/05/2021 10.5	08/04/2021 Flow estimated at ~2.0 l/sec; very clear
Spring near Ballymachill River	West of swallow hole from Tooreen Lough	05/05/2021 7.30	05/05/2021 703	05/05/2021 13.5	Very slow seepage, clear
Main spring	North-west of Tooreen Lough	03/03/2021 - 08/04/2021 7.67 05/05/2021 7.20	03/03/2021 592 08/04/2021 633 05/05/2021 729	03/03/2021 7.4 08/04/2021 8.4 05/05/2021 10.4	08/04/2021 Flow estimated at ~5.8 l/sec; very clear

GW seepage	North-west (in wooded area)	05/05/2021 7.70	05/05/2021 685	05/05/2021 10.5	05/05/2021 Minimal upwelling and discharge observed
Ponds to North	Main pond to East	05/05/2021 N/A	05/05/2021 N/A	05/05/2021 N/A	05/05/2021 Observed as generally drying out
Spring at Ardnamurry Lough	North of Ardnamurry Lough	08/04/2021 7.47 05/05/2021 7.80	08/04/2021 874 05/05/2021 648	08/04/2021 11.8 05/05/2021 10.8	08/04/2021 Wet conditions observed. 05/05/2021 Observed as generally damp only
Swallow hole from Ardnamurry Lough	South of R352	03/03/2021 7.80 05/05/2021 7.20	03/03/2021 540 05/05/2021 651	03/03/2021 6.0 05/05/2021 10.4	05/05/2021 Flow estimated at ~0.5 l/sec; very clear

Table 6.1 above indicates EC values that would be typical of groundwater (mineralised waters) rather than surface water, and this ties in with the monitored feature types (springs, seepages etc) as presented. Note: While a similar EC profile (~632uS/cm) is presented for the stream water at the point of discharge via the swallow hole to the west of Tooreen Lough and that of the main spring farther to the north, the estimated flow rates for each, in addition to the pH values recorded on 08/04/2021 would infer no connectivity, especially as the flow to the swallow hole is less than that recorded at the main spring discharge.

6.3.7 Flood Risk

According to the Flood Risk Assessment (FRA) carried out by Clifton Scannell Emerson Associates (CSEA, 2021), there is no risk of flooding affecting the site from fluvial or coastal sources, since the site lies within Flood Zone C (i.e., where the probability of flooding from rivers is less than 0.1% or 1 in 1000). This Flood Risk Assessment report is included with the planning and the flood map extent of the Ballymacahill River (and main spring discharge to the east of this watercourse) is presented in Figure 6-2 above.

A regularly maintained drainage system would ensure that the network remains effective and in good working order should a large pluvial storm event occur. The FRA (CSEA, 2021) also concluded that the proposed development will not increase flood risk potential in any downstream third-party land.

6.3.7.1 Groundwater Flooding with pluvial influence

Groundwater flooding occurs when full storage in the underground aquifer is reached and rainfall (meteoric recharge) cannot discharge quick enough, causing the local water table to rise above the ground surface. According to the Geological Survey of Ireland (GSI), groundwater flooding in Ireland occurs mainly on the limestone lowlands to the west of the Shannon. The prevalence of groundwater flooding in the western counties is fundamentally linked to bedrock geology. The limestone bedrock in these areas has been dissolved over time in a process known as karstification, creating a subterranean network of water-bearing fractures and conduits with limited storage capacity. Surface drainage systems are frequently absent within well-developed karst

landscapes. Instead, the groundwater conduit flow system acts as the main drainage mechanism for the region.

The following site-specific data was used to determine the potential of groundwater flooding across the site:

1. CFRAM flood maps.
2. Topography.
3. Walk over survey to assess water level marks and review of historical photographs of surface water features, including lakes.
4. Review of contemporary borehole logs drilled through both the overburden and the underlying bedrock.

These data have been used to assess the potential for groundwater flooding.

The topographical gradient is quite variable across the proposed development. Overall, the elevation falls from east to west/ southwest with detailed elevation of approx. +15mOD (meters above Ordnance datum) in the west and +46mOD in the east. The topography (presence of low-lying depressions) and presence of springs and discharge to ground points (swallow holes) is crucial in determining where groundwater flooding could occur at/ within the proposed development site boundary.

There are four water features of significance either within the site boundary or along the site boundary where historically flooding has occurred (see Figure 6-2). These are: Tooreen Lough to the south (within the proposed development boundary), Ardnamurry Lough farther to the east (outside but adjacent to the eastern site boundary line), and two separate pond features located to the north (2 no. ponds) and northeast (1 no. pond) – both lie within the proposed development boundary.

The two lake features discharge to ground at nearby swallow holes as presented in Figure 6-2 above. All four areas are likely to be a combination of groundwater contribution and ponding rainfall. The latter two (i.e., Tooreen Lough and Ardnamurry Lough) are recorded as continuing to discharge during dry spells (observed on site in April/ May 2021). All four features are located within [locally] low-lying depressions within the landscape.

All these water features have been observed to expand in terms of lateral extent seasonally with autumn/ winter flooding and this footprint is generally followed by recession during drier conditions in summertime for example. Figure 6-2 above presents the local drainage map and historical water mark for each of these features. The historical water mark has been defined based on desk review of historical aerial imagery, field mapping of wetland vegetation as well as on the ground marking using fence posts to observe fluctuations in water levels (refer to below for the ponds to the north for example). These water levels are also based on available aerial imagery during high rainfall periods, see Insert 6.4 below. This filling and emptying/ lowering of water levels is likely based on exceedance/ enhancement of storage capacity of the karst conduit system in wetter months in addition to pluvial components.

Insert 6.3 presents [recent] imagery of the recession in water levels at the (2 no.) ponds to the north.

Insert 6.3 *Ponds to the north -Observed recession in water levels April to May 2021*

Water level loggers have also been installed since April 2021 to allow continuous water level monitoring for pre-construction seasonal variation monitoring at Tooreen Lough and the ponds to the north (eastern pond).

Based on available historical aerial imagery, the water level in Tooreen Lough appears to not dramatically fluctuate. The aerial image from February 2009 (significant flood in Ennis Town), flooding is noted in the west and south-west of the site due to the antecedental weather conditions. This is confirmed in the March 2012 aerial photograph where the features to the west and south-west almost recede completely and again, Tooreen Lough does not change, see Insert 6.4 below.

Insert 6.4 *The fluctuation of Tooreen Lough based on high flood and rainfall events.*

In terms of bedrock geology, groundwater flooding is more susceptible in areas where karstification is more prominent than where competent limestone bedrock prevails. Defining the geological setting in which the full site boundary lies is based on a combination of data provided by studies carried out by the GSI as well as based on the site-specific exploratory hole drilling and geophysical studies. These investigations follow best practice and were undertaken in May-June 2021 to provide a

comprehensive assessment of the water and soils environment and are described within Chapter 5 Land Soils and Water. Karst limestone with the presence of dolomite as the dominant bedrock geology has been identified in the western and south-western section of the site while more competent limestone rock is interpreted to prevail from the boundary with the karst in the west towards the centre of the site and extending eastwards towards Ardnamurry Lough, refer to Chapter 5 of this EIA Report.

Refer to Chapter 5 (Land, Soils, Geology & Hydrogeology) for further details on the underground connection potential of these features.

6.3.8 Ecology Receptors

As outlined in Chapter 7 (Biodiversity), there are a number of water habitats which are water fed/ maintained. These are described in Section 7.3.2.1. International and national habitats which are dependent on '*no measurable change in the natural water environment'* are summarised as follows:

Table 6. 2 *Ecological attributes within the site boundary*

Alluvial woodland [*91E0] (WN5 Riparian Woodland and WN6 Wet Willow-Alder-Ash Woodland) GW fed	International
Cladium Fen [*7210] (FS1) GW fed	International
Alkaline fen [7230] (PF1 – Rich Fen and Flush)	National
Molinia Meadows [6410] (GS4 Wet Grassland) GW fed	National

The above habitats are presented in Figure 6-4 below and Figure 7.8 of Chapter 7 (Biodiversity) of this EIA Report which shows the level of ecological importance of habitats at the development site. It is noted that an area of International Importance (alluvial woodland) is present at the edge of Fen habitat at Tooreen Lough and along the eastern boundary. Furthermore, the Reed and Large Sedge swamp (Cladium Fen) area is located along the eastern boundary of the proposed development site. Further information on the habitats is discussed in Chapter 7 (Biodiversity) of this EIA Report. There are no specific groundwater dependent species identified with the habitats present. As such the habitats are dependent on influx of flood water (rainwater and or groundwater) only.

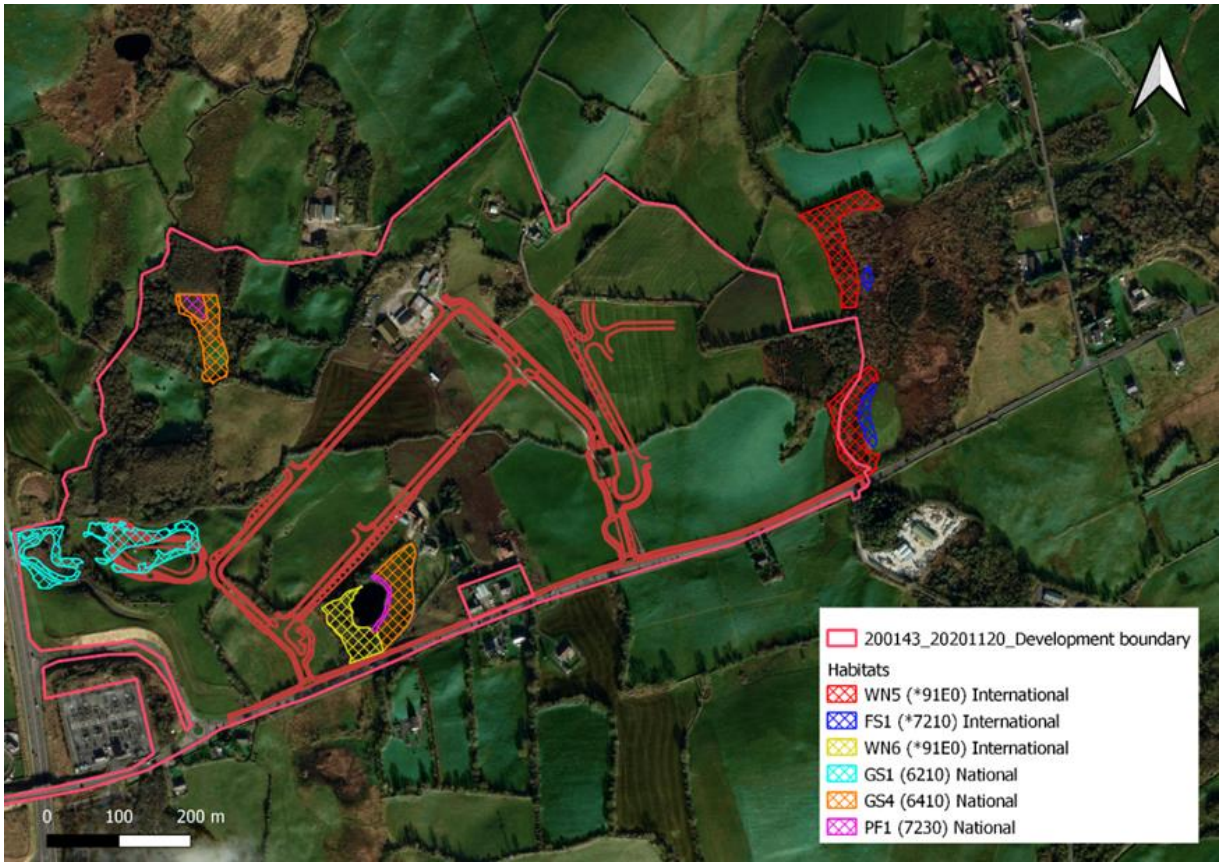

Figure 6-4 *Ecological features location within the site boundary.*

Fen type habitat was located in two different areas. These are considered of National Importance according to their species composition and structure.

The small area of rich fen and flush, located in the far northwest of the proposed development site, described as a wetland/pond feature, corresponded to a depression between wooded areas, and are naturally relatively species-rich vegetation communities. It is likely to have formed as a consequence of a lake infilling and can be described as a topogenous fen (i.e. forming in a valley or depression). A more-species-poor fen community occurs bordering on the landward side of reed and tall sedge swamp vegetation at Tooreen Lough.

Fen habitats located within these two particular areas corresponded to the description of the Annex I habitat Alkaline fen [7230], which are described as '*Wetlands mostly or largely occupied by peat- or tufa-producing small sedge and brown moss communities developed on soils permanently waterlogged, with a soligenous or topogenous base-rich, often calcareous water supply, and with the water table at, or slightly above or below, the substratum…*' within the Interpretation Manual of European Union Habitats (European Commission, 2013). The examples of rich fen and flush habitats within these two areas are considered to be of National Importance.

The areas of oak-ash-hazel woodland and immature woodland in the northwest, Tooreen Lough, the alluvial woodland (*91E0), Molinea meadows (6410) and alkaline fen (7230) surrounding Tooreen Lough and in the north west, and calcareous grassland (6210) adjacent to the attenuation pond by the M18 Motorway, will be protected as 'Ecological Buffer Space' designated by Clare County Development Plan Variation No. 1. These areas will be retained, protected from development and will not be directly impacted from the development.

The wetland in the north of the site will also not be impacted by the proposed hardstand footprint of the development.

6.3.9 Fisheries

Fish species are protected under the Fisheries Acts and by fishing by-laws. Atlantic salmon, river lamprey and the brook lamprey are listed on Annex II of the EU Habitats Directive. Electrofishing surveys were not carried out as part of the field surveys.

The proposed development site lies within the Fergus_SC_040 catchment. The EPA segment of the Spancelhill Stream which is contained within the study area is Spancelhill_010. Spancelhill_010 segment is c. 7.5km and consists of the channel of the Spancelhill Stream from its starting point in O'Briens Big Lough, to where it joins the River Fergus downstream of the proposed development site. The Spancelhill Stream and the River Fergus have not been surveyed by Inland Fisheries Ireland (IFI) for their Ecological Fish Status. There are five Annex II fish species found within the Lower River Shannon SAC, i.e., sea lamprey Petromyzon marinus, brook lamprey Lampetra planeri, river lamprey Lampetra fluviatilis, Atlantic salmon Salmo salar and twaite shad Alosa fallax, the four former species of which are Qualifying Interests of the SAC. The three lamprey species and Atlantic salmon have all been observed to be spawning in the Lower Shannon and its tributaries (NPWS, 2013d). There was one fish species record, sea lamprey, identified within c. 2km returned from the desk study.

Note: While fish surveys were not carried out in the waterbodies within the proposed development site boundary, both Tooreen Lough and the M18 Attenuation Pond have potential to hold populations of small fish species.

6.3.10 Areas of Conservation

According to the NPWS (2021) on-line database there are no special protected areas on or in the vicinity of the subject site. The closest European listed sites are as follows;

- Lower River Shannon Special Area of Conservation (SAC) (site code 002165) - circa. 2.1 km to the southwest of the site.
- Ballyallia Lake SAC and proposed National Hertiage Area (pNHA) (site code: 000014) - circa. 2.3 km to the west of the subject site.
- Ballyallia Lake Special Protection Area (SPA) (site code: 004041) - circa. 2.8 km to the northwest of the subject site.
- Newpark House (Ennis) pNHA (site code: 000061) - circa. 1.6 km to the southwest of the site.

A potential source-pathway-receptor (SPR) link exists between the proposed development site and the following European sites: Lower River Shannon SAC and River Fergus and River Shannon Estuaries SPA. This link is via the Ballymacahill (Spancelhill) River which flows along the north-western boundary of the proposed development site, flowing downstream before joining the River Fergus and finally discharging into the Fergus Estuary. The Dromore Woods and Loughs SAC is located c. 4.5km northwest of the proposed development site and is upstream of the proposed development. A portion of the River Fergus flows through this European site. The River Fergus then flows c. 9.3km downstream, via Ballyallia Lough SAC, and combines with the outfall of the River Fergus that connects with the Ballymacahill River, upstream of this. There is therefore a hydrological link between the proposed development site and European sites therein.

Figure 6-5 below presents the location of these protected areas in the context of the subject development site.

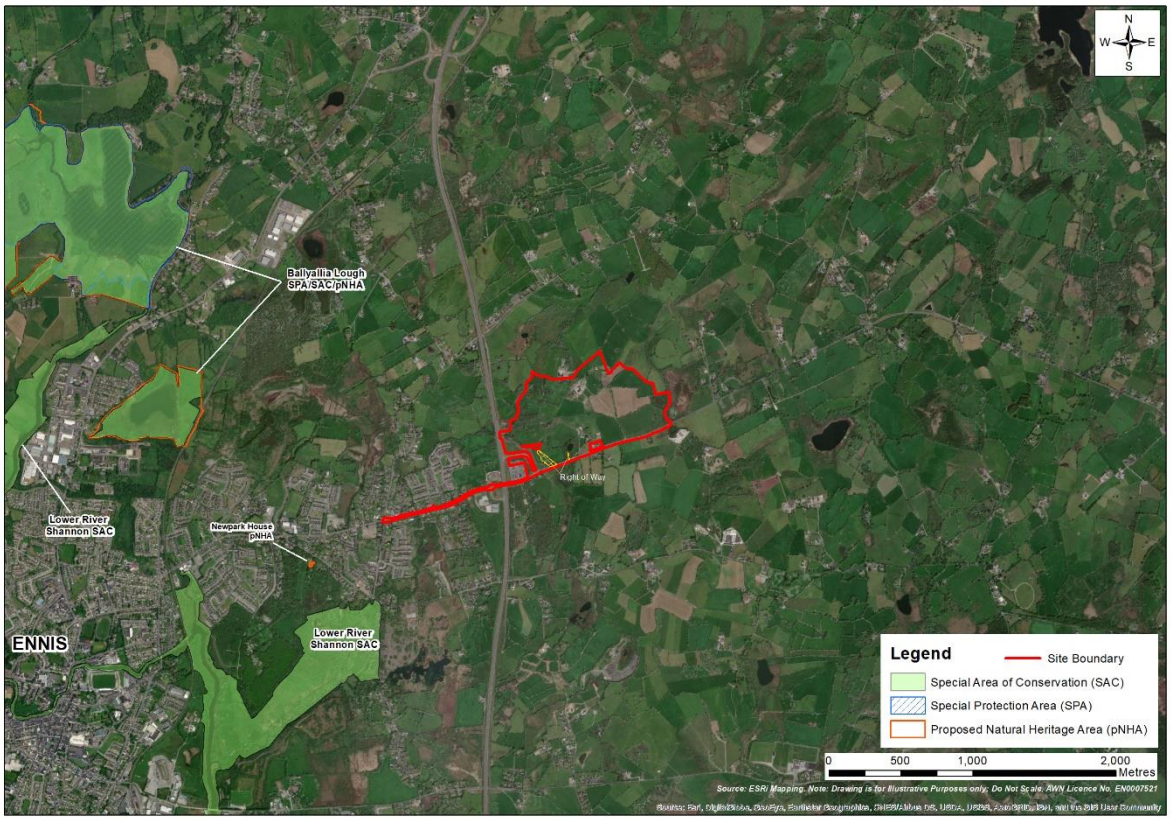

Figure 6-5 *Natura Sites in the Context of the Subject Site (Source: NPWS, 2021)*

6.3.11 Rating of Importance of Hydrological Attributes

Based on the TII methodology (2009) (See Appendix 6.1) the importance rating of the hydrological features within the development boundary site is presented in Table 6. 3 below.

Table 6. 3 *Summary of Hydrological Evaluation of Identified Attributes*

Hydrological Feature	Importance of Attribute	Comment
Ardnamurry Lough	Medium to High	Based on habitat / ecological evaluation
Tooreen Lough and associated spring and swallow hole.	Medium to High	Based on habitat / ecological evaluation.
Pond to the North-East	Low	Based on habitat / ecological evaluation.
Ponds to the North	Low	Based on habitat / ecological evaluation.
Spring / seepage in wooded area to the east of Ballymacahill River	Medium to High	This feature is considered low to Medium to High with potential connection to the Ballymacahill River and therefore the Lower Shannon River SAC downgradient.
Ballymacahaill River	High	This feature is considered High as there is a direct connection to the Lower Shannon River SAC, 2.1 km

Hydrological Feature	Importance of Attribute	Comment
		downgradient from the proposed development site.

As there is a direct hydrological connection between the site and Lower Shannon River protected sites (SAC), the overall attribute significance is considered to be High to Very High.

6.4 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

The proposed development is c. 58 hectares in area and comprises:

- Six (6) no. data centres buildings (DC1 to DC6).
- A gas-powered Energy Centre and Above Ground Installation (AGI).
- A new 110kV substation, two drop down masts and underground grid connection.
- Fibre connection.
- Connection and upgrade of foul sewer and mains supply extending along the existing R352.
- Undergrounding of two of the existing overhead 110kv circuits.
- Associated Infrastructure: including roads and a attenuation pond.

The proposed development represents an overall increase in hardstanding surfaces of approx. 17.3 hectares. The rest of the site comprises landscaping and undeveloped areas. Ecological buffer zones cover c. 10 ha of lands as seen in Figure 2.1 in Chapter 2 Description of the Proposed Development. These were delineated following assessment undertaken as part of the area assessment within the Clare County Development Plan 2017 – 2023 (Variation No. 1). Further assessment has been undertaken by the project ecologist to protect ecology during construction and operation of the proposed development.

The proposed development site boundary includes approx. 2.1 km of the existing Tulla Road for connection to sewer.

Two of the 110kV overhead circuits which currently traverse the site will be brought underground to the [existing] Ennis substation as they come on to the site on the eastern side.

Further details of the proposed development are described in Chapter 2 (Description of the Proposed Development). The details of the construction and operation of the development in terms of Hydrology are detailed in the subsections below.

6.4.1 Construction Phase

The key civil engineering works which will have a potential impact on the water and hydrological environment during construction of the proposed development are summarised below.

- Excavation of the proposed attenuation pond to the southwest of the site (proposed lowest surface water capture point within the main development site).

- Excavations are required for foundations of buildings and installation of associated services included within the development. This may include installation of load-bearing piles to target depth at select data centre footprints.
- Possible discharge of collected rainwater/ minimal dewatering during excavation works and groundworks (the extent of which is dependent on the time of year development works are carried out).
- Construction activities will necessitate storage of cement and concrete materials, temporary oils, and fuels on site. Small localised accidental releases of contaminating substances including hydrocarbons have the potential to occur from construction traffic and vehicles operating on site.
- Construction of culvert pipes to receive overflow water from Tooreen Lough as well as installation of a concrete ring and chamber at the existing swallow hole receiving stream water from the lough. There is also a proposed overflow pipe from this swallow hole (dimensions to include correction for climate change effects).
- Potential localised earthworks south of the existing pond to the north of the proposed Energy Centre.
- Localised excavations (cuts) and infill (build-up) as part of the designed elevation changes across the proposed development site.

6.4.2 Operational Phase

The key activities which will have a potential impact on the hydrological environment during operation of the proposed development are summarised below:

6.4.2.1 Increase in Hard Standing Area

The proposed surface water network(s) for the development will collect runoff from roofs, roads and other hard standing areas in a sealed system of pipes and gullies. The proposed development represents an overall increase in hardstanding surfaces of approx. 17.3 hectares. Refer also to Section 6.4.2.3 for additional detail on surface water management and maintaining existing surface water/ groundwater interaction.

6.4.2.2 Storage of Hazardous Materials:

In the event of a loss of power supply, the emergency generators are designed to automatically activate and provide power to the data storage facility. The generators will be supplied by low sulphur diesel. Fuel oil for the emergency generators is the only required bulk chemical required on site. Located within the services yard of three of the six datacentres, it is proposed to have up to 7 bunded above ground bulk storage tanks for fuel oil (440m^3 for three (3 no.) data storage facilities), distribution pumps, overground delivery pipeline to the belly tanks for diesel fired standby generators within each data storage facility.

The proposed Energy Centre will have back-up fuel storage with up to 20 fully bunded above ground bulk storage tanks for fuel oil (total of 1,440 m^3 of fuel oil). The total fuel store will be 2,900 m^3 (or 2,494 tonnes). All bunds will be capable of containing 110% of the volume of the largest drum/tank within the bund or 25% of the total volume of the substance stored and will designed in accordance with the EPA's guidelines for the storage and transfer of materials for scheduled activities (EPA, 2004).

The site is traversed by a high-pressure Gas Networks Ireland gas pipeline running in a S-N direction to the east of the development site. An Above Ground Installation (AGI) will be constructed to facilitate supply for the Energy Centre.

6.4.2.3 Surface Water Management:

The proposed surface water drainage system for the development comprises various drainage components including positive stormwater networks, attenuation systems and several Sustainable Drainage Systems (SuDS) elements. The proposed surface water drainage was designed in accordance with the SuDS Manuel 2015 and includes correction for climate change effects. The intention of the proposed surface water management plan is to maintain existing surface water (and groundwater) flow patterns. Drainage for non-paved areas will continue to discharge to ground. Drainage in areas of fuel storage will be fully sealed.

The developed area of the site is 17.3 ha and attenuation has been designed on site for the 1:100-year flood event including consideration of a 20% allowance for climate change effects. An overflow subsurface pipeline will discharge at current discharge rates (greenfield) to the Ballymacahill River. Drainage will be from a single lined fully designed attenuation pond feature to be located to the southwest of the site.

Rainwater run-off from the roofs of the six Data Centres will be collected and will feed water harvesting tanks with any excess overflow into the common road drainage network. This water will be available as cooling water. Other SuDS measures will include permeable paving and swales. These drains and swales will discharge to the surface water attenuation pond where the discharge will be controlled using a 'Hydrobrake Optimum' vortex flow control device to limit the maximum discharge to 50 l/s during the 1:100-year storm (the calculated Q-bar value attributed to the site is 61 l/s).

The attenuation pond will be constructed to retain a constant volume of water to promote settling and reduce conveyance of suspended solids and other particles to the receiving watercourse. An attenuation volume of 9,293 m³ is designed as part of the proposed development. A Class (I) by-pass separator with a suitable capacity will be installed downstream of the proposed hydrobrake unit. The function of the separator is to intercept pollutants (any petroleum/ oil) and prevent their entry to the Ballymacahill River. As such, there is no potential for increase either flooding or impact on water quality as a result of the proposed development. Further details are provided within the CSEA (2021) engineering report prepared for planning.

The attenuation pond has two (2) no. design levels. The two levels are summarised as follows:

(i) 1:100 + 20% climate change, and
(ii) 1:1000 year. Please see table below.

Additional details on the attenuation pond are provided in Table 6.5 below.

Table 6.4 *Design details for the attenuation pond*

Description	Data	Level mOD/remarks
Top Area	5184.3 m^2	+15.23
Bed Area	2591.0 m^2	+12.23, 3m total depth
Storage during 1/100 year + 20% CC	6864 m^3	+14.24 , FB = 990mm
Storage during 1/1000 year	9293 m^3	+14.79, FB= 440mm
Side-slope grading	1:3	-
Hydrobrake Max. outflow rate during 1/100 year +20% CC	50.6 l/s	-
Hydrobrake Max. outflow rate during 1/1000 year	56.1 l/s	-

6.4.2.4 Wastewater

Existing System

The site is currently not serviced by foul sewage.

According to Clare County Council and Irish Water drawings, there is an existing 225mm diameter foul drain that forms part of an existing foul drainage network that services the existing Knockanean area southwest of the proposed development along the existing Tulla Road/R352. This existing 225mm diameter foul drain discharges to the existing Pumping Station of Gort Na mBlath located approximately 550 metres farther west from the proposed development.

Proposed System Connection

The proposed Art Data Centre Development, subject to this planning application, comprises a gravity foul sewer networks consisting of 150mm diameter pipes size. As such, the overall wastewater discharges associated with the proposed development are in accordance the demand/ discharge rates outlined in the Pre-Consultation Enquiry (PCE) provided to Irish Water (IW).

The design Dry Weather Flow (DWF) of the development is 20.9 m^3/d for the entire site catchment. A peak of 0.6 l/s domestic/ staff wastewater flow was included as part of the submitted PCE to IW. The proposed foul drainage service attributed to the site will incorporate a foul pumping station and associated rising main which will also include a 24-hour emergency storage tank in the unlikely event that the proposed foul pump malfunctions. The proposed 24-hour emergency storage tank shall be situated in an open space located southwest of the proposed data storage buildings. Maintenance access to both the pump chamber and 24-hour emergency storage tank will be incorporated into the design. This proposed pumping system will transfer the generated wastewater via a rising main which runs along the Tulla Road (southwest of the site) to the existing Gort Na mBlath Pumping Station.

All wastewater works to be in accordance with the relevant Irish Water Code of Practice. It is proposed to use the 24-hour emergency storage tank as to avoid foul discharge from the development during peak domestic wastewater hours in the town.

This might be achieved by allowing for the proposed pumping system to operate only during night times (typically between 00:00 hrs and 06:00 hrs). However, the operation of the proposed pumping station is subject to agreement with the Department of Water and Drainage in Clare County Council.

The final discharge point from the Ennis North WWTP is the River Fergus. This WWTP is required to operate under an EPA licence (D0048-01) and to meet environmental legislative requirements. A review of the available Annual Environmental Reports (AERs) provided as part of the EPA licence requirements, confirms the WWTP is generally operating in compliance. There were some minor exceedances which relates to chemical problems, equipment failure and maintenance issues. These were temporary and rectified within the normal response time by Irish Water.

The domestic/ staff wastewater peak design flow is 0.6 l/s (51.84 m^3/day) (Source: CSEA, 2021). The peak foul discharge calculated for the proposed development is well within the capacity of the WWTP. Even without treatment at the Ennis North WWTP, the peak effluent discharge, calculated for the proposed development, would equate to 0.79% of the licensed discharge at Ennis North WWTP. This would not impact on the overall water quality within River Fergus and therefore would not have an impact on the current Water Body Status (as defined within the Water Framework Directive). (Note: the peak effluent discharge equates to approx. 0.003% of the licensed maximum discharge (peak hydraulic capacity) at Ennis North WWTP). Therefore, the wastewater discharge volume from the proposed development site will not have a negative impact on the Ennis North WWTP and, as a consequence, will not have a negative impact on the receiving environment, e.g., River Fergus.

Further detail in relation to wastewater emissions is presented in the CSEA (2021) Engineering Planning Report – Drainage and Water Services (RPT-20_110-001).

6.4.2.5 Water Supply

A 450mm diameter mains runs along the Tulla Road. Following a proposed upgrade for connection (within the existing road), it will have capacity to supply adequate water for the proposed development.

Water is required for cooling equipment, cleaning, general potable supply for drinking and sanitary facilities. This will be sourced from mains water supply and on-site rainwater harvesting. The 450mm diameter mains runs along the Tulla Road and following a proposed upgrade for connection (within the existing road), has capacity to provide an adequate supply of water to the proposed development. Residual cooling water, associated with the evaporative cooling process, is to be discharged from the air handling units to the surface water drainage network. When evaporative cooling is required the average rate of demand for the proposed development is estimated to be less than 1,000 m^3/day for the whole site. It is proposed to store at least 48 hours' worth of rainwater at each data storage facility for the purpose of supplying the evaporative coolers prior to using the public water supply. Of the water supplied, only 40% will be discharged to the surface water system as the remainder will be lost to evaporation in the cooling process. This results in an average daily discharge of 400 m^3/day. The peak rate of discharge for the proposed development will be 205 l/s. As the cooling water will only be required during periods of hot dry weather (i.e., temperature exceeds, 27°C), the discharge to the surface water network will not coincide with any rainfall events.

Consultation with IW has confirmed that sufficient water and wastewater capacity is available. A PCE was submitted to IW which addressed water demand (and

wastewater) for the proposed development (Appendix 13.1 of this EIA Report). The overall water demand associated with the proposed development is in accordance with the water demand outlined in the PCE.

Further detail in relation to water supply emissions is presented in the CSEA (2021) Engineering Planning Report – Drainage and Water Services (RPT-20_110-001).

6.4.3 Do Nothing Scenario

The proposed development land is currently agricultural land; the land is zoned 'enterprise' which provides for the use and development of land for high end research and development, business science and technology-based industry, financial services, call centres/telemarketing, software development, data centres, enterprise and incubator units, small/medium manufacturing or corporate office in high quality campus/park type development.' It is likely that the land use will change over time even if this development does not go ahead. The associated impact of any such development in accordance with the zoning objective will be similar to the proposed development for the surrounding hydrological environment.

6.5 POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT

An analysis of the potential impacts of the proposed development on the hydrological environment during the construction and operation is outlined below. Receptors include the Ballymacahill River, internal [shallow] drainage ditches running along some field boundaries, as well as ponds, Tooreen Lough and swallow holes which lead to underground conduits, all of which ultimately discharge to west/ southwest and to the Ballymacahill River.

The site is drained by an internal field drainage network and karst flow. This network ultimately flows in a west to south westerly direction towards the Ballymacahill River which in turn joins the Fergus River approx. 3.0 Km downstream. The River Fergus discharges to the sea at Shannon Estuary over 7.0 Km downstream of the site. The Ballymacahill River flows towards the Lower River Shannon SAC) located c. 2.1 Km to the southwest of the site.

6.5.1 Construction Phase

6.5.1.1 Increased Sediments Loading in Surface Water Run-off

Surface water runoff during the construction phase may contain increased silt levels or become polluted from construction related activities. Runoff containing large amounts of silt can cause damage to surface water systems and receiving watercourses (for example Tooreen Lough). Silt-laden water can arise from dewatering of excavations, exposed ground, stockpiling of subsoils/ rock material and from access/ haulage tracks and roads.

6.5.1.2 Accidental Spills and Leaks

As with all construction projects there is potential for water (rainfall and/ or groundwater) to become contaminated with pollutants associated with construction related activity.

During construction of the development, there is a risk of accidental pollution incidences from the following sources:

- Cement/ concrete (increase turbidity and pH) – arising from construction phase materials.
- Hydrocarbons (ecotoxic) – accidental spillages from construction plant or on-site storage.
- Wastewater (nutrient and microbial rich) – arising from accidental discharge from on-site toilets and washrooms.

Due to the distance to the Lower River Shannon SAC, the proposed development does not have the potential to affect the water quality, and therefore the integrity, of this Natura 2000 site due to:

- An accidental pollution event during construction or discharge of silt laden water (without mitigation) has the ability to locally affecting water quality in the Ballymacahill River. However, based on the low chemical loading (c. < 5000 litres of oil and alkaline run-off from cementing works), together with the available attenuation and dilution within the Ballmacahil river and the Fergus there is no potential for exceedance of SI thresholds (i.e. S.I. European Communities Environmental Objectives Regulations, 2009 [S.I. No. 272 of 2009 as amended by SI No. 77 of 2019]) at the SAC.
- Due to its close proximity to the proposed development site via connectivity with the Ballymacahill River there is potential for local disturbance and/ or change in morphology of the river if not appropriately attenuated and outfall designed appropriately.

6.5.1.3 Potential Blockage of Swallow Holes & Springs

Due to the proposed construction compound located immediately southwest of Data Centre DC6 and beside the existing swallow hole that receives water from Tooreen Lough stream flow, there is a potential that this feature could be blocked temporarily. Blockages could arise as a result of sediment runoff, or storage of subsoil/ rock material for example.

Similar to the swallow hole at DC6, the main spring located to the immediate north of DC6 may also potentially be impacted from adjacent earthworks (sediment run-off for example).

6.5.1.4 Summary of Construction Phase Impacts

A summary of construction phase impacts for the proposed development (with and without mitigation) following EPA (2017) EIA guidelines is provided in Table 6. 5 below.

Table 6. 5 *Impact Assessment of Proposed Construction Activities*

Water Feature	Summary of Works Proposed	Magnitude of Impact - without mitigation measures	Magnitude of Impact - with mitigation measures
Ardnamurry Lough	Outside of the Construction Works	No Impact predicted	No Impact predicted
Tooreen Lough	Excavations, infill and construction activities in the vicinity of this feature.	*Temporary, Significant impact*	*Temporary, Imperceptible impact*
Pond to the North-East (North of the Energy Centre)	Excavations, infill and construction works in the vicinity of this feature	*Temporary, Significant impact*	*Temporary, Imperceptible impact*

Water Feature	Summary of Works Proposed	Magnitude of Impact - without mitigation measures	Magnitude of Impact - with mitigation measures
Ponds to the North	Excavations, infill and construction works in the vicinity of this feature	*Temporary, Significant impact*	*Temporary, Imperceptible impact*
Swallow hole south of Tulla Road	Outside of the Construction Works	No Impact predicted	No Impact predicted
Main Spring north west of Tooreen Lough	Excavations, infill and construction works in the vicinity of this feature	*Temporary, Significant impact*	*Temporary, Imperceptible impact*
Stream and Swallow hole west of Tooreen Lough and south of DC6	Stream will be culverted, and swallow hole will be covered with a concrete manhole with cover.	*Temporary, Moderate impact*	*Temporary, Imperceptible impact*
Ballymacahaill River	Construction activities in the vicinity of features with direct connectivity to this waterbody.	*Temporary, Significant impact*	*Temporary, Imperceptible impact*
Lower River Shannon SAC	Downgradient (over 2.0 km) of the Ballymacahaill River.	*Temporary, Significant impact*	*Temporary, Imperceptible impact*

6.5.2 Operational Phase

6.5.2.1 Increase in hardstanding

The increase in hardstanding (17.3 ha), if not adequately attenuated on site, would result in an increase in run-off rate and potential downgradient flooding. As described in Section 6.4.2.3 above, the design has incorporated adequate attenuation for a 1: 100-year flood event including correction for climate change effects.

The increase in hardstanding can cause increases in surface water run-off which has the potential to impact on the water quality and quantity of the hydrological environment and especially the Ballyamachill River (with downstream links to the SAC). Furthermore, this increase in surface water runoff has the potential to increase off-site flooding to neighbouring lands if not appropriately attenuated.

Refer also to Section 6.4.2.3 for additional detail on surface water management and maintaining existing surface water/ groundwater interaction which is applicable also to the long-term operation of the proposed development.

6.5.2.2 Accidental Spill and Leaks

The development includes the storage and use of diesel fuel which has the potential to have water quality impacts if a leak/ spill occurs and is not adequately mitigated. The design incorporates containment measures and measures for treatment of any spills/ leaks (described in Section 6.6 below).

6.5.2.3 Summary of the Operational Phase Impacts

A summary of operational phase impacts for the proposed development (with and without mitigation) following EPA (2017) EIA guidelines is provided in the Table 6. 6 below.

Table 6. 6 *Impact Assessment of Proposed Operational Phase*

Water Feature	Magnitude of Impact -without design measures [1]	Magnitude of Impact – with design and mitigation measures
Ardnamurry Lough	No Impact predicted	No Impact predicted
Tooreen Lough	*Temporary, Significant impact*	*Long-term Imperceptible impact*
Pond to the North-East (North of the Energy Centre)	*Temporary, Significant impact*	*Long-term Imperceptible impact*
Ponds to the North	*Temporary, Significant impact*	*Long-term Imperceptible impact*
Swallow hole south of Tulla Road	No Impact predicted	No Impact predicted
Main Spring north west of Tooreen Lough	*Temporary, Significant impact*	*Long term, Imperceptible impact*
Stream and Swallow hole west of Tooreen Lough and south of DC6	*Temporary, Moderate impact*	*Long-term Imperceptible impact*
Ballymacahaill River	*Temporary, Significant impact*	*Long-term Imperceptible impact*
Lower River Shannon SAC	*Temporary, Significant impact*	*Long-term Imperceptible impact*

[1] The Impact Assessment without design mitigation measures assumes that the attenuation pond, interceptor and other measures in place fail during the operational phase. However, these mitigation measures are a part of the design of the proposed development. The majority of the failures would result in increased flows to the receiving waterbody.

6.6 REMEDIAL AND MITIGATION MEASURES

The design has taken account of the potential impacts of the development on the hydrology environment local to the area where construction is taking place and containment of contaminant sources during the operational phase of the site. These design measures and mitigation measures are described below.

Due to the inter-relationship between land, soils, geology, hydrogeology, ecology and hydrology, the following mitigation measures discussed will be considered applicable to each of the respective chapters. Waste Management is also considered an interaction in some sections.

6.6.1 Construction Phase

In order to reduce the potential for any adverse impacts on the existing hydrological environment, a number of mitigation measures will be adopted as part of the construction works on site.

A Construction Environmental Management Plan (CEMP) and Construction Surface Water Management Plan (SWMP) for the site are included with the planning documentation. The contractor will be obliged to implement the measures outlined in the CEMP and SWMP (refer to Chapter 13 of this EIA Report). The CEMP sets out the overarching vision of how the construction of the proposed development will be managed in a safe and organised manner by the Contractor.

The CEMP will be a live document and it will go through a number of iterations before works commence and during the works. It will set out requirements and standards which must be met during the construction stage and will include the relevant mitigation measures outlined in the EIA Report and any subsequent planning conditions relevant to the proposed development.

The SWMP follows best international practice, including, but not limited to:

- CIRIA, (2001), Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors, (C532) Construction Industry Research and Information Association;
- CIRIA (2002) Control of water pollution from construction sites: guidance for consultants and contractors (SPI56) Construction Industry Research and Information Association
- CIRIA (2005), Environmental Good Practice on Site (C650); Construction Industry Research and Information Association
- BPGCS005, Oil Storage Guidelines;
- Eastern Regional Fisheries Board, (2006), Fisheries Protection Guidelines: Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites;
- CIRIA 697, The SUDS Manual, 2007; and
- UK Pollution Prevention Guidelines (PPG) UK Environment Agency, 2004.

6.6.1.1 Surface Water Run-Off

As there is potential for run-off to directly or indirectly discharge to a watercourse, the SWMP includes specific mitigation measures to manage run-off and water quality during the construction phase. These include:

- No direct run-off will be allowed to ecological buffer zones, any open water, or karst swallow holes as identified. Construction run-off will be collected and discharged through sediment traps/ siltbuster type settlement tanks prior to discharge to ground or to the on-site attenuation tank.
- Silt [trap] fencing will be emplaced around buffer zones and along open water courses and swallow holes to prevent any direct run-off to these areas.
- Provision of exclusion zones and barriers (e.g. silt trap/ fences) between earthworks, stockpiles and temporary surfaces to prevent sediment washing into the existing drainage systems and hence the downstream receiving water environment.
- Provision of temporary construction surface drainage and sediment control measures to be in place before earthworks commence.
- A hydrocarbon interceptor will be installed upgradient of the attenuation pond to provide treatment in the event of an accidental release of oil from construction vehicles.
- Any minor ingress of groundwater and collected rainfall in the excavation will be pumped out during construction. It is estimated that the inflow rate of groundwater will be low and limited across the site.
- Daily monitoring (visual inspection) will be adopted to ensure that the water is of sufficient quality to discharge from the attenuation pond. The outlet of the pond includes a shut off valve should the water quality be deemed to be poor and require further treatment prior to discharge.
- The temporary storage of excavated subsoil/ rock material will be carefully managed. Stockpiles will be tightly compacted to reduce runoff and graded to aid in runoff collection. This will prevent any potential negative impact on the stormwater drainage and the material will be stored away from any surface water drains. Movement of material will be minimised to reduce the degradation of soil structure and generation of dust.
- Excavations will remain open for as little time as possible before the placement of fill. This will help to minimise the potential for water ingress into excavations.
- Excavated soil/ rock material from site works will be stored away from existing drainage features to remove any potential impact.
- Weather conditions will be considered when planning construction activities to minimise the risk of run-off from the site and the suitable distance of topsoil piles from surface water drains will be maintained.
- A specific method statement will be prepared for the discharge outlet from the attenuation pond to the Ballymachaill River. The outfall structure will be designed with headwall, wingwalls and a bed apron to prevent local scouring of the banks and the channel bed. This, together with management of flow to mimic current run-off rates, will ensure no measurable impact on river morphology, existing surface water flow hydraulics or the potential for an increase in the risk of flooding.
- A method statement for installation of the discharge pipe and outlet structure from Tooreen Lough will be provided by the contractor for approval by CCC and IFI stakeholders.

6.6.1.2 Fuel and Chemical Handling

Any fuels or chemicals (including hydrocarbons or any polluting chemicals) will be stored in a designated, secure bunded area(s) within the designated contractor's compound to prevent any seepage of potential pollutants into the local surface water network. These designated areas will be clearly sign-posted and all personnel on site will be made aware of their locations and associated risks.

All mobile fuel bowsers shall carry a spill kit and operatives must have spill response training. All fuel containing equipment such as portable generators shall be placed on drip trays. All fuels and chemicals required to be stored on- site will be clearly marked. Care and attention will be taken during refuelling and maintenance operations. Particular attention will be paid to gradient and ground conditions, which could increase risk of discharge to waters.

To minimise any impact on the underlying subsurface strata from material spillages, all oils, solvents and paints used during construction will be stored within temporary bunded areas within the contractor's compound. Oil and fuel storage tanks shall be bunded to a volume of 110% of the capacity of the largest tank/container within the bunded area(s) (plus an allowance of 30 mm for rainwater ingress). Drainage from the bunded area(s) shall be diverted for collection and safe disposal.

Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles will take place in a designated area within the contractor's compound which will be away from surface water gullies or drains. In the event of a machine requiring refuelling outside of this area, fuel will be transported in a mobile double skinned tank. An adequate supply of spill kits and hydrocarbon adsorbent packs will be stored in this area. All relevant personnel will be fully trained in the use of this equipment. Guidelines such as '*Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors*' (CIRIA 532, 2001) will be complied with.

Where feasible, all ready-mixed concrete will be brought to site by truck. A suitable risk assessment for wet concreting will be completed prior to works being carried out which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil. Wash down and washout of concrete transporting vehicles will take place at an appropriate facility offsite and no washing of concrete from vehicles will be done on site.

In the case of drummed fuel or other chemical which may be used during construction, containers should be stored in a dedicated internally bunded chemical storage cabinet and labelled clearly to allow appropriate remedial action in the event of a spillage.

Emergency response procedures will be outlined in the detailed CEMP. All personnel working on the site will be suitably trained in the implementation of the procedures, and upskilled where necessary.

6.6.1.3 Accidental Spills

A robust and appropriate Spill Response Plan and Environmental Emergency Plan will be prepared prior to works commencing and they will be communicated, resourced and implemented for the duration of the works. Emergency procedures/ precautions and spillage kits will be available and construction staff will be trained and experienced in emergency procedures in the event of accidental fuel spillages.

Machinery activities on site during the construction phase may result in contamination of runoff/ surface water. Potential impacts could arise from accidental spillage of fuels, oils, paints etc. which could impact surface water if allowed to infiltrate to runoff to surface water systems and/or receiving watercourses. However, implementation of the mitigation measures outlined in the CEMP and detailed above will ensure that this does not occur.

Concreting operations carried out near surface water drainage points during construction activities could lead to discharges to a watercourse. Concrete

(specifically, the cement component) is highly alkaline and any spillage to a local watercourse would be detrimental to water quality and local fauna and flora. However, control of run-off from concrete work areas as outlined in the CEMP will ensure that any impact will be mitigated.

6.6.1.4 Foul Water

Welfare facilities (canteens, toilets etc.) will be available within the construction compound and these will remain in place for the construction phase of the proposed development. The offices and site requirements will initially need to have their own power supply (generator), water deliveries and foul water collection until connections are made to the mains networks (refer to Section 6.6.2 Operational Phase below). All welfare systems will be fully sealed and temporary in terms of usage.

6.6.1.5 Water Supply

The works Contractor will be obliged to put Best Practice measures in place to ensure that there are no interruptions to the public/ private water supply for the area unless this has been agreed in advance.

Strict quality control measures will be undertaken while laying pipes to minimise or eradicate infiltration and ex-filtration.

6.6.1.6 Earthworks - Subsoil/ Rock Removal and Compaction

Temporary storage of excavated subsoil and rock will be carefully managed in such a way as to prevent any potential negative impact on the receiving hydrological [and hydrogeological] environment. The material will be stored away from any surface water drains (see Section 6.4.2.3 above). Movement of material will be minimised to reduce degradation of soil/ rock structure and the generation of dust.

All excavated materials will be visually assessed for signs of possible contamination such as staining or strong odours. Should any unusual staining or odour be noticed, samples of this soil will be analysed for the presence of potential contaminants to ensure that historical pollution of the soil has not occurred. Should it be determined that any of the subsoil/ rock matrix excavated is contaminated, this will be segregated and appropriately disposed of by a suitably permitted/ licensed waste disposal contractor with appropriate record keeping from source to permitted disposal.

Ground investigations carried out by Ground Investigations Ireland (GII) at the site in 2021 (Refer to Chapter 5 where soil quality data and borehole data is assessed) found no signs of ground contamination at any of the exploratory holes (trial pits and boreholes) completed across the site. Nonetheless, all excavated materials will be visually assessed for signs of possible contamination such as staining and/ or strong odours. Should any unusual staining or odour be noticed, samples of this soil will be analysed for the presence of potential contaminants to ensure that historical pollution of the subsoil has not occurred. Should it be determined that any of the soil/ rock matrix excavated is contaminated, this will be effectively segregated (and away from water features) and appropriately disposed of by a suitably permitted/ licensed waste disposal contractor (again with correct paper trail records maintained).

6.6.1.7 Protection of Hydrological / Hydrogeological Water Features

This section describes the specific mitigation measures implemented during construction for the protection of the existing identified surface water features and

maintaining the existing surface water drainage system. Given the interconnectivity between the identified surface water features and groundwater type features in what is a karst environment then all mitigation measure which apply to hydrology will also apply to hydrogeology (Refer to Chapter 5, Section 5.6).

These measures will be implemented in association with the measures described above to ensure the protection of all hydrological [and hydrogeological] attributes. Mitigation measures are further discussed in the CEMP and SWMP for the development.

Tooreen Lough

There will be no construction works carried out within Tooreen Lough. There will be no oil or subsoil storage in the vicinity of this feature. An ecological buffer of at least 10 metres applies to this feature.

It is proposed that that overland stream discharging from Tooreen Lough will be culverted. The culvert will be designed in accordance with *Section 50 of the Arterial Drainage Act, 1945*, as amended and the overground pipe will be adequately for winter flows. This will ensure continued conveyance of existing flows without any upgradient or downgradient impacts on flow or water quality. The culvert will be adequately sized for current and future flow conditions.

Ardnamurry Lough

There are no construction activities planned for this area and this feature is located upgradient and outside of the red line boundary, along the eastern boundary of the proposed development. Therefore, no mitigation measures are needed for this feature.

Swallow Hole (Receiving water from Tooreen Lough) located south of DC6

Prior to commencement of construction works, the discharge stream from Tooreen Lough and swallow hole will be clearly delineated and marked. The swallow hole will be surrounded by a concrete ring with chamber and accessed by a manhole cover to avoid blockage during works on the site. This swallow hole will be monitored daily to ensure it is free flowing. i.e. ensuring no change to the existing flow regime there.

Main Spring located north of DC6

Prior to commencement of construction works, the spring and areas around this feature will be clearly delineated and marked. There are no proposed construction works within this spring area and a buffer zone of at least 10 metres will be implemented to ensure that the integrity of the spring is protected. Therefore, maintaining the flow and water quality of this spring. Daily to weekly monitoring of the spring in terms of flow and water quality will be recorded during construction phase works.

Furthermore, provision of exclusion zones and barriers (e.g. silt fences) between earthworks, stockpiles and temporary surfaces to prevent sediment washing into the existing drainage systems like this feature and hence protecting the integrity of this feature.

Pond located North of the Energy Centre

There are no construction activities proposed within this feature. It is proposed that the Energy Centre will be built up by infill material and a retaining wall will be built to protect the pond feature. An existing [field dividing] wall is in place and will be protected throughout the construction phase works.

As previously discussed, there will be no stockpiling of subsoil/ rock matrix by this feature as well as no fuel storage - fuel will be adequately stored in effective bunds located within the contractor compound. Provision of exclusion zones and barriers (e.g. silt fences) between earthworks, stockpiles and temporary surfaces to prevent sediment washing into the existing drainage systems such as this feature and hence protecting the integrity of this attribute.

Ponds located North of the DC4

There are no construction phase activities proposed within these two (2) no. features, however the proposed Data Centre building DC4 is located in close proximity. It is proposed that the DC4 structure will be 'built up' using engineered infill material.

As previously discussed, there will be no stockpiling of subsoil/ rock matrix or fuel storage within 10 m of this feature and no fuel storage within this area. Fuel will be adequately stored in fully contained bunds located within the contractor compound. Provision of exclusion zones and barriers (e.g. silt fences) between earthworks, stockpiles and temporary surfaces will be undertaken to prevent sediment washing into these ponds.

Karst Features - potential conduits/ flow paths

The protection and integrity of potential karst conduits (groundwater flow paths) and the associated mitigation measures during construction are discussed in Chapter 5 of this EIA Report.

6.6.2 Operational Phase

The development includes the storage of up to 7 no. bunded above ground bulk storage tanks for fuel oil distribution pumps, overground delivery pipeline to the belly tanks for diesel fired standby generators within each data storage facility. Both the Data Centres and Energy Centre building will have bulk oil storage. However oil storage is fully bunded, within areas of hardstand where rainage is designed to discharge through a petrol interceptor. These interceptors will ensure containment of any accidental leak/spill during refueling etc.

An additional oil interceptor will be installed upgradient of the attenuation pond to capture and treat any minor leaks from vehicles within car park areas.

The proposed surface water drainage service to the development comprises various drainage components including positive stormwater networks, attenuation systems and several Sustainable Drainage Systems (SuDS) elements. The proposed surface water drainage was designed in accordance with the SuDS Manual 2015.

6.6.2.1 *Emergency Response Procedures*

As normal for a development site of this type, all staff will be suitably trained in emergency response procedures and standard operating procedures (SOPs) to

respond to an on-site fuel spillage incident. All employees will be provided with such equipment, information, training and supervision as is necessary to implement the emergency response procedures and SOPs.

6.6.2.2 *Environmental Procedures*

Containment measures are included within the design to reduce potential for environmental impact. There will be comprehensive emergency response procedures and SOPs to respond to chemical/ oil spillage of all types. All employees will be provided with such equipment, information, training and supervision as is necessary to implement the emergency response procedures and SOPs.

6.6.2.3 Fuel Storage

The provision of suitable spill kit facilities and training of operatives in use of same; should be undertaken at the operational stage in order to manage any leaks from fuel storage and vehicles resulting in water quality impacts.

All bunds will be capable of containing 110% of the volume of the largest drum/tank within the bund or 25% of the total volume of the substance stored and will designed in accordance with the EPA's guidelines for the storage and transfer of materials for scheduled activities (EPA, 2004). As oil is only required for emergency operation only and testing, refuelling requirement is very low therefore the risk from tanker movement is low. A dedicated tanker unloading area will be provided at each of these service yards which will be surrounded by a drainage channel to capture any run-off. A class 1 oil-water full retention separator will be installed to capture any oil in the run-off from the pad. A standard operating procedure for fuel unloading will be in place at the site and tanks will be fitted with high level alarms to prevent overfilling.

The storage of fuel oil for the emergency generators should be restricted to the generator yard, the bulk fuel tanks and belly tanks should be bunded, and the over ground delivery pipeline double-lined. The final design for the diesel storage will be contained within a bunded area in line with the requirements of the *Guidance to Storage and Transfer of Materials for Scheduled Activities* (EPA, 2005).

In terms of the risk to the underlying aquifer (with connectivity to surface water features) this is considered low due to the mitigation in place for containment, delivery and distribution and use of oil interceptors on the stormwater system downgradient of the off-loading area and prior to discharge from the site.

6.6.2.4 Foul Water

During the operational phase, the site will operate in compliance with the requirements of an Irish Water (IW) licence for discharge to sewer.

The proposed Art Data Centre Development, subject to this planning application, will comprise a gravity foul sewer network as discussed under Section 6.4.2.4 above.

All wastewater works to be in accordance with Irish Water Code of Practice and the final discharge point from the Ennis North WWTP will be the River Fergus, as discussed under Section 6.4 above – Characteristics of the Proposed Development. Consultation with CCC personnel has confirmed there is adequate capacity for the wastewater at the receiving WWTP and a review of the licence shows that the plant is generally in compliance with its licence requirements.

6.6.2.5 Storm Water & Surface water run-off

The proposed development will provide full attenuation for increase in hardstand area in compliance with the requirements of the Greater Dublin Strategic Drainage Study. The proposed surface water drainage service to the development comprises various drainage components including positive stormwater networks, attenuation systems and several Sustainable Drainage Systems (SuDS) elements. The proposed surface water drainage was designed in accordance with the SuDS Manual 2015. This is further detailed under Section 6.4.2.3 Characteristics of the Proposed Development - Operational Phase.

A number of measures will be put in place to minimise the likelihood of any spills entering the water environment to include the design of the car park, fitting of refuelling areas with hydrocarbon interceptors and on-site speed restrictions. Refer to the Infrastructure Report for further details (CSEA, 2021).

It is proposed to ultimately discharge surface water from the proposed development, post attenuation and outflow restrictions into the existing main drainage feature in the wider area namely the Ballymacahill River.

To minimise any impact to receiving water flows, the design incorporates effective attenuation to greenfield run-off rates for new hardstanding areas following the Institute of Hydrology Report Number 124 (IH 124) Methodology. The proposed attenuation storage volumes are sized to accommodate any potential increase in surface water run-off rates up to the 1000-year return period storm event with an allowance for climate change effects. Run-off rates are controlled by a hydrobrake system which discharges attenuated water at greenfield run-off rates. These rates will mimic existing run-off rates and will not change the morphology of the nearby river.

All outfall structures will be designed with an outlet structure that includes headwall, wingwalls and a bed apron to prevent local scouring of the banks and the channel bed. This, together with management of flow to mimic current run-off rates, will ensure no measurable impact on river morphology, existing surface water flow hydraulics or the potential for an increase in the risk of flooding.

To facilitate high flood conditions at Tooreen Lough an overflow will be provided at the swallow hole to direct water to a localised area within the proposed development site to alleviate flood levels. Refer to Flood Risk Assessment Report (CSEA, 2021).

6.6.2.6 Protection of Surface Water Features

Intermittent and ongoing inspection and maintenance of the swallow hole south of DC6 discharge from Tooreen lough will be undertaken to ensure free flowing discharge to Ballymacahill River along the western boundary of the proposed development.

6.7 CUMULATIVE IMPACTS

The cumulative impact of the proposed development with any/all relevant other planned or permitted developments (as described in Chapter 3 and Appendix 3.1)) are discussed below.

6.7.1 Construction Phase

Impacts to water during construction are associated with spillage and leakage of oils and fuels and potential silt deposition in watercourses due to disturbance of land. With the proposed mitigation in place (as outlined in Section 6.6 above) including the management of run-off using sediment ponds, stockpiling of soil away from open water, and management of accidental discharges, there is low potential for construction at the proposed development to impact on receiving waters. Contractors for the proposed development will be contractually required to operate in compliance with the CEMP which includes the mitigation measures outlined in this EIA Report. With these measures in place, there will be no change in water body status, water quality or flow as a result of construction for the proposed project and the impact as described above are concluded as being of *imperceptible* significance with a *neutral* impact *o*n water. The other developments will be required, during construction, to protect water quality in compliance with legislative standards for receiving water quality and having regard to the nature and extent of that development, the cumulative or in-combination impacts are considered to be of *imperceptible* significance with a *neutral* impact *o*n water.

6.7.2 Operational Phase

The operation of the proposed development will have a longterm *imperceptible* significance with a *neutral* impact on quality due to the measures in place to protect water quality and manage stormwater discharge within the design for the proposed development. The proposed development has incorporated suitable containment measures for proposed oil storage, incorporated interceptors in areas of potential accidental spills/leaks and provided sufficient attenuation to manage run-off rates to greenfield run-off rates. The impact is considered to be of *imperceptible* significance with a *neutral* impact on water having regard to the designed mitigation measures. The other developments considered, which ae identified in Chapter 3 and Appendix 3.1, will be required during operation to meet legislative requirements in relation to water quality and mitigate for hardstand in terms of run-off rates. As such the cumulative or in-combination impacts are considered to be of *imperceptible* significance with a *neutral* impact on water.

6.8 RESIDUAL IMPACTS OF THE PROPOSED DEVELOPMENT

6.8.1 Construction Phase

The implementation of mitigation measures outlined above (Section 6.6) will ensure that the predicted impacts on the hydrological [and therefore the hydrogeological] environment do not occur during the construction phase and that the residual impact will be **short-term-imperceptible-neutral**. Following the TII (2009) criteria (refer to Appendix 6.1) for rating the magnitude and significance of impacts on the hydrological related attributes, the magnitude of impact is considered **negligible**.

6.8.2 Operational Phase

The implementation of the design and mitigation measures highlighted above (Section 6.6) will ensure that the predicted impacts on the hydrological [and therefore the hydrogeological] environment do not occur during the operational phase and that the residual impact will be **long-term-imperceptible-neutral**. Following the TII (2009) criteria (refer to Appendix 6.1) for rating the magnitude and significance of impacts on the hydrological related attributes, the magnitude of impact is considered **negligible**.

6.9 MONITORING OR REINSTATEMENT

6.9.1 Construction Phase

During construction phase the following monitoring measures are proposed subject to planning conditions:

- Weekly checks will be carried out to ensure surface water drains are not blocked by silt, or any other items, and that all soil storage is located at least 10 metres from the nearest surface water receptors. A regular log of inspections will be maintained, and any significant blockage or spill incidents will be recorded for root cause investigation purposes and updating procedures to ensure incidents do not re-occur.
- Daily inspection of surface water run-off from the attenuation pond and sediment controls e.g. silt traps will be carried during the construction phase. Continuous monitoring system for pH, temperature, electrical conductivity and total organic carbon to be installed to ensure water quality discharging from site is of good quality and meets the respective S.I. threshold values.
- Regular inspection of construction mitigation measures will be undertaken e.g. concrete pouring, refuelling etc.
- Regular monitoring of the surface water drainage features and swallow holes to ensure all are free flowing.
- Regular monitoring of the silt traps/ trenches/ fences around established buffer zones to ensure on-going protection of all surface water attributes.

6.9.2 Operational Phase

Maintenance of the surface water drainage system and foul sewers as per normal urban developments is recommended to minimise any accidental discharges to ground.

Long term environmental monitoring will follow the approved Environmental Management Plan for the completed development and will include key details as per any permitted discharges.

Inspection and maintenance of the swallow hole south of DC6 discharge from Tooreen Lough to ensure free-flowing discharge to Ballymacahill River along the western boundary of the proposed development.

Three yearly inspection of bund integrity as per EPA guidance.

7.0 BIODIVERSITY

7.1 INTRODUCTION

This chapter provides an assessment of the potential ecological effects of the proposed data centre campus development at Toureen, Ennis Co. Clare (refer to Figure 7.1 for location). The proposed development site is approximately 60 hectares. The project will consist of the development of six data hall buildings, offices, a vertical farm, an electrical substation, an energy centre, a transformer compound, undergrounding of circuit cable, associated infrastructure and a number of car parking areas (hereinafter referred to as the proposed development). A detailed description of the proposed development is included in Chapter 2 with the characteristics in relation to biodiversity described in Section 7.4.

The proposed development site is located in the 10km Grid Square R37 at R 37315 79402, east of Ennis. The land within the site comprises mainly of agricultural fields, used for pasture of cattle and sheep. A number of barns and sheds utilised for agricultural use, and four residential houses are also present within the lands. In the north west of the site, a well-established oak-ash-hazel woodland is bordered by the Spancelhill Stream. Toureen Lough lies in the south of the site, with wetland habitats present in the west and north. The field boundaries within the site largely consist of hedgerows, dry stone walls, and treelines. The R352 bounds the proposed development site to the south, with agricultural lands surrounding the north, east and south of the site, and the townland of Ennis to the west.

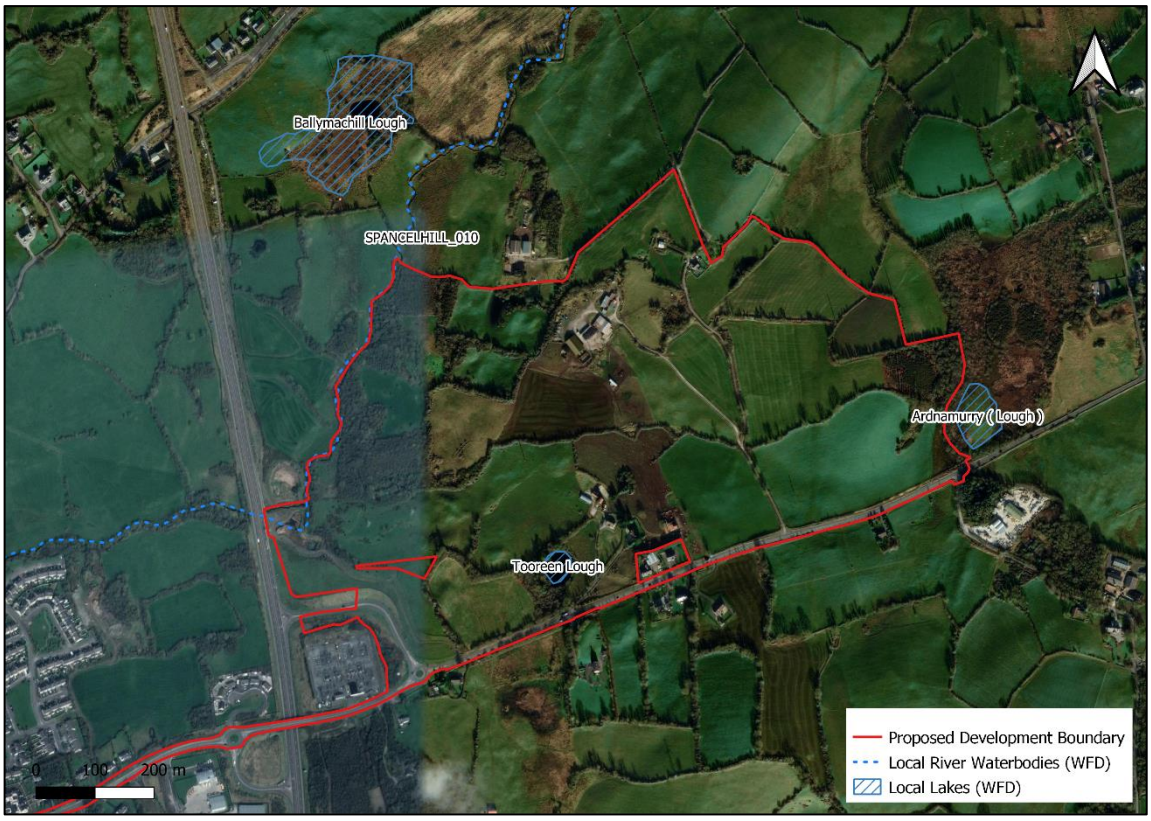

Figure 7.1 *The proposed development in relation to wider surroundings and waterbodies*

The purpose of the report is to:

- Establish and evaluate the baseline ecological environment, as relevant to the proposed development
- Identify, describe and assess all potentially significant ecological effects associated with the proposed development
- Set out the mitigation measures required to address any potentially significant ecological effects and ensure compliance with relevant nature conservation legislation
- Provide an assessment of the significance of any residual ecological effects
- Identify any appropriate compensation, enhancement or post-construction monitoring requirements

Planning, Policy and Legislation

The collation of ecological baseline data and the preparation of this assessment has had regard to the following legislation and policy documents. This is not an exhaustive list but the most relevant legislative and policy basis for the purposes of preparing this EcIA.

The following international legislation of particular relevance to the proposed development:

- Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora; hereafter, referred to as the 'Habitats Directive'. The Habitats Directive is the legislation under which the Natura 2000 network1 was established and special areas of conservation (SACs) are designated for the protection of natural habitat types listed in Annex I, and habitats of the species listed in Annex II, of that directive.
- Directive 2009/147/EEC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds; hereafter, referred to as the 'Birds Directive'. The Birds Directive is the legislation under which special protection areas are designated for the protection of endangered species of wild birds listed in Annex I of that directive.
- The following national legislation of particular relevance to the proposed development:
- Wildlife Acts 1976 to 2019; hereafter collectively referred to as the 'Wildlife Acts'. The Wildlife Acts are the principal pieces of legislation at national level for the protection of wildlife and for the control of activities that may harm

[1] The Natura 2000 network is a European network of important ecological sites, as defined under Article 3 of the Habitats Directive 92/43/EEC, which comprises both special areas of conservation and special protection areas. Special conservation areas are sites hosting the natural habitat types listed in Annex I, and habitats of the species listed in Annex II, of the Habitats Directive, and are established under the Habitats Directive itself. Special protection areas are established under Article 4 of the Birds Directive 2009/147/EC for the protection of endangered species of wild birds. The aim of the network is to aid the long-term survival of Europe's most valuable and threatened species and habitats.

In Ireland these sites are designed as *European sites* - defined under the Planning Acts and/or the Birds and Habitats Regulations as (a) a candidate site of Community importance, (b) a site of Community importance, (c) a candidate special area of conservation, (d) a special area of conservation, (e) a candidate special protection area, or (f) a special protection area. They are commonly referred to in Ireland as Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).

wildlife. All bird species, 22 other animal species or groups of species, and 86 species of flora are protected under this legislation.

- Planning and Development Acts 2000 to 2020; hereafter collectively referred to as the 'Planning and Development Acts'. This piece of legislation is the basis for Irish planning. Under the legislation, development plans (usually implemented at local authority level) must include mandatory objectives for the conservation of natural heritage and for the conservation of European Sites. It also sets out the requirements in relation to environmental assessment with respect to planning matters, including transposition of the Habitats and Birds Directive into Irish law.
- European Communities (EC) (Birds and Natural Habitats) Regulations 2011 to 2015; hereafter the 'Birds and Habitats Regulations'. This legislation transposes the Habitats and Birds Directives into Irish law. It also contains regulations (49 and 50) that deal with invasive species (those included within the Third Schedule of the regulations).
- Flora (Protection) Order, 2015. This lists species of plant protected under Section 21 of the Wildlife Acts.
- Plans and policies that are relevant to the proposed development include:
    - National Biodiversity Action Plan 2017-2021 (Department of Culture Heritage and the Gaeltacht, 2017)
    - *Clare County Development Plan 2017 – 2023 (As Varied)* (Clare County Council, 2017) (specific objectives and policies can be found in Chapter 3 of the EIAR)
    - *Clare Biodiversity Action Plan 2017 – 2023* (Clare County Council, 2017)
    - *Clare County Development Plan 2017 – 2023 Variation No. 1,* (Clare County Council, 2019)
    - The *Limerick County Development Plan 2010-2016 (*Limerick County Council, 2010)
    - *Shannon Town and Environs Local Area Plan 2012-2018 (*Clare County Council, 2018)
    - *The Galway County Development Plan 2015-2021 (*Galway County Council, 2015)
    - *The Kerry County Development Plan 2015-2021 (Kerry County Council, 2015)*

7.2 METHODOLOGY

7.2.1 Scope of the Assessment

The study area is defined by the zone of influence of the proposed development with respect to the ecological receptors that could potentially be affected.

The Zone of Influence (ZoI), or distance over which potentially significant effects may occur, will differ across the Key Ecological Receptors (KERs), depending on the potential impact pathway(s). The results of both the desk study and the suite of ecological field surveys undertaken has established the habitats and species present within, and in the vicinity of, the proposed development site. The ZoI and study area was then informed and defined by the sensitivities of each of the KERs present, in conjunction with the nature and potential impacts associated with the proposed development.

The ZoI of habitat loss impacts will be confined to within the proposed development boundary.

The ZoI of potential impacts on surface water quality in the receiving freshwater, estuarine and coastal ecosystems associated with waterbodies that are hydrologically connected to the proposed development via the Spancelhill Stream, which is located along the north-western boundary.

The ZoI of air quality effects related to dust deposition is likely to be located within and/or adjacent to the proposed development site boundary.

The ZoI of general construction activities (*i.e.* risk of spreading/introducing non-native invasive species, and disturbance due to increased noise, vibration, human presence and lighting) is not likely to extend more than several hundred metres from the proposed development.

7.2.2 Desk study

A desk study was undertaken in April 2021 to collate available information on the local ecological environment. The following resources were used to inform the assessment presented in this report:

- Data on European sites, Natural Heritage Areas (NHAs) or proposed Natural Heritage Areas (pNHAs) as held by the National Parks and Wildlife Service (NPWS) from https://www.npws.ie/protected-sites and https://www.npws.ie/maps-and-data – refer to Appendix 7.1 and Figure 7.5 for descriptions and locations of protected sites in the vicinity of the proposed development
- Records of rare and protected species for the 10km grid square(s), as held by the National Biodiversity Data Centre www.biodiversityireland.ie or the NPWS – refer to Appendix 7.2 for all desk study flora and fauna records
- Spatial information relevant to the planning process including land zoning and planning applications from Department of Housing Planning, Community and Local Government web map portal. Available from https://myplan.ie/
- Ordnance Survey Ireland mapping and aerial photography from http://map.geohive.ie/
- Data on waterbodies, available for download from the Environmental Protection Agency (EPA) web map service. Available from https://gis.epa.ie/EPAMaps/
- Information on soils, geology and hydrogeology in the area available from the Geological Survey Ireland (GSI) online Spatial Resources service. Available from https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx
- Information on the conservation status of birds in Ireland from Birds of Conservation Concern in Ireland (Gilbert *et al.*, 2021)
- Information on the location, nature and design of the proposed development supplied by the applicant's design team.
- University of Bristol Speleological Society – Irish caves locations. Available from http://www.ubss.org.uk
- Clare County Wetlands Survey 2008 (Clare County Council, 2008). Available from https://wetland.maps.arcgis.com
- Information contained within the Environmental Impact Assessment Report (EIAR) prepared for the proposed development planning application, including Chapter 3 Planning and Development Context, Chapter 5 Land, Soils & Geology and Hydrogeology, Chapter 6 Hydrology, Chapter 8 Air Quality & Climate, Chapter 9 Noise and Vibration, Chapter 10 Landscape and Visual.
- Site Lighting Analysis Report and Light Spill Modelling Study, produced by Hurley Palmer Flatt (June 2021)

- The Construction and Environmental Management Plan, produced by AWN Consulting Ltd. (July 2021)
- The Landscape and Biodiversity Management Plan produced by Nicholas de Jong Associates (June 2021)
- The Landscape Design Strategy produced by Nicholas de Jong Associates (June 2021)
- Construction & Demolition Waste Management Plan For A Proposed Development, "Art Data Centre", produced by AWN Consulting Ltd. (July 2021).
- Surface Water and Pollution Management Plan, Art Data Centre, produced by Clifton Scannell Emerson Associates (CSEA), (June 2021).
- *Appropriate Assessment Screening Report for: Art Data Centres, Ennis Campus* (Scott Cawley Ltd., 2021).
- *Natura Impact Statement for: Art Data Centres, Ennis Campus (Scott Cawley Ltd., 2021)*

7.2.3 Field survey

Ecological field surveys were carried out following the best practice professional guidelines between June – October 2018, and July 2020 - April 2021. The surveys and survey dates are presented in Table 7.1.

Table 7.1 Ecological surveys and survey dates

Survey	Survey Date(s)	Surveyor(s)
Habitat surveys	27th July 2018 16th August 2018 8th – 10th July 2020	Scott Cawley Ltd.
Badger surveys	7 – 9th July 2020	Scott Cawley Ltd.
Otter surveys	7th – 9th July 2020	Scott Cawley Ltd.
Breeding bird surveys	25th June 2020 6th July 2020 20th April 2021	Scott Cawley Ltd.
Wintering bird surveys	24th September 2020 20 – 21st October 2020 9th November 2020 4th December 2020 24th January 2021 17th February 2021 8th March 2021	Scott Cawley Ltd. and independent ornithologist, André Robinson
Bat surveys (Specific dates can be found in Table 7.6): Building surveys (internal and external) Static detector activity surveys	 6th – 8th July 2020 July – October 2018 July - October 2020	Scott Cawley Ltd.

Survey	Survey Date(s)	Surveyor(s)
Walked transect surveys	7th and 16th August 2018 July – August 2020	
Roost emergence/re-entry activity surveys	July – September 2020	

7.2.3.1 Habitats and Flora Survey

Terrestrial and aquatic habitat surveys were undertaken of the proposed development site on the 27th July and 16th August 2018 by Kate-Marie O'Connor B.A. (Hons) M.Sc. and Colm Clarke B.A. (Hons) M.Sc., and on the 8th – 10th July 2020 by Siofra Quigley B.Sc. (Hons) M.Sc. and Alexis Fitzgerald B.A. (Hons) M.Sc. following the methodology described in *Best Practice Guidance for Habitat Survey and Mapping*[2]. All habitat types were classified using the *Guide to Habitats in Ireland*[3], recording the indicator species and abundance using the DAFOR scale[4] and recording any species of conservation interest. Vascular and bryophyte plant nomenclature generally follow that of The National Vegetation Database[5], having regard to more recent taxonomic changes to species names after the New Flora of the British Isles[6] and the British Bryological Society's Mosses and Liverworts of Britain and Ireland: A Field Guide[7]. Annex I habitat types were classified after the Interpretation manual of European Union Habitats EUR28[8] with reference to the corresponding national habitat survey reports and NPWS wildlife manuals, as applicable. The nomenclature for Annex I habitats follows that of the Interpretation manual of European Union Habitats EUR28 with abbreviated names after those used in The Status of EU Protected Habitats and Species in Ireland. Volume 1: Summary Overview[9]. Relevés (*i.e.* sampling points of a defined size) were also taken within the following areas of habitats in order to determine whether or not they conformed to Annex I habitats:

[2] Smith, G.F., O'Donoghue, P., O'Hora, K. & Delaney, E. (2011) *Best Practice Guidance for Habitat Survey and Mapping*. The Heritage Council Church Lane, Kilkenny, Ireland.

[3] Fossitt, J.A. (2000) *A Guide to Habitats in Ireland*. Heritage Council, Kilkenny.

[4] The DAFOR scale is an ordinal or semi-quantitative scale for recording the relative abundance of plant species. The name DAFOR is an acronym for the abundance levels recorded: Dominant, Abundant, Frequent, Occasional and Rare.

[5] Weekes, L.C. & FitzPatrick, Ú. (2010) The National Vegetation Database: Guidelines and Standards for the Collection and Storage of Vegetation Data in Ireland. Version 1.0. Irish Wildlife Manuals, No. 49. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

[6] Stace, C. (2019) New Flora of the British Isles. 4th Edition. C&M Floristics.

[7] Atherton, I., Bosanquet, S. & Lawley, M. (2010) Mosses and Liverworts of Britain and Ireland: A Field Guide. Latimer Trend & Co., Plymouth.

[8] CEC. (Commission of the European Communities) (2013) Interpretation manual of European Union Habitats EUR28. European Commission, DG Environment.

[9] NPWS (2019). The Status of EU Protected Habitats and Species in Ireland. Volume 1: Summary Overview. Unpublished NPWS report.

- Species-rich dry calcareous and neutral grassland (GS1)
- Wet grassland (GS4)
- Reed and Large Sedge Swamps (FS1)
- Riparian woodland (WN5)

The relevé size was 2m^2 for all habitats except woodland habitats, which were sampled using a 10m^2 relevé, and information collected included the following:

- A list of all plant species present along with their associated percentage cover;
- A habitat condition assessment based on criteria which were drawn from the national surveys of this Annex I habitat conducted on behalf of NPWS (*i.e.* Long et al., 2018; Martin *et al.*, 2018; O'Neill *et al.*, 2013; Perrin *et al.*, 2014; Wilson & Fernández, 2013); and,
- Notes on the threats and/or management of the overall surrounding area. Where applicable, the Annex I habitat was also assigned to a vegetation community.

7.2.3.2 Fauna Surveys

Terrestrial Mammals (excl. Bats)

A terrestrial fauna survey (excluding bats) was undertaken on the 7th to 9th July 2020 by Síofra Quigley B.Sc. (Hons) M.Sc. The presence/absence of terrestrial fauna species were surveyed through the detection of field signs such as tracks, markings, feeding signs, and droppings, as well as by direct observation. The habitats on site were assessed for signs of usage by protected/red-listed fauna species, and their potential to support these species. Surveys to check for the presence of badger *Meles meles* setts and otter *Lutra lutra* holts within the study area, and to record any evidence of use, were undertaken. Indirect method of surveying for red squirrel *Sciurus vulgaris* and pine marten *Martes martes* were also undertaken, which included checking tree canopies for the presence of potential dreys and dens.

Infra-red motion-activated cameras were deployed in areas of suitable habitat to confirm usage of certain mammal species, specifically for badger, pine marten, and red squirrel within the woodland habitat in the north west, and to determine usage of Spancelhill Stream for foraging/commuting otters in the north west (under NPWS Licence No. 007/2020). These cameras were deployed for a period of 27 nights between 23rd September – 20th October 2020. The mammal ledge located in the west of the site in the culvert beneath the M18 Motorway was also checked for signs of otter or other mammal usage during surveys carried out along the Spancelhill Steam in 2020.

Breeding Birds

Breeding bird surveys were undertaken on the 25th June and 6th July 2020 by Shea O'Driscoll B.Sc. (Hons) M.Sc., and on the 20th April 2021 by Shane Brien B.Sc. M.Sc. using a methodology adapted from the *Bird Monitoring Methods - A Manual of Techniques for Key UK Species* [10] (see Table 7.2 for more details) The study area covered the lands within the proposed development site, which were slowly walked in a manner allowing the surveyor to come within 50m of all habitat features. Birds were

[10] Gilbert, G., Gibbons, D.W. & Evans, J. (1998) Bird Monitoring Methods - A Manual of Techniques for Key UK Species. RSPB: Sandy

identified by sight and song, and general location and activity were recorded using the British Trust for Ornithology (BTO) species and activity codes. Buildings and barns within the proposed development site were also checked for nesting barn swallows *Hirundo rustica*, house martins *Delichon urbicum* and barn owls *Tyto alba*.

Table 7.2 *Breeding bird survey details*

Date (Sunrise)	Survey Time	Weather Conditions
25/06/2020 (05:12)	05:00-08:00	Mild, partly sunny weather with temperatures around 16°C.
06/07/2020 (05:20)	05:15-08:30	Mild, sunny, dry weather with temperatures around 14°C and light breeze.
20/04/2021 (06:26)	06:45-10:45	Humid day, moderate, wet conditions from rain the day before, overcast (cloud 7/8), slight breeze, temperatures around 9°C.

Wintering birds

Wintering bird surveys were undertaken once a month during the period of September 2020 and March 2021 by Shane Brien B.Sc. (Hons) M.Sc. and Niall McHugh B.Sc. (Hons) both of Scott Cawley Ltd, and André Robinson, an independent ornithologist, using a methodology based on the *Bird Monitoring Methods - A Manual of Techniques for Key UK Species*. The study area covered the lands within the proposed development site within the red line boundary and the area under land ownership to the east of the site (not within the red line boundary). Lands were initially surveyed visually using binoculars/scope from a vantage point(s) at the edge of the study area followed by a walkover of the area to identify birds which may not be visible from a distance (*e.g.* waders) and evidence of usage by wildfowl such as swans or geese (*i.e.* droppings). Birds were identified by sight and general location and activity. They were recorded using the British Trust for Ornithology (BTO) species and activity codes.

Hen harrier

Vantage point surveys for the presence of hen harrier were carried out in accordance with best practice guidelines *Raptors – a Field Guide to Surveys and Monitoring (Second Edition 2009)* (Hardey *et al.*, 2009)[11]. The habitats within the site were assessed for suitability for roosting and/or foraging hen harrier. Suitable wintering roosting and foraging habitat was identified within the east of the site, where the wetland/swamp habitats were located. A suitable vantage point was determined that appropriately covered the area identified as potential wintering roosting and foraging habitat. This area was surveyed for two hours at dusk, during monthly visits between September 2020 and March 2021. The site is not suitable as foraging habitat during

[11] Hardey J, Crick H, Wernham C, Riley H, Etheridge B and Thompson D (2009) Raptors: A Field Guide to Survey and Monitoring, 2nd Edition. TSO, Edinburgh.

the breeding season, as this typically occurs on moorlands and young forestry plantations[12][13][14].

Table 7.3 *Wintering bird and hen harrier survey details*

Survey type	Date (Sunrise/sunset)	Survey Time	Weather Conditions
Wintering bird	24/09/2020 (07:25)	08:00-12:35	Dry, overcast weather with a slight breeze. Temperatures between 8°C and 14°C.
Hen harrier	24/09/2020 (19:29)	18:25 – 20:00	Dry, 50% cloud cover, strong winds blowing in a westerly direction. Temperature of 11°C.
Wintering bird	21/10/2020 (08:14)	08:00-15:15	Overcast with light breeze and occasional showers. Temperatures of 9 - 12°C.
Hen harrier	20/10/2020 (18:29)	17:05-18:48	Overcast with intermittent showers and north west moderate breeze. Temperatures of 10 - 13°C.
Wintering bird	09/11/2020 (07:49)	08:00-15:30	Overcast with east-south easterly winds. Temperatures of 11°C.
Hen harrier	09/11/2020 (16:50)	15:30-17:35	Overcast with slight winds in south easterly direction. Temperatures of 10°C
Wintering bird	04/12/2020 (08:30)	08:30-15:00	North westerly winds, mostly overcast with temperatures between 4-5°C. Shower of rain in last hour of survey.
Hen harrier	04/12/2020 (16:22)	15:00-17:00	Force 4 winds, with constant rain. Temperature of 4°C.
Wintering bird	24/01/2021 (08:35)	08:15-15:30	Southerly, light winds, partially overcast with temperatures of 2-3°C.
Hen harrier	24/01/2021 (17:06)	15:45-18:00	No rain, light winds, with temperatures of 2-3°C.
Wintering bird	17/02/2021 (07:49)	08:15-15:45	Westerly winds, mostly overcast with temperatures of 6-8°C.
Hen harrier	17/02/2021 (17:52)	16:15-18:45	West south west winds, mostly dry with intermittent light showers. Temperatures of 6°C.
Wintering bird	08/03/2021 (07:06)	08:00-16:45	North-easterly light winds, overcast with no rain. Temperatures between 6-9°C.
Hen harrier	08/03/2021 (18:23)	17:15-19:15	Intermittent drizzle with light winds. Temperature of 8°C.

[12] Ruddock, M., Mee, A., Lusby, J., Nagle, A., O'Neill, S. & O'Toole, L. (2016). The 2015 National Survey of Breeding Hen Harrier in Ireland. Irish Wildlife Manuals, No. 93. National Parks and Wildlife Service, Department of the Arts, Heritage and the Gaeltacht, Ireland.

[13] Barton, C., Pollock, C., Norriss, D.W., Nagle, T., Oliver, G.A. & Newton, S. (2006). The second national survey of breeding hen harriers Circus cyaneus in Ireland 2005. Irish Birds 8: 1-20.

[14] Norriss, D.W., Marsh, J., McMahon, D. & Oliver, G.A. (2002). A national survey of breeding hen harriers Circus cyaneus in Ireland 1998-2000. Irish Birds 7: 1–10.

Bats

Building and tree surveys

A ground-level assessment of trees, structures and buildings within the subject lands, to examine their suitability to support roosting bats and potential to act as important landscape features for commuting/foraging bats, was based on guidelines (see Table 7.4) in *Bat Surveys for Professional Ecologists: Good Practice Guidance* (Collins ed., 2016) and included inspections of trees, structures and buildings for potential roost features (PRFs), and for signs of bats (staining at roost entrances, droppings, carcasses, insect remains). This included internal access of barns and outbuildings to assess for the actual presence of bats, and for evidence as described above. Residential buildings were unable to be accessed due to Covid 19 restrictions, however all buildings were assessed externally, and barns/farm buildings were assessed internally and externally. Building and tree surveys were undertaken during surveys carried out in 2018 and 2020.

Table 7.4 *Guidelines for assessing the potential suitability of proposed development sites for bats, based on the presence of habitat features within the landscape, applied according to professional judgement. (Collins (2016)*

Suitability	Description Roosting habitats	Commuting and foraging habitats
Negligible	Negligible habitat features on site likely to be used by roosting bats.	Negligible habitat features on site likely to be used by commuting or foraging bats.
Low	A structure with one or more potential roost sites that could be used by individual bats opportunistically. However, these potential roost sites do not provide enough space, shelter, protection, appropriate conditions and/or suitable surrounding habitat to be used on a regular basis or by larger numbers of bats (i.e. unlikely to be suitable for maternity or hibernation). A tree of sufficient size and age to contain PRFs but with none seen from the ground or features seen with only very limited roosting potential.	Habitat that could be used by small numbers of commuting bats such as a gappy hedgerow or unvegetated stream, but isolated, i.e. not very well connected to the surrounding landscape by other habitat. Suitable, but isolated habitat that could be used by small numbers of foraging bats such as a lone tree (not in a parkland situation) or a patch of scrub.
Moderate	A structure or tree with one or more potential roost sites that could be used by bats due to their size, shelter, protection, conditions and surrounding habitat but unlikely to support a roost of high conservation status (with respect to roost type only – the assessments in this table are made irrespective of species conservation status, which is established after presence is confirmed).	Continuous habitat connected to the wider landscape that could be used by bats for commuting such as lines of trees and scrub or linked back gardens. Habitat that is connected to the wider landscape that could be used by bats for foraging such as trees, scrub, grassland or water.
High	A structure or tree with one or more potential roost sites that are obviously suitable for use by larger numbers of bats on a more regular basis and potentially for longer periods of time due to their size, shelter, protection, conditions and surrounding habitat.	Continuous, high-quality habitat that is well connected to the wider landscape that is likely to be used regularly by commuting bats such as river valleys, streams, hedgerows, lines of trees and woodland edge. High-quality habitat that is well connected to the wider landscape that is likely to be used regularly by foraging bats such as broadleaved woodland, treelined watercourses and grazed parkland.

Suitability	Description Roosting habitats	Commuting and foraging habitats
		Site is close to and connected to known roosts.

Transect surveys

Two extended dusk and one all night bat activity walked transect surveys were undertaken within the subject lands. The extended dusk surveys commenced 15 minutes before sunset and lasted for approximately two hours. One full night survey was also undertaken from 15 minutes before sunset, until just before sunrise. This full night survey was carried out to determine how bats use the proposed development site throughout the night. Details of dates, timings, weather, and other details are shown in Table 7.5 below. Two routes were walked by two surveyors during each visit, the routes are illustrated on Figure 7.2. The focus of the routes was to survey linear vegetation features and field boundaries. However, this was also dependent on access between fields. Direct observations of how bats use the landscape were recorded, and handheld ultrasound detectors (Elekon Batlogger M) were used to identify the bat species by their calls. Data generated from the transect surveys was analysed using Elekon BatExplorer software, whereby calls were identified to species level (where this was possible), through professional judgement and with reference to *British Bat Calls: A Guide to Species Identification* (Russ, 2012). Transect surveys were undertaken in 2018 and 2020, however in 2018, two dusk transects were carried out, and in 2020 two dusk surveys and one full night survey were undertaken.

Table 7.5 *Details of transect surveys undertaken within the proposed development site.*

Date (Sunset/Sunrise)	Survey Time	Survey Type	Weather Conditions
08/07/2020 (22:00)	21:47- 23:39	Dusk transect survey	Mild, wet weather with temperatures around 16°C and light breeze. Overcast with light to moderate rain throughout the night.
28-29/07/2020 (21:35/05:20)	21:20 – 05:00	All night transect survey	Dry and partially overcast, with temperatures between 13 - 14°C.
18/08/2020 (20:55)	20:42 – 22:31	Dusk transect Survey	Dry, mild partly cloudy weather with temperatures around 16°C and light breeze.

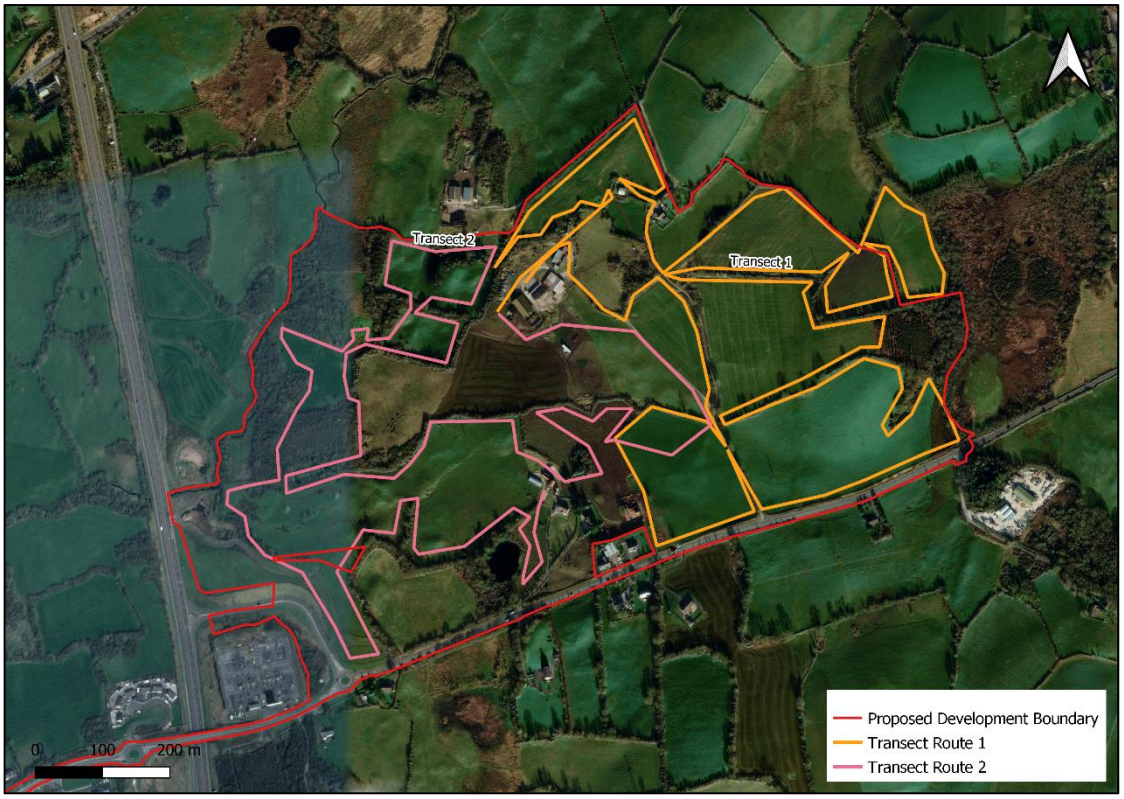

Figure 7.2 *Indicative transect routes walked within the site*

Automated static detectors

The walked transect surveys were supplemented by automated static bat detectors (*i.e.* Song Meter SM2). This use of static bat detectors at a fixed location for an extended period of time increases the likelihood of recording lesser horseshoe bats present on site compared to walked transects only. Detectors were deployed for a minimum period of 8 nights at 15 different locations within the subject lands between the 6th July and 20th October 2020. Locations of these deployments were chosen with an emphasis on areas identified as being potentially suitable for commuting and/or foraging bats, whilst also ensuring the site was covered as best as possible. Locations of the deployed static detectors can be found in Figure 7.3. Once the detectors had been deployed for a minimum of 7 nights, they were collected and the data was analysed using Kaleidoscope bat analysis software. This software identifies each individual bat call recorded by the detectors, which can then be used to identify the calls by species.

The average number of calls recorded per night for each species was calculated for each individual static detector. These averages were then examined against the transect survey results, and based on this analysis the features, which are important for commuting and/or forging bats within the proposed development boundary, were identified. 14 static detectors were also deployed in 2018, in similar positions to 2020.

Figure 7.3 *Locations of deployed static bat detectors*

Roost emergence/re-entry activity surveys

A number of bat roost emergence/re-entry activity surveys were undertaken at six buildings and 10 structures within the lands by surveyors who are experienced in bat activity surveys. The surveys were designed with reference to methodologies in *Bat Surveys for Professional Ecologists: Good Practice Guidelines* (3rd edn.) (Collins, 2016), survey details and map showing building locations are provided in Table 7.6 and Figure 7.4. Observations of bat activity were recorded, with data generated from the surveys analysed using Elekon BatExplorer software, whereby calls were identified to species level (where this was possible), through professional judgement and with reference to *British Bat Calls: A Guide to Species Identification* (Russ, 2012). Roost emergence/re-entry surveys were only carried out in 2020.

Table 7.6 *Details of emergence/re-entry bat surveys undertaken within the proposed development site*

Building ID Number	Building suitability, surveyed internally/externally	Number of emergence/re-entry surveys	Date of surveys	Survey time (sunset/sunrise)	Weather Conditions
BB 1A and 1B	Low Internals carried out on BB 1A, unable to carry out internals on BB 1B due to safety concerns. Externals carried out on both	2 (1 dusk, 1 dawn)	09/07/2020	21:47 – 23:37 (21:59)	Dry, clear skies, temperatures between 12 - 14°C.
			19/08/2020	04:54 – 06:24 (06:24)	Dry, overcast, light breeze with temperatures of 17°C.

Building ID Number	Building suitability, surveyed internally/externally	Number of emergence/re-entry surveys	Date of surveys	Survey time (sunset/sunrise)	Weather Conditions
BB 2	Moderate Externals only carried out	2 (1 dusk, 1 dawn)	10/07/2020	03:22 – 05:22 (05:24)	Clear, dry night with no wind, temperatures between 12 - 14°
			21/09/2020	19:20 – 21:02 (19:37)	Dry, overcast with no wind, temperatures of 15°C
BB 3	High Externals only carried out	3 (2 dusks, 1 dawn)	07/07/2020	21:47 – 23:37 (22:00)	Overcast, light to heavy rain with no wind, temperatures of 15 - 16°C
			31/07/2020	04:20 – 05:51 (05:53)	Overcast, light rain with no wind, temperatures of 17°C
			19/08/2020	20:39 – 22:22 (20:52)	Overcast, no rain, light breeze, temperatures of 19°C
BB 4A, 4B, 4C, and 4D	Low Internals and externals carried out	1 (dusk)	06/07/2020	21:47 – 23:30 (22:01)	Light rain, overcast with no wind, temperatures of 15 - 17°C
BB 5A and 5B	Moderate (3 surveys undertaken due to poor survey conditions on first survey) Externals carried out on both, internal on BB 5B.	3 (2 dawns, 1 dusk)	27/07/2020	21:18 – 23:10 (21:36)	Overcast, with heavy rain for brief period during survey then dry for rest of survey, no wind, temperatures of 13 - 15°C
			18/08/2020	04:53 – 06:24 (06:23)	Overcast, no rain, light winds, temperatures of 16 - 17°C
			22/09/2020	05:24 – 07:25 (07:22)	Clear skies, no rain or wind, temperatures of 11 - 13°C
BB 6A, 6B, and 6C	Low Externals and internal surveys carried out	1 (dawn)	28/07/2020	03:47 – 05:48 (05:48)	Overcast, light rain, no wind, temperatures of 12 - 13°C
BB 7	Moderate (3 surveys undertaken due to	3 (2 dusks, 1 dawn)	29/07/2020	21:16 – 22:56 (21:33)	Overcast with light to moderate rain, gusty winds,

Building ID Number	Building suitability, surveyed internally/externally	Number of emergence/re-entry surveys	Date of surveys	Survey time (sunset/sunrise)	Weather Conditions
	poor survey conditions)				temperatures of 15°C
	External and internal survey carried out		21/08/2020	04:55 – 06:22 (06:28)	Overcast, no rain, moderate winds, temperatures of 15°C
			22/09/2020	19:24 – 21:00 (19:34)	Overcast, no rain or wind, temperatures of 13°C
BB 8	Moderate External survey only	2 (2 dawns)	30/07/2020	04:20 – 06:05 (05:51)	Overcast, light rain, no wind, temperatures of 16 - 19°C
			23/09/2020	05:54 – 07:20 (07:24)	Clear skies, light rain towards the end of the survey, no wind, temperatures of 11 - 12°C
BB 9	Moderate External survey only	2 (2 dusks)	30/07/2020	21:20 – 23:01 (21:31)	Overcast, dry, with no wind, temperatures of 16 - 17°C
			23/09/2020	19:20 – 21:03 (19:31)	Clear skies, dry, no wind, temperatures of 8 - 12°C

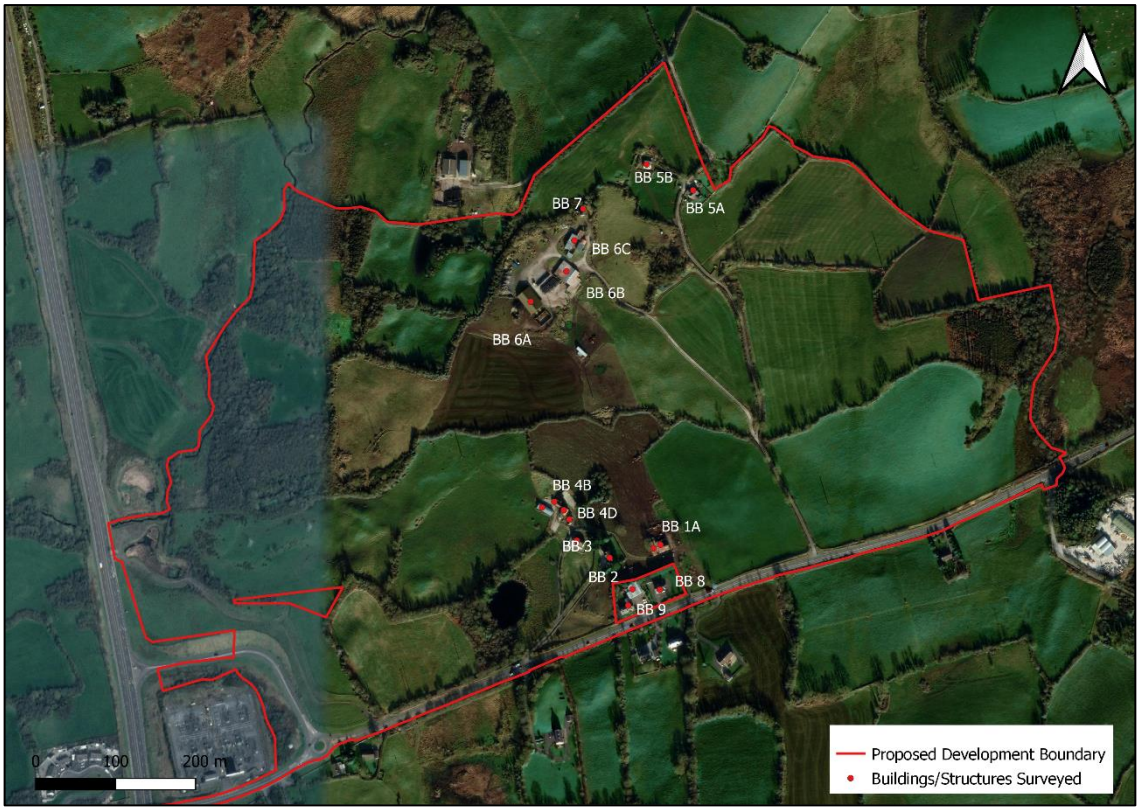

Figure 7.4 *Location of buildings surveyed and associated ID number*

Amphibians and Reptiles

A survey for suitable habitat for amphibians and reptiles was undertaken during surveys in July 2020. Suitable habitat for amphibians, such as ponds and wet ditches, and reptiles, such as habitats with stone walls, rocks or logs suitable for basking, were recorded and mapped, as well as any direct observations of individuals.

Survey limitations

Mammal surveys, such as badger surveys, are typically carried out during winter months due to better visibility associated with plant senescence. Dense vegetation, such as dense bramble scrub, may affect the surveyor's ability to find entrances to badger setts and holts, and these may be missed even when reasonable effort is applied into finding them. The aforementioned factors are not considered to pose any a limitation on the ecological assessment of the proposed development site for mammals as there were very little areas of scrub within the development, and no evidence of mammals (e.g. mammal paths) were identified within these areas. Camera traps were also deployed in addition to badger, otter and other mammal surveys.

Occupied residential houses (*i.e.* BB 2, BB 3, BB 5, BB 8 and BB 9) could not be surveyed internally for the presence of roosting bats due to health and safety concerns associated with COVID-19. The absence of an internal inspection does not compromise the assessment of the structure's potential to support roosting bats as buildings that were assessed as having moderate potential (according to BCT guidelines), had at least two emergence/re-entry surveys within the active bat season and during optimal survey conditions.

A number of surveys experienced poor weather during surveys, i.e. bat surveys, and wintering bird surveys, which could have implications for results. Any bat activity surveys that experienced poor weather, were repeated when weather had improved. For wintering bird surveys, the visibility was considered acceptable for all surveys undertaken. Therefore, bad weather is not considered a limitation.

Bat hibernation surveys were not undertaken within this site, as the majority of buildings with suitability for hibernation, will be retained within the development. There were no suitable roosting sites for lesser horseshoe bat which roost in caves during hibernation. The barns/sheds are not suitable for hibernation for any bat species, and will be removed as part of the development. However, one building (BB 7) which does have low hibernation potential will be removed, and as pipistrelle bat species can use buildings as winter roosting sites, a precautionary approach is employed, with any removal of buildings requiring mitigation measures to check for bats pre-demolition. Whilst a hibernation survey was not carried out on BB 7, the features suitable for hibernating bats were inaccessible and could not be inspected. This is not considered a limitation as mitigation measures have been included.

Five of the 15 statics were deployed in late September which would be considered late in the season. However, weather conditions during September and October 2020 were unseasonably mild and as such, it was considered that all static deployments were undertaken in suitable conditions for recording bat activity. As 2018 surveys included static detector surveys, two seasons of bat activity (2018 and 2020) within the site have been carried out, providing a robust baseline. Whilst surveys carried out in 2018 are considered out of date in the context of guidelines (CIEEM, 2019), results from 2018 are included to provide a better understanding of bat usage of the proposed development site. Bat surveys in April and October, where they meet certain weather conditions and temperature requirements, are also considered acceptable within BCT guidelines.

Although a lot of the routes walked during transects did not pick up any calls, the difficulty in picking up brown long-eared bat calls during transect surveys due to their quiet echolocation calls and late emergence, may have impacted the results from transect surveys. However, this is not considered to be a limitation as a more accurate description of how brown long-eared bat use the lands can be predicted from the static detector deployments.

The surveys for amphibians in July 2020 included habitat suitability assessment surveys only. Common frog surveys are typically carried out in February and March and include searches for their spawn, whereas smooth newt surveys include specialist surveys involving trapping and/or night-time torching of suitable waterbodies between March and June. The aforementioned factors are not considered to pose any limitation on the ecological assessment as a precautionary approach is employed and any suitable habitat is assumed to contain these species, and mitigated for appropriately.

Specific fish and invertebrate surveys were not undertaken within the proposed development. However, this is not considered to be a limitation to the assessment as a precautionary approach is applied and it is assumed any suitable habitat identified could hold populations of species based on local records.

Despite the limitations noted above, sufficient survey data was gathered to fully inform the assessment of impacts, the mitigation measures described in this report and the assessment of residual impacts predicted in relation to the proposed development.

7.2.4 Consultations

The following organisations with relevance to ecology were consulted:

- The National Parks & Wildlife Service (NPWS) section of Department of Housing, Local Government and Heritage (formerly Department of Culture, Heritage and the Gaeltacht)
- The Vincent Wildlife Trust

A summary of these consultations with relevance to Appropriate Assessment is provided in Table 7.7 below.

Table 7.7 *Ecological issues raised during consultations.*

Consultee	Date of Consultation	Issues Raised	Relevant Section of the NIS where this is addressed
NPWS - Department of Housing, Local Government and Heritage (formerly Department of Culture, Heritage and the Gaeltacht)	15/01/2021	NPWS raised concerns regarding light spill from the proposed development on important ecological features for commuting and/or foraging bats, specifically in relation to lesser horseshoe bat, and that a light spill model would be a key factor in informing mitigation. NPWS highlighted the critical timing needed for compensatory planting of ecological corridors. NPWS queried whether hen harrier winter roost surveys would be undertaken. NPWS queried the culvert with otter ledges in place for the M18 Motorway and whether they discharge onto the site, and if they had been checked for otter usage. NPWS queried whether translocating calcareous grassland would be assessed fully and appropriately. NPWS noted hydrological issues in the northern part of the site and that further investigations were required to assess any potential hydrology constraints. NPWS queried if hibernation surveys were undertaken for bats.	Section 7.6.1.1 and 7.6.1.4 addresses mitigation required for light spill and early planting regimes. Section 7.2.4.2 details specific surveys undertaken for the site (including hen harrier). Section 7.2.4.2 details the otter surveys undertaken within the site. Section 7.6.1.3 addresses mitigation necessary for the translation of calcareous grassland.
Vincent Wildlife Trust	13/01/2021	Topics discussed included: Additional areas for planting were recommended within the proposed development site. Linear habitats for bats along Toureen Laneway was recommended to be maintained and kept completely dark. The Light Spill Model would be crucial in informing our assessment. Planting of native species on site was recommended.	Section 7.2.5 of the NIS addressed mitigation required for light spill and planting regimes.
Public consultations, including landowners, neighbours	22/04/2021	No issues were raised during these consultations regarding ecology.	-

Consultee	Date of Consultation	Issues Raised	Relevant Section of the NIS where this is addressed
and local councillors.			

7.2.5 Ecological Evaluation and Impact Assessment

7.2.5.1 Ecological Evaluation

Ecological receptors (including identified sites of ecological importance) are valued with regard to the ecological valuation examples set out in *Guidelines for Assessment of Ecological Impacts of National Roads Schemes: Revision 2*[15] and the guidance provided in *Guidelines for Ecological Impact Assessment in the UK and Ireland* [16] – refer to Appendix 7.7 for examples of how ecological importance is assigned. In accordance with these guidelines, important ecological features within what is referred to as the Zone of Influence (ZoI) of the proposed development which are "both of sufficient value to be material in decision making and likely to be affected significantly" are deemed to be 'Key Ecological Receptors' (KERs). These are the ecological receptors which may be subject to significant effects from the proposed development, either directly or indirectly. KERs are those biodiversity receptors with an ecological value of local importance (higher value) or greater.

7.2.5.2 Impact Assessment

Ecological impact assessment is conducted following a standard source-pathway-receptor model, where, in order for an impact to be established all three elements of this mechanism must be in place. The absence or removal of one of the elements of the mechanism is sufficient to conclude that a potentially significant effect would not occur.

- Source(s) – *e.g.* pollutant run-off from proposed works
- Pathway(s) – *e.g.* groundwater connecting to nearby qualifying wetland habitats
- Receptor(s) – *e.g.* wetland habitats and the fauna and flora species they support

Characterising and Describing the Impacts

The parameters considered in characterising and describing the potential impacts of the proposed development are per the EPA's *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*[17] and CIEEM's *Guidelines for Ecological Impact Assessment in the UK and Ireland*: whether the effect is positive,

[15] NRA (2009) Guidelines for Assessment of Ecological Impacts of National Roads Schemes: Revision 2. National Roads Authority.

[16] CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland. Chartered Institute of Ecology and Environmental Management, Winchester, UK.

[17] Environmental Protection Agency. (2017) Guidelines on the information to be contained in Environmental Impact Assessment Reports. Draft, August 2017. (refer to Table 3.3)

neutral or negative; the significance of the effects; the extent and context of the effect; the probability, duration and frequency of effects; and, cumulative effects.

Cumulative effects can result from individually insignificant but collectively significant actions taking place over a period of time or concentrated in a location. The following development types are included in considering cumulative effects:

- Existing projects (under construction or operational)
- Projects which have been granted consent but not yet started
- Projects for which consent has been applied for which are awaiting a decision, including those under appeal
- Projects proposed at a plan level, if relevant (*e.g.* future strategic infrastructure such as roads or greenways)

The likelihood of an impact occurring, and the predicted effects, can also be an important consideration in characterising impacts. In some cases, it may not be possible to definitively conclude that an impact will not occur. In these cases, the evaluation of significant effects is based on the best available scientific evidence but where reasonable doubt still remains then the precautionary principle is applied and it may need to be assumed that in the absence of mitigation significant effects may occur. Professional judgement is used in considering the contribution of all relevant criteria in determining the overall magnitude of an impact.

Significant Effects

In determining whether potential impacts will result in significant effects, the CIEEM guidelines were followed. The approach considers that significant effects will occur when there are impacts on either:

- the structure and function (or integrity) of defined sites, habitats or ecosystems; or
- the conservation status of habitats and species (including extent, abundance and distribution).

Integrity

The term “integrity” may be regarded as the coherence of ecological structure and function, across the entirety of a site that enable it to sustain all of the biodiversity or ecological resources for which it has been valued (NRA, 2009).

The term ‘integrity’ is most often used when determining impact significance in relation to designated areas for nature conservation (*e.g.* SACs, SPAs or pNHA/NHAs) but can also be the most appropriate method to use for non-designated areas of biodiversity value where the component habitats and/or species exist with a defined ecosystem at a given geographic scale.

An impact on the integrity of an ecological site or ecosystem is considered to be significant if it moves the condition of the ecosystem away from a favourable condition: removing or changing the processes that support the sites’ habitats and/or species; affects the nature, extent, structure and functioning of component habitats; and/or, affects the population size and viability of component species.

Conservation Status

Similar definitions for conservation status given in the EU Habitats Directive 92/43/EEC, in relation to habitats and species, are also used in the CIEEM (2018) and NRA (2009) guidance which are summarised as follows:

- For natural habitats, conservation status means the sum of the influences acting on the natural habitat and its typical species, that may affect its extent, structure and functions as well as its distribution, or the long-term survival of its typical species, at the appropriate geographical scale
- For species, conservation status means the sum of influences acting on the species concerned that may affect the abundance of its populations, as well as its distribution, at the appropriate geographical scale

An impact on the conservation status of a habitat or species is considered to be significant if it will result in a change in conservation status, having regard to the definitions of favourable conservation status provided in the EU Habitats Directive 92/43/EEC – *i.e.* into the future, the range, area and quality of habitats are likely to be maintained/increased and species populations are likely to be maintained/increased.

According to the CIEEM methodology, if it is determined that the integrity and/or conservation status of an ecological receptor will be impacted on, then the level of significance of that impact is related to the geographical scale at which the impact will occur (i.e. local, county, national, international). In some cases an impact may not be significant at the geographic scale at which the ecological feature has been valued but may be significant at a lower geographical level. For example, a particular impact may not be considered likely to have a negative effect on the overall conservation status of a species which is considered to be internationally important. However, an impact may occur at a local level on this internationally important species. In this case, the impact on an internationally important species is considered to be significant at only a local, rather than an international level.

7.3 RECEIVING ENVIRONMENT

7.3.1 Designated sites

7.3.1.1 European sites

Special Areas of Conservation (SAC) are designated under the EC Habitats Directive (92/43/EEC) for the protection of habitats listed on Annex I and/or species listed on Annex II of the Directive. Special Protection Areas (SPAs) are designated under the Birds Directive (2009/147/EC) for the protection of bird species listed on Annex I of the Directive, regularly occurring populations of migratory species (such as ducks, geese or waders), and areas of international importance for migratory birds.

SACs and SPAs are offered additional protection under county development plans, as is the case for the *Clare County Development Plan 2017-2023 Variation no 1*, through Objective CDP14.9 on Natura 2000 sites which requires that planning authorities give due regard to their protection in planning policies and decisions (Clare County Council, 2017).

The proposed development does not overlap with any European sites. There are 23 European sites within the vicinity of the proposed development. The nearest European site is the Lower Shannon SAC, located *c.* 1.4km south-west of the proposed

development site. The next closest European site is Ballyallia Lake SAC, located *c.* 2.2km north west of the proposed development, designated for Natural eutrophic lakes habitat type (NPWS, 2017). A section of this European site also overlaps with Ballyallia Lough SPA, located c. 2.5km north west of the proposed development site.

The Spancelhill River flows along the north-western boundary of the proposed development site, flanked by the woodland on the southern bank and improved agricultural grassland and scrub on the northern bank. It flows between two attenuation ponds located within and adjacent to the western section of the proposed development site, before exiting the site through a culvert under the M18 Motorway to Ennis. Spancelhill River then flows *c.* 2.1km downstream into the River Fergus, which in turn discharges into the Fergus Estuary *c.* 4.9km downstream. The River Fergus overlaps with the Lower River Shannon SAC where the Spancelhill Stream joins the River Fergus, and the Fergus Estuary overlaps with the River Shannon and River Fergus Estuaries SPA *c.* 4.9km downstream. Therefore, the closest European site to the proposed development, is the Lower River Shannon SAC, located 2.1km downstream, or 1.3km south west (as the crow flies) to the proposed development.

The Dromore Woods and Loughs SAC is located *c.* 4.5km north west of the proposed development site. A portion of the River Fergus flows through this European site. The River Fergus then flows *c.* 9.3km downstream, via Ballyallia Lough SAC, and combines with the outfall of the River Fergus that connects with the Spancelhill stream, upstream of this.

There is therefore a hydrological link between the proposed development site and European sites.

There are 12 SACs designated for populations of lesser horseshoe bat within 15km of the proposed development. The nearest SAC designated for populations of lesser horseshoe bat is the Old Domestic Building (Keevagh) SAC, located *c.* 4.3km south west of the proposed development. A detailed analysis of how lesser horseshoe bat use the proposed development site can be found in Section 7.3.3.5.

There are four SPAs within 15km of the site. The nearest SPA is Ballyallia Lough SPA, located *c.* 2.5km north west of the site, designated for its wetlands and wildfowl, including: wigeon *Anas penelope*, gadwall *Mareca strepera*, teal *Anas crecca*, mallard *Anas platyrhynchos*, shoveler *Spatula clypeata*, coot *Fulica atra*, and black-tailed godwit *Limosa limosa*. The River Shannon and River Fergus Estuaries SPA also designated for its wetlands and waterbirds, is located *c.* 7km downstream of the site, via Spancelhill River which flows along the western boundary of the site, and the River Fergus.

The SAC and SPA sites in the vicinity of the proposed development, their distance from the proposed development and their qualifying interests/special conservation interests are presented in Appendix 7.2.

The locations of those SAC and SPA sites relative to the proposed development are illustrated on Figure 7.5 below.

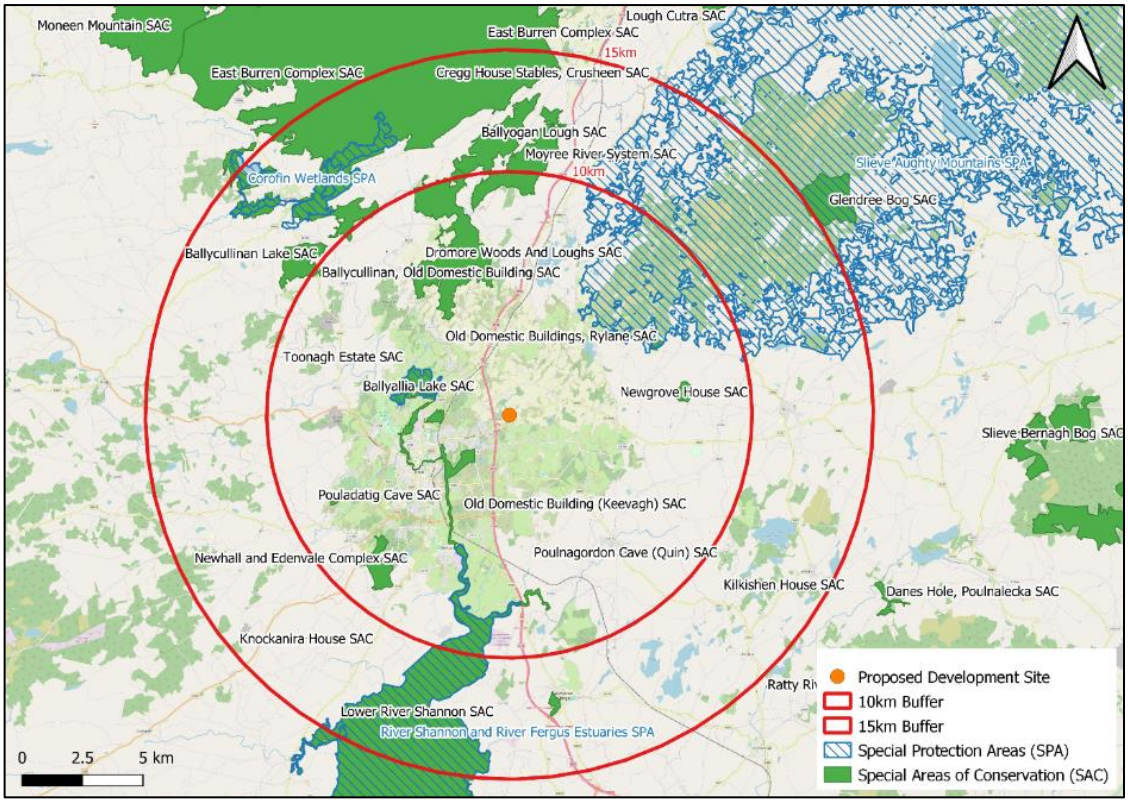

Figure 7.5 *European sites in the vicinity of the proposed development*

7.3.1.2 Nationally designated sites

Natural Heritage Areas (NHAs) are designated under the Wildlife Acts to protect habitats, species or geology of national importance. In addition to NHAs there are proposed NHAs (referred to as pNHAs), which are also sites of significance for wildlife and habitats and were published on a non-statutory basis in 1995, but have not since been statutorily proposed or designated. Proposed NHAs are offered protection in the interim period under county or city development plans, as is the case for the *Clare County Development Plan 2017 – 2023* through Objective B3 which requires that planning authorities give due regard to their protection in planning policies and decisions (Clare County Council, 2017).

The proposed development does not overlap with any National sites. There are 24 National sites within the vicinity of the development, two of them being NHAs, and 22 pNHAs. The closest NHA is Oysterman's Marsh NHA, located c. 5.6km north-east of the proposed development. The closest pNHA is Newpark House (Ennis) pNHA, located c. 1.5km west of the proposed development.

The Spancelhill River which flows along the north western boundary of the site, flows under the M18 through a culvert, before flowing *c.* 2.1km downstream into the River Fergus, which then discharges into the Fergus Estuary, *c.* 4.9km downstream. The Fergus Estuary and Inner Shannon, North Shore pNHA overlaps with the Fergus Estuary at this outfall of the River Fergus. There is therefore a hydrological link between the proposed development site and National sites downstream.

The NHA and pNHA sites in the vicinity of the proposed development, their distance from the proposed development and their qualifying interests/special conservation interests are presented in Appendix 7.1.

The locations of those NHA and pNHA sites relative to the proposed development are illustrated Figure 7.6 below.

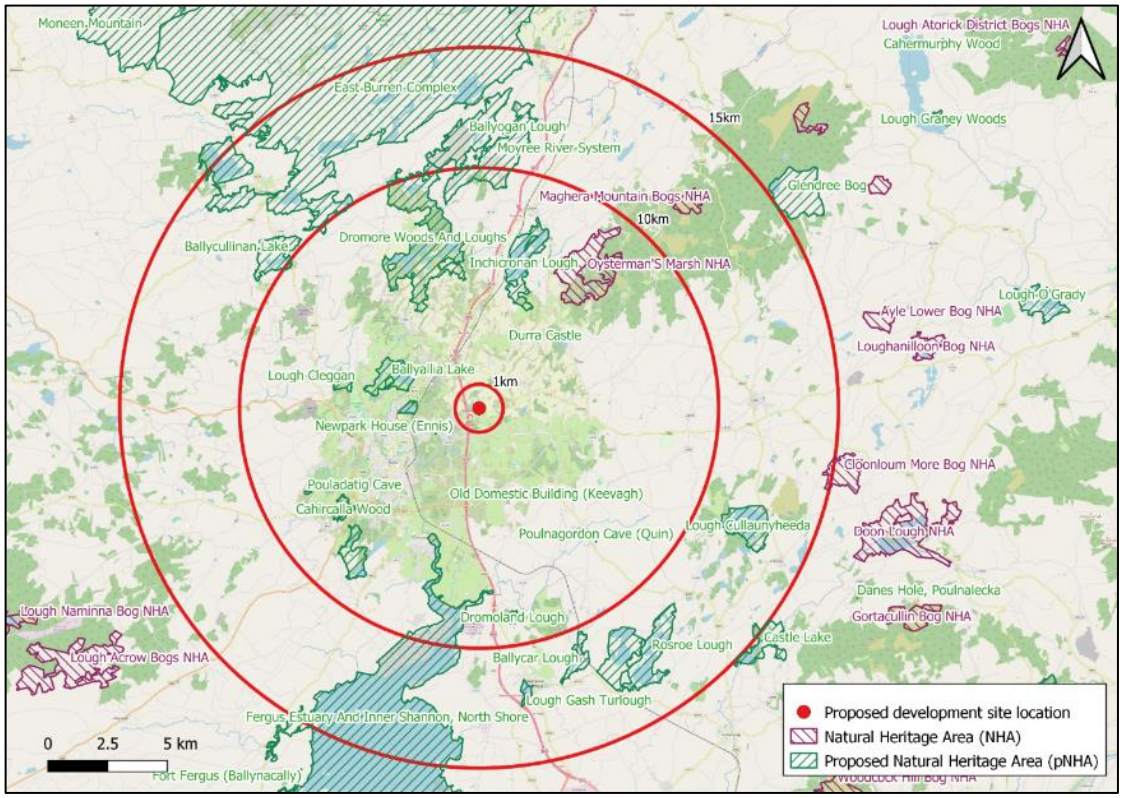

Figure 7.6 *National sites in the vicinity of the proposed development*

7.3.2 Habitats and Flora

7.3.2.1 Habitats

No protected plant species contained within the Flora (Protection) Order, 2015 were recorded within the proposed development site during surveys undertaken in 2018 and 2020. *Galium uliginsosum*, a rare plant species (of least concern) contained within *Ireland Red List No. 10: Vascular Plants* (Wyse Jackson *et al.*, 2016), was identified within the proposed development site, in the rich fen and flush habitat in the north of the site. There were no species listed on *Ireland Red List No. 8: Bryophytes* (Lockhart *et al.*, 2012) recorded within the proposed development site in either years. No non-native, invasive plant species listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations, 2011 were recorded within the proposed development site in 2018 or 2020.

Each habitat identified within the proposed development site was classified according to Fossitt (2000)[3] and their corresponding level of ecological importance was determined in accordance with CIEEM (2018) and NRA (2009) guidelines. A detailed description of each habitat valued as being local importance (higher value) or higher is provided below along with an overall summary of all other habitats. Habitats valued as being of local importance (higher value) or higher include the following:

- Mesotrophic lake (FL4)
- Other Artificial Lakes and Ponds (FL8)

- Reed and large sedge swamps (FS1) including the Annex I habitat *Cladium* Fens [*7210]
- Depositing/Lowland Rivers (FW2)
- Marsh (GM1)
- Dry calcareous and neutral grassland (GS1) including the Annex I habitat Calcareous grassland [6210]
- Wet grassland (GS4) including the Annex I habitat *Molinia* meadows [6410]
- Rich Fen and Flush (PF1) including the Annex I habitat Alkaline fens [7230]
- Hedgerows (WL1)
- Treelines (WL2)
- Oak-ash-hazel woodland (WN2)
- Riparian woodland (WN5) including the Annex I habitat Alluvial Woodland [*91E0]
- Wet Willow-alder-ash woodland (WN6) including the Annex I habitat Alluvial Woodland [*91E0]
- Immature woodland (WS2)

Several areas of some of these habitats (*i.e.* dry calcareous and neutral grassland, wet grassland, oak-ash-hazel woodland and hedgerows) were valued as being of local importance (lower value) due to being less species diverse, improved in nature, and in poor quality due to cattle poaching.

Figure 7.7 presents all habitats identified and mapped within the proposed development site, while Figure 7.8 presents the level of ecological importance of these habitats. Habitats beyond the red line boundary that are considered to be of international importance are included in Figure 7.8 as they are within the ground water ZoI from the proposed development site. Species lists for each of the habitats valued as being of local importance (higher value) or higher are provided in Appendix 7.3.

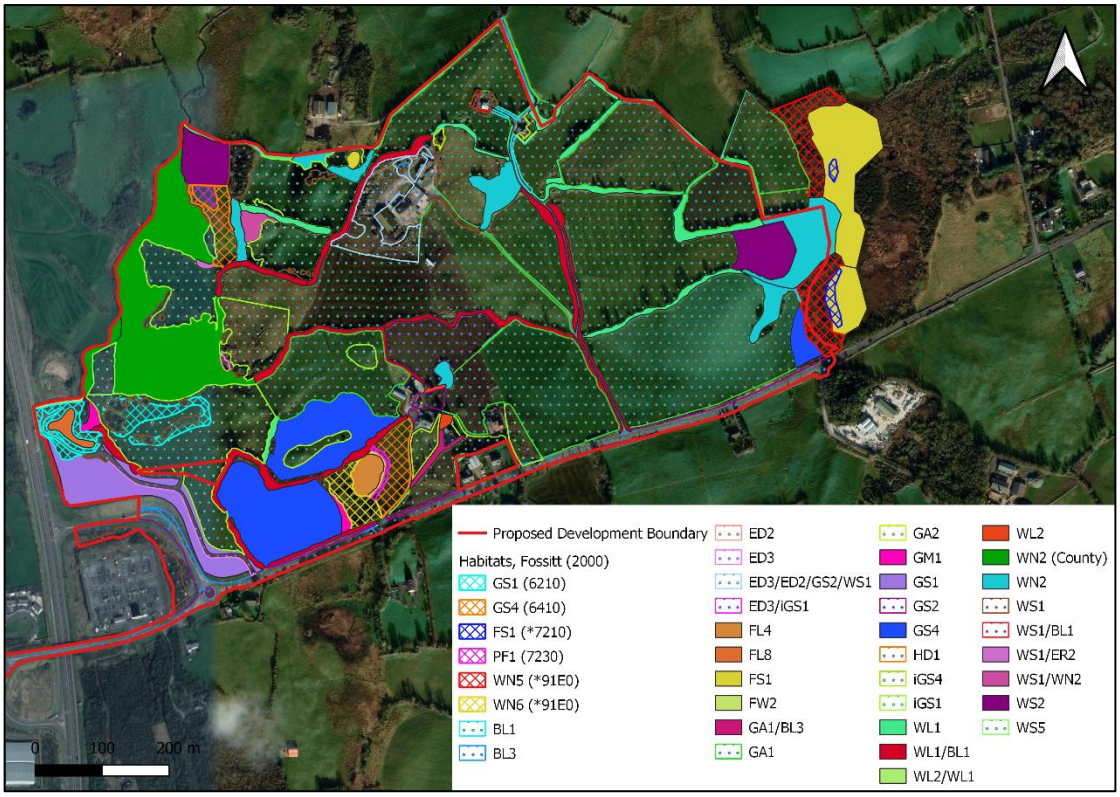

Figure 7.7 *Habitats identified within the proposed development site, as classified according to Fossitt, J.A (2000) and the Interpretation manual of European Union Habitats EUR28 (CEC, 2013)*

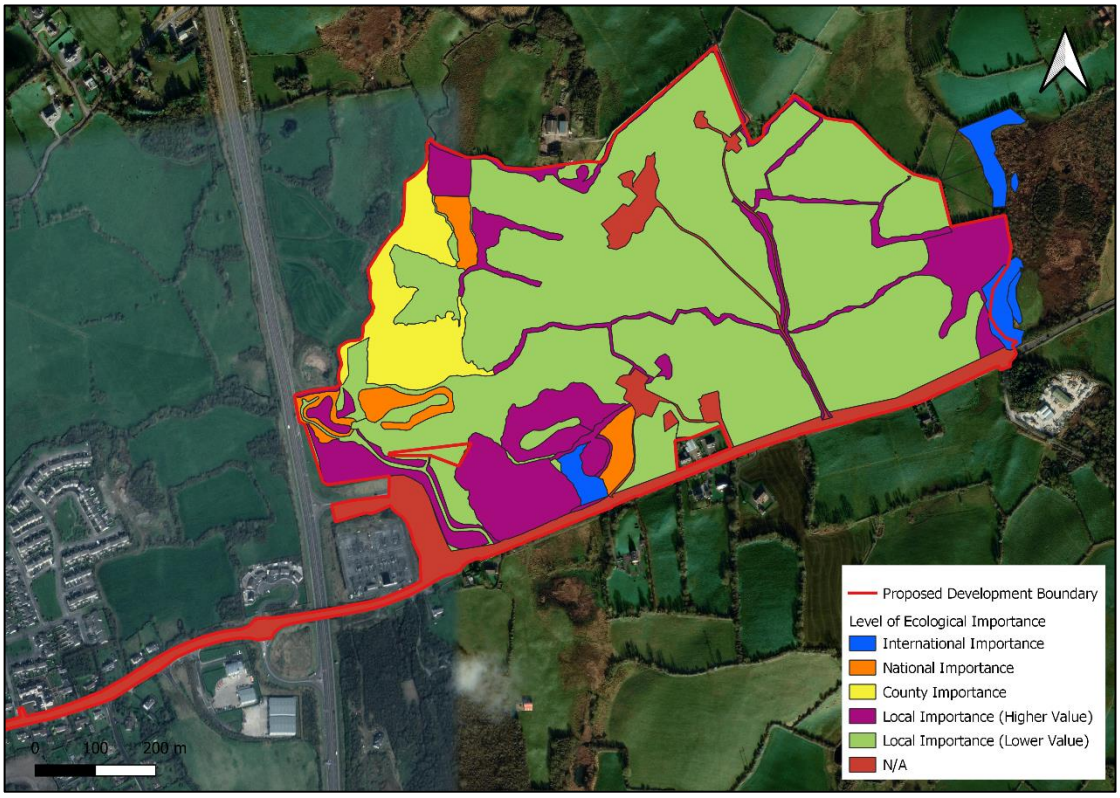

Figure 7.8 *Level of ecological importance of each habitat identified within the proposed development site, as determined in accordance with CIEEM (2018) and NRA (2009) guidelines*

Habitats valued as being of national, county or local importance (higher value)

Mesotrophic Lakes (FL4), c. 0.21ha in total area (see Plate 1)

A small mesotrophic lake, referred to as Toureen Lough (ITM grid reference 537343 679385), was identified in close proximity to the southern boundary of the proposed development site, directly north of an existing farm laneway. Lake water was clear with no signs of algal growth. *Nuphar alba* was noted in the centre of the lake, while reed vegetation forms the dominant feature fringing the lake edge. At a few smaller locations along the lake's eastern boundary, *Nasturtium officinale* and *Apium nodiflorum* occurred where cattle were accessing the lake to drink. Other species found here included; *Potamogeton natans*, *Lemna minor*, and *Ranunculus flammula*. This habitat is valued as being of local importance (higher value) due to the diversity of plant species present in the context of the surrounding local environment.

Plate 1. *Toureen Lough, with evidence of cattle poaching along its periphery*

Other Artificial Lakes and Ponds (FL8), c. 0.13ha in total area (see Plate 2)

This habitat consisted of an existing attenuation pond of the M18 Motorway (ITM grid reference 536891 679457) located adjacent to the western boundary of the proposed development site, directly south of the Spancelhill Stream. It contained a variety of macrophytes, which included floating plant species, such as *Lemna minor* and *Potamagon* species, as well as emergent plant species, such as *Typha latifolia*, *Alisma plantago-aquatica* and *Sparganium erectum*. It was bordered by a fringe of reed and large sedge swamps habitat, which was dominated by *Phragmites australis*.

The level of importance of this habitat was valued as being of local importance (higher value) due to the diversity of plant species present in the context of the surrounding local environment, and relatively good quality of the habitat due to it being fenced off from the surrounding agricultural lands.

Plate 2 *Existing attenuation pond of the M18 Motorway dominated by various macrophytes species*

Reed and Large Sedge Swamps (FS1) c. 2ha in total area (See Plate 3)

Reed and large sedge swamp (FS1) also occurs across an extensive area to the east of the red line boundary, adjacent to the riparian woodland habitat described below. Here the conditions are too wet and inundated to support true riparian woodland, and instead a swamp habitat occurs, interspersed with scattered inundation-tolerant shrubs and scrub vegetation (WS1). This habitat hosts a number of typical species of swamp habitat, including the dominant common reed and the occasional large sedge species, *Cladium mariscus*, along with *Carex rostrata* and *Carex paniculata. Menyanthes trifoliata* provides a dense mat of floating vegetation, whilst on the open water itself, *Lemna minor* is abundant, alongside *Nuphar lutea*. The scattered scrubby areas are dominated by *Salix cinerea*, hybrid willow and some *Myrica gale*, and mostly occur on the somewhat higher, drier parts of the swamp.

Some swamp vegetation with great fen-sedge in Ireland may be classified as the EU Habitats Directive Annex I habitat *Cladium* fen [*7210], which is described in detail by NPWS (2019). Eight positive indicator species (namely *Cladium mariscus*, *Juncus articulatus*, *Carex paniculata, Carex rostrata*, *Equisetum fluviatile*, *Galium palustre*, *Lythrum salicaria* and *Mentha aquatica* – "typical species" as per NPWS, 2019) in total for this Annex I habitat were recorded in the wider swamp habitat here, but no high-quality indicator species were recorded. *Cladium mariscus* was also recorded within the relevés themselves. It is occasionally present in this habitat and is not generally forming dense stands, as it is largely out-competed by common reed. This vegetation represents a relatively species-poor calcareous swamp/fen habitat. Nonetheless, NPWS (2019) state that areas/stands of great fen-sedge "*including areas that support species-poor vegetation*" are referrable to the Annex I 7210 habitat. Therefore, following a precautionary principle, this swamp habitat located in east beyond the red line boundary, must classify as Annex I *Cladium fen* 7210 habitat. This habitat is currently considered to be stable in Ireland (NPWS, 2019). The habitat in the east is considered to be of international importance as it is a priority Annex I habitat.

The margins of the aforementioned mesotrophic lake (Toureen Lough) were dominated by *Typha latifolia* and *Phragmites australis* vegetation, with occasional colonising *Salix* spp. This habitat formed a tall and dense buffer between the lake and surrounding vegetation and occurs within the lake shallows. Likewise, the margins of the attenuation pond were comprised of this habitat. It is a naturally relatively species-poor habitat; however, it is considered to be of local importance (higher value), due to its rarity in the wider local environment. The habitat at Toureen Lough merged with

alkaline fen at its outward edge. This transition area was marked by the emergence of *Carex paniculata* as the dominant species.

Plate 3. *Reed and large sedge swamp habitat to the east of the red line boundary, with common reed and great fen-sedge present*

Depositing/lowland Rivers (FW2) (See plate 4)

The Spancelhill Stream, a tributary of the River Fergus, is located only partially within the proposed development site as it flows along the north-western and western boundaries in proximity of the oak-ash-hazel woodland. From there, it flows under the M18 Motorway via an existing culvert. Plant species growing in association with the stream included a variety of emergent macrophytes such as *Filipendula ulmaria*, *Typha latifolia*, *Mentha aquatica*, *Apium nodiflorum* and *Phragmites australis*. The ground substrate of the Stream was mixed, with some areas dominated by gravel, with other areas extremely soft and silty. Depth ranged from *c.* 50cm – 1m, and was *c.* 2-3m wide. Whilst this habitat is badly poached by cattle, resulting in a partially degraded habitat, the level of importance of this habitat was valued as being of local important (higher value) due to the connectivity it provides to areas downstream.

Plate 4 *Spancelhill Stream with evidence of cattle poaching along banks*

Marsh (GM1), c. 0.13ha in total area

This habitat was located within the southern section of the proposed development site adjacent to a wet grassland field, and directly east of the Spancelhill Stream in close proximity to the attenuation pond. In both areas, ground conditions were damp under foot with water of a depth of *c.* 5cm noted in parts. The level of importance of this habitat was valued as being of local important (higher value) due to the diversity of plant species present in the context of the surrounding local environment.

It was dominated by species typical of wet, marshy ground conditions such as *F. ulmaria*, *L. salicaria*, *M. aquatica*, *A. nodiflorum*, *Epilobium hirsutum*, *P. australis* and *Salix* species. This habitat, located adjacent to the wet grassland field, gradually graded into wet woodland as tree species, such as *Salix* species, became more dominant. There was no evidence of extensive grazing or poaching within these areas located.

Dry Calcareous and Neutral Grassland (GS1), c. 2.2ha in total area (see Plate 5)

This habitat was present:

- on the hillslopes of undulating, neutral grassland fields located within the south-western section of the proposed development site;
- either side of the existing laneway leading to the attenuation pond; and,
- on top of the banks of the attenuation pond.

The level of importance of this habitat within these different areas varied (*i.e.* national importance and local importance (higher value)) according to their species composition and structure.

A variety of calcicole plant species were recorded across this habitat. These included *Briza media* and *Linum catharticum*, which are high quality positive indicator species of the Annex I habitat Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) [6210], hereafter referred to as calcareous grassland [6210] (as per O'Neill *et al.*, 2013), and *Daucus carota*, *Leontodon saxatilis* and *Galium verum*, which are positive indicator species of this same-said Annex I habitat. Common grass species were also recorded, including *Festuca rubra*, *Holcus lanatus*, *Agrostis stolonifera*, *Cynosurus cristatus* and *Dactylis glomerata*, as were forb species typical of more improved agricultural grassland, such as *Senecio jacobaea*, *Ranunculus repens* and *Trifolium repens*. These species were notably more dominant in areas valued as being of local importance (higher value) in comparison to the areas valued as being of national importance. There was evidence of heavy grazing and poaching on the hillslopes. Both areas located at the attenuation pond and within the adjacent field within the south-western corner of the proposed development site were stockproof.

Two areas of this habitat were valued as being of national importance as they corresponded to the Annex I habitat calcareous grassland [6210] due to their species composition and structure as recorded in the respective relevés. The overall conservation status of this Annex I habitat is "*Bad*" (NPWS, 2019) and as such this habitat is considered to be of high conservation concern at a national level. These areas were located on the hillslopes located within an improved neutral grassland field and on top of the banks of the attenuation pond. Two high quality positive indicator species and four positive indicator species of this Annex I habitat (as per O'Neill *et al.*,

2013) were recorded in both relevés taken in these areas. These areas did not correspond to the priority Annex I habitat[18], *i.e.* the orchid-rich variant of 6210, as no orchid species were identified within these areas. Both these areas are considered to be of poor quality (or "*unfavourable*" conservation status, O'Neill *et al.*, 2013) as they failed the condition assessment on the criterion of number of indicator positive indicator species being less than seven and in the case of the former area, the criterion of evidence of serious grazing or disturbance in the local vicinity. This area is under threat from scrub encroachment.

Plate 5 *Area of Annex I habitat dry calcareous grassland [6210], valued as being of national importance, located on top of the banks of the attenuation pond*

Wet Grassland, c. 4ha in total area (see Plate 6)

The majority of this habitat was located:

- within the south-western section of the proposed development site in close proximity to Toureen Lough, a shallow drainage ditch and an area of wet woodland;
- within the north-western section of the proposed development site located east of the woodland; and,
- along the south-eastern boundary of the site, directly west of Ardnamurry Lough which is located outside the proposed development site.

The level of importance of this habitat within these different areas varied (*i.e.* national importance and local importance (higher value)) according to their species composition and structure.

Typical wet grassland species recorded included *Molinia caerulea*, *F. ulmaria*, *Galium palustre* and *Lotus pedunculatus*, which are positive indicator species of the Annex I habitat *Molinia* meadows on calcareous, peaty or clayey-silt laden soils (*Molinion caeruleae*) [6410], hereafter referred to as *Molinia* meadows [6410] (as per O'Neill *et al.*, 2013). Other species typical of wet habitats recorded included *L. salicaria*, *Iris pseudacorus*, *Cardamine flexuosa* and *Hypericum tetrapterum*. Common grass species recorded included *H. lanatus*, *Anthoxanthum odoratum*, *C. cristatus* and

[18] A priority status is accorded to Annex I habitats that are in danger of disappearance and whose natural range falls within the territory of the European Union (O'Neill *et al.*, 2013).

Alopecurus geniculatus, while rush species recorded included *Juncus articulatus*, a positive indicator species of the Annex I habitat *Molinia* meadows [6410], and *J. effusus* and *J. inflexus*. Species typical of more improved grassland habitats, such as *Lolium perenne*, *T. repens*, *R. repens* and *Plantago lanceolata* were also recorded. Overall these species did not dominate the species composition; however, they were notably more dominant in areas valued as being of local importance (higher value) in comparison to those valued as being of national importance. There was evidence of extensive heavy grazing and poaching within the fields located within the southern section of the proposed development site.

There were two areas of this habitat that were valued as being of national importance as they corresponded to the Annex I habitat *Molinia* meadows [6410] due to their species composition and structure as recorded in a relevé. The overall conservation status of this Annex I habitat is "*Bad*" (NPWS, 2019) and as such this habitat is considered to be of high conservation concern at a national level. These areas were located within the north-western section of the proposed development site, east of the oak-ash-hazel woodland and south of the planted immature woodland and rich fen and flush, and in a field by Toureen Lough. One high quality positive indicator species and four positive indicator species of this Annex I habitat (as per O'Neill *et al.*, 2013) were recorded within the relevé taken in the north-western area. The high quality positive indicator species *Dactylorhiza fuchsia* and positive indicator species *Juncus articulatus* were both recorded outside, but within close proximity to the relevé. No relevé was taken within the field by Toureen Lough; however, it was noted that a total of eight positive indicator species of this Annex I habitat (as per O'Neill *et al.*, 2013) were recorded within this area, but no high-quality positive indicator species were recorded. It was also noted that the sward was diverse throughout and had a high proportion of forbs to grasses. The field by Toureen Lough was heavily grazed and poached at the time of survey. The most abundant species was articulated rush *Juncus articulatus*, although its total cover was limited by the high grazing levels.

This area is considered to be of poor quality (or "*unfavourable*" conservation status, O'Neill *et al.*, 2013) as it failed the condition assessment on the criteria of number of indicator positive indicator species being less than seven and the ration of forb to graminoid species.

Plate 6 *Area of Annex I habitat Molinia meadows [6410], valued as being of national importance, located within the north-western section of the proposed development site*

Rich Fen and Flush (PF1), c. 0.13ha in total area (see Plate 7)

This habitat was located in two different areas, one of which was located within the northern section of the proposed development site, while the second was located within the southern section. The level of importance of this habitat within these different areas were both of national importance according to their species composition and structure.

The small area of rich fen and flush, located in the far north west of the proposed development site, described as a wetland/pond feature, corresponded to a depression between wooded areas, and are naturally relatively species-rich vegetation communities. It is likely to have formed as a consequence of a lake infilling and can be described as a topogenous fen (*i.e.* forming in a valley or depression). It was notable for the presence of *Typha latifolia*, *Sparganium erectum* in combination with a sward dominated by *Schoenus nigricans*, and sedge species such as *Carex flacca*, *C. paniculata* and *C. nigra*, over a brown moss understorey, which included the abundant *Calliergonella cuspidata*. The characteristic *Galium uliginosum* was relatively abundant, as was *M. aquatica*. This habitat merged with the adjacent Annex I habitat *Molinia* meadows [6410] characterised by rushes and purple moor-grass at its edge.

A more-species-poor fen community occurs bordering on the landward side of reed and tall sedge swamp vegetation at Toureen Lough. Here the overstorey is a near monoculture of *Carex paniculata*, with occasional *Lychnis flox-cuculi* and a few forb species of the adjacent wet grassland habitat, with which it merges at its edge.

Fen habitats located within these two particular areas corresponded to the description of the Annex I habitat Alkaline fen [7230], which are described as "*Wetlands mostly or largely occupied by peat- or tufa-producing small sedge and brown moss communities developed on soils permanently waterlogged, with a soligenous or topogenous base-rich, often calcareous water supply, and with the water table at, or slightly above or below, the substratum…*" within the *Interpretation Manual of European Union Habitats* (European Commission, 2013). The conservation status of alkaline fens [7230] in Ireland is "*bad*" due to ongoing losses in national area, and due to the poor condition of a large proportion of the habitat within the country (NPWS, 2019).

The examples of rich fen and flush habitats within these two areas are considered to be of national importance. The total area of this habitat within the lands is relatively small, however they are a naturally species-rich habitat type and correspond to an Annex I habitat type, which is of "*bad*" conservation condition in Ireland. It is considered likely that similar examples of this habitat occur within the surrounding area based on the author's knowledge of the geography of the surrounding landscape and a review of orthophotography of the locality, and for this reason the habitat is not considered to be rare or unusual locally.

Plate 7 *Fen habitat in north western section of the site*

Hedgerow (WL1), c. 5.38km in total length (see Plate 8)

The majority of the field boundaries located across the proposed development site consisted of this habitat. Several of which were growing adjacent to stone walls, while others were adjacent to drainage ditches. The level of importance of some hedgerows was valued as being of local importance (higher value) due to their structure and plant species composition. These hedgerows were notably more diverse in comparison to those valued as being of local importance (lower value).

Overall, these hedgerows were dominated by *Corylus avellana*. Other woody species present included *Crataegus monogyna*, *Fraxinus excelsior*, *Ilex aquifolium* and *Rubus fruticosus*. *Acer pseudoplatanus*, *Sambucus nigra* and *Rosa sp.* were also present in some of these hedgerows; however generally in lower abundances. *Hedera helix* was often recorded growing in association with several of these woody species. The understorey of these hedgerows were not especially species rich. It generally included species common to more shaded environments, such as *Arum maculatum*, *Geranium robertianum* and *Asplenium scolopendrium*, and others common to hedgerows, such as *Galium aparine* and *Anthriscus sylvestris.* A number of these hedgerows were growing adjacent to stone walls, which formed field boundaries.

Plate 8 *Hedgerow, valued as being of local importance (higher value), located in the southern section of the proposed development site*

Oak-ash-hazel Woodland (WN2), c. 5.5ha in total area (see Plate 9)

The majority of this habitat, which was generally dominated by a low canopy of *C. avellana*, was identified within the north-western section of the proposed development site, adjacent to semi-natural and improved grassland fields and planted immature woodland. There were also four other relatively small, isolated blocks of this habitat, ranging from *c.* 0.34-0.08ha in total area, that were located: in close proximity to the northern boundary; in the centre of the proposed development site north-east of existing farm buildings; and, adjacent to the eastern boundary of the proposed development site.

The level of importance of this habitat within these different areas varied (*i.e.* county importance and local importance (higher value)) according to their structure (including geological structure) and plant species composition. The most important area is the largest woodland block (*c.* 3.6ha in total area) located within the north-western section of the proposed development site, east of the Spancelhill stream. This block of woodland is valued as being of county importance, while all other areas of this habitat are valued as being of local importance (higher value).

Overall, the woodland canopy was relatively low and dominated by *C. avellana*, *C. monogyna* and *Fagus sylvatica*. *F. excelsior*, *I. aquifolium* and *S. nigra* were also recorded; however, in lower abundances in comparison to the former three species. Below this, the shrub layer was dominated by *Rubus fruticosus* and *Prunus spinosa*, while the field layer contained a variety of herbaceous species typical of shaded woodlands such as *Oxalis acetosella*, *Geum urbanum, Circaea lutetiana*, *G. robertianum* and *A. maculatum*. *H. helix* was also noted densely covering the field layer, as well as growing on the woody tree species. Other herbaceous species recorded included those typical of more improved habitats including *Urtica dioica* and *R. repens*. A limited number of fern species were recorded. These comprised of *Dryopteris filix-mas* and *A. scolopendrium*. Exposed rocky limestone outcrops of varying sizes were present, often densely covered in moss species *Fissidens spp.* and *H. helix*. There was evidence of grazing and poaching by livestock throughout this habitat with numerous paths passing through the woodland, resulting in relatively large areas of exposed soil.

A relevé was taken within this area to confirm whether or it corresponded to the wooded variant of Annex I priority habitat Limestone pavement [*8240]. Whilst this area did contain 12 positive indicator species of this Annex I habitat (as per Wilson & Fernández, 2013), it was determined that it did not correspond to this Annex I habitat for the following reasons:

- It lacked the distinctive clint and gryke and/or shattered limestone pavement geological structure that is characteristic of this Annex I habitat (as per Wilson & Fernández, 2007);

- It lacked a sufficient percentage cover of exposed rock (*i.e.* at least 50%, the percentage cover of exposed bare soil was 60%[19]); and,

[19] According to the *Interpretation Manual of European Union Habitats EUR28* (Commission of the European Communities, 2013), "*The rock surface* [of this Annex I habitat] *is almost devoid of overlying soils (considerably less than 50% cover) except for some patches of shallow skeletal or loessic soils, although more extensive areas of deeper soil occasionally occur; sometimes there is encroachment of peat.*"

- The average depth of soil present was *c.* 14cm, which in the context of this Annex I habitat is not considered to be not shallow enough (> 2cm).

The other areas of this habitat that are valued as being of local importance (higher value) were less species-rich compared to this large block of woodland and generally lacked the more typical woodland structure (*i.e.* a relatively well-developed understorey layer) and the exposed rocky outcrops. Significant encroachment from scrub species (*i.e. R. fruticosus*, *Ulex euroaepus* and *P. spinosa*) was noted within two of the four isolated woodland blocks valued as being of local importance (higher value). This may be have resulted in the stunted growth of *C. avellana*, *C. monogyna* and *F. sylvatica* within these particular areas. Consequently, these areas may be described as a mosaic of woodland and scrub habitats. All these areas are valued as being of local importance (higher value) primarily due to their importance in maintaining ecological corridors.

Plate 9 *Oak-ash-woodland habitat dominated by C. avellana with exposed rocky outcrops and valued as being of county importance, located within the north-western section of the proposed development site.*

Riparian woodland (WN5), c. 1.03ha in total area

Riparian woodland (WN5) occurs along the margins of the wider swamp area to the east of the red line boundary of the proposed development site. This habitat hosts a number of classic riparian woodland plant species, including the dominant canopy species *Salix cinerea* subsp. *oleifolia* and *Salix* × *multinervis,* as well as shrub and low woody shrub species like *Myrica gale*, *Hedera helix* and *Rubus fruticosus* agg., and a herb layer of such species as *Filipendula ulmaria, Juncus effusus, Angelica sylvestris, Galium palustre* and *Carex paniculata*. The inundated condition of the herb layer is indicated by the presence of *Comarum palustre* and *Menyanthes trifoliata*.

Some areas of riparian woodland habitat in Ireland may be classified as the EU Habitats Directive priority Annex I habitat *[91E0] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*). The description of the Irish variant of this habitat is outlined within O'Neill & Barron (2013) and is based on the outcomes of the *National Survey of Native Woodland 2003-2008* (Perrin *et al.*, 2008). A minimum of seven indicator species of Perrin *et al.* (2008), at least one of which must be *Alnus glutinosa*, *Fraxinus excelsior* or *Salix* sp., must be present in the monitoring plot for vegetation to correspond to *[91E0] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*), based on the assessment methodology of Perrin *et al.*, (2008). The status of Alluvial woodland *91E0 primarily depends on; the canopy being dominated by *Salix*

sp., the woodland is flooded routinely, and that the woodland is more than 4m in width, all of which this habitat possesses. As only three positive indicator species (namely *Filipendula ulmaria, Angelica sylvestris* and *Stellaria palustris*) were recorded in this riparian woodland habitat, this habitat is of poor quality, however this habitat is under threat in Ireland from habitat loss (NPWS, 2019). Therefore, the habitat here is considered to be of international importance. It has been valued as such due to the overall naturalness of the vegetation type, as it has the three factors that the status of Alluvial woodland habitat relies on (as previously described), as well as considering the conservation status of the habitat in Ireland and its status as a priority habitat.

Wet Willow-Alder-Ash Woodland (WN6), c. 1.5ha in total area, (see Plate 10)

A small area of wet woodland is located on the southern and western shores of Toureen Lough, where the dominant overstorey tree is grey willow *Salix cinerea*. It occurs in an area between Toureen Lough and the southern boundary of the lands with the R352 road.

As mentioned, grey willow was the most abundant canopy species, with some goat willow *S. capraea* and very occasional eared willow *S. aurita*. The canopy is low, *c.* 5-10m high, with many of the willow species with partially collapsed branches. Alder *Alnus glutinosa* appears occasionally, while hazel *Corylus avellana* begins to appear where the ground is drier. Understorey species noted included canary reed-grass *Phalaris arundinacea*, with abundant meadowsweet and enchanter's-nightshade *Circaea lutetiana,* and occasional wild Angelica *Angelica sylvestris*, flag iris *Iris pseudacorus* and greater tussock-sedge. Part of the canopy has recently been cleared by coppicing, which is probably linked to the presence of overhead power lines.

While a relevé was not undertaken within the woodland, a comparison of species composition against communities described within the Irish Vegetation Classification (IVC) indicates that it most closely aligns with the IVC category "WL3F *Salix cinerea* – *Phalaris arundinacea* woodland". This is a community of heavy, base-rich soils. It is rare in the west of the country, with the exception of Clare (Perrin *et al.*, 2008).

This woodland type within the proposed development site corresponds to the Annex I priority habitat *"[91E0] alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)*", herein referred to as "alluvial woodland [*91E0]", based on its location within 20m of Toureen Lough, and due to the presence of typical alluvial woodland [*91E0] species, as per Perrin *et al.* (2008). Seven positive indicator species were recorded within the woodland, while a single negative indicator species, sycamore *Acer pseudoplatanus*, was recorded, albeit with very low abundance. Alluvial woodland [*91E0] is a priority habitat, meaning it is a habitat in danger of disappearance at a European level, and whose natural range falls mainly within the territory of the European Union (European Commission, 2013). The conservation status of alluvial woodland [91E0] in Ireland is "*bad*" (NPWS, 2019), because it is a highly fragmented habitat occurring as small pockets of woodland, with a very limited total area within the country. The example within the subject lands is considered to be of international importance. It has been valued as such due to the overall naturalness of the vegetation type, and the diversity of species present, as well as considering the conservation status of the habitat in Ireland and its status as a priority habitat.

Plate 10 *Wet willow-alder-ash woodland habitat dominated by grey willow, with typical [91E0] alluvial woodland understorey.*

Immature woodland (WS2), c. 1.1ha in total area

This habitat was located along the northern boundary of the proposed development site adjacent to fen habitat and along the eastern boundary of the proposed development site adjacent to an improved grassland field. Both areas had been recently planted with tree saplings. The former area was fenced-off and inaccessible; therefore, it was surveyed from the existing fenceline. It was dominated by planted *Alnus glutinosa* and *Salix cinerea*, while *Viburnum opulus* was occasionally present. The latter area was partially accessible. It contained tree species *Quercus sp.*, *Betula sp.*, *F. sylvatica*, *Sorbus aucuparia* and *C. avellana*. This area gradually became more dominated by scrub species, such as *R. fruticosus*, *U. europaeus* and *Pteridium aquilinum*, to the east. The level of importance of this habitat was valued as being of local important (higher value) primarily due to its importance in maintaining ecological corridors.

Overall summary of the habitats valued as being of local importance (lower value) and/or of artificial nature

The majority of the proposed development site (*i.e.* c. 41ha in area) consisted of habitats that were valued as being of local importance (lower value) or of artificial nature. These predominantly comprised relatively large fields of improved agricultural grassland (Plate 11). Some of these fields located within the western section of the proposed development site were identified as neutral calcareous grasslands as they exhibited significant signs of land improvement. Whilst some calcicole species were recorded within these fields *Daucus carota* and *Lotus corniculatus*, they were in very low abundances and overall, these fields were dominated by species typical of more improved agricultural grassland habitats.

One improved wet grassland field was noted along the southern boundary of the proposed development site, directly north of the R352. Likewise, whilst it contained some species that were typical of wet grassland, it was dominated by those more typical of improved grassland habitats. Dry meadows and grassy verges was recorded along the bank of the M18 Motorway, which was dominated by large tussocks of *Arrhenatherum elatius,* along the roadside verge of the R352 and within the existing farmyard located off the R352. There were also some relatively small areas of amenity grassland, i.e. lawns located within private gardens.

Some hedgerows located within the proposed development site were valued as being of local importance (lower value) as they were species-poor, often containing only one species, recently planted and heavily pruned. There was a species-poor treeline/hedgerow of planted young saplings of *Crataegus monogyna* and *Fraxinus excelsior* considered to be of local importance (lower value) located along the boundaries of a field located in close proximity to the southern boundary.

There were two relatively small blocks of oak-ash-hazel woodland that were valued as being of local importance (lower value), due to species-poor upper storey, dominated by *Corylus avellana*, and very species poor understorey, which was in parts dominated by scrub encroachment. There were a number of relatively small patches of scrub habitat scattered across the site, often in association with hedgerows, woodland and stone wall habitats. There was also a relatively small area dominated by *P. aquilinum* located directly west of the wet woodland within the south-western section of the proposed development site.

Recolonising bare ground comprised the private laneway from the R352 to the attenuation pond located within the western section of the proposed development site and two other patches located with improved dry calcareous and neutral grasslands which consisted of exposed ground which had been recolonised.

There were drainage ditches located across the site in association with hedgerows. These generally contained shallow stagnant water and in parts were heavily poached by livestock. A locally fed spring was identified in the west of the site, between the improved grassland habitat and the oak-ash-hazel woodland. This flowed eastwards along a drainage ditch and into Spancelhill Stream in the west of the site. There was limited macrophyte species present within this habitat. They were valued as being of local importance (lower value).

An area of recently felled woodland (WS5) was identified within the Oak-Ash-Hazel Woodland (WN2) on the western side of the proposed development site, along the banks of the Spancelhill Stream.

Habitats valued as being of artificial nature included spoil and bare ground, buildings and artificial surfaces, such as the existing residential and farm buildings, private roads and other areas of concrete/hard standing such as farm yards, and stone walls and other stonework that were not associated with any other habitat.

Plate 11. *An example of improved agricultural grassland that dominates the habitats within the site.*

7.3.3 Fauna

7.3.3.1 Terrestrial Fauna (Excluding bats)

Badger

Badger *Meles meles*, and their breeding and resting places, are protected under the Wildlife Acts. The NBDC data search returned 40 records of badger within *c.* 2km of the proposed development with the latest from 2018 (Appendix 7.2).

Evidence of badger activity was found within the woodland area in the north-western section of the proposed development site. Two confirmed badger setts, badger hair, snuffle holes, and mammal paths were identified within this woodland habitat. One sett (located *c.* 180m west from the footprint of the proposed development) consisted of a single entrance and is likely to be a subsidiary or outlier sett (Figure 7.9). This sett is being actively used by badger as confirmed with the identification of badger hair at its entrance, and fresh, heaped soil in front of the sett. Mammal paths were evident throughout the woodland, however these paths cannot be confirmed as solely badger as cattle traverse the area frequently. A second sett was also identified in this woodland, *c.* 30m north-east of the other sett and *c.* 200m from the footprint of the proposed development. This sett consisted of three entrances with varying levels of activity. Badger scratching was evident on an adjacent tree. This sett is also likely used as a subsidiary or annex. A badger was confirmed using this sett from the deployed camera trap. Snuffle holes were also identified in the area around the sett.

A potential sett was identified amongst mounds of rocks within the woodland area, located *c.* 170m from the footprint of the proposed development. Large crevices were evident here, that may extend underground. At least one badger was identified on the deployed cameras traversing over the rocks, possibly emerging and/or entering a crevice. Pine martens were also identified using this area possibly for refuge.

The habitats within the proposed development site (*i.e.* grassland, scrub, hedgerow and woodland), provide suitable foraging and commuting habitat for badger.

Due to their stable Irish populations, badger are considered to be of “Least concern” in terms of conservation (Nelson *et al.*, 2019). The local badger populations are valued to be of local importance (higher value), as there is an abundance of suitable habitat within the proposed development site and its vicinity, which has been confirmed by the presence of a number of active badger setts, and from the NBDC desk study search with 40 records within 2km.

Otter

Otter *Lutra lutra*, and their breeding and resting places, are protected under the Wildlife Acts. Otter are also listed on Annex II and Annex IV of the EU Habitats Directive and are afforded strict protection under the Habitats Directive and the European Communities (Birds and Natural Habitats) Regulations, 2011. The NBDC data search returned 16 records for otter within *c.* 2km of the proposed development, with the latest from 2018 (Appendix 7.2). Locations of these records included along a section of the River Fergus through Ennis town, and the eastern banks of Ballyallia Lough, both of which have hydrological connections with the proposed development site.

No holts or couches were identified along Spancelhill Stream, Toureen Lough, or the attenuation ponds located within the western section of the proposed development site. Two otter spraints were identified on rocks within Spancelhill Stream, adjacent to the

woodland located within the north-eastern section of the site *c.* 180m west of the footprint of the proposed development at its closest point (Figure 7.9). The mammal ledge located underneath the M18 Motorway culvert in the west of the site was also checked for otter usage, with no evidence identified during surveys carried out.. No other evidence of otter activity was recorded within the proposed development site.

The banks of Toureen Lough were deemed to be unsuitable for otter holt creation as they consisted of waterlogged soils frequently poached by cattle. Fish are present in Toureen Lough and therefore, it is suitable foraging habitat for otter. Whilst there is no surface hydrological connection between Spancelhill Stream and Toureen Lough, otter may still cross the site from the Spancelhill Stream to Toureen Lough (c. 385 in distance). No evidence of this was recorded during any of the surveys.

Spancelhill Stream is suitable for otter holt/couch creation, and for commuting or foraging otter. Evidence of otter activity was identified within the Stream. The Stream is subject to frequent pollution from cattle manure and feeding areas, which may limit its suitability for otters. Otters were not identified on the camera trap that was deployed along the Stream.

Otters are Qualifying Interest (QI) species of nearby European Sites: Lower River Shannon SAC located *c.* 2.1km downstream of the proposed development site, via the Spancelhill Stream and the River Fergus; and, Dromore Woods and Loughs SAC, located c. 4.5km from the proposed development site as the crow flies and *c.* 12.9km upstream of the proposed development, via the River Fergus and the Spancelhill Stream. The local otter population is valued as being of international importance as it may be connected with the Qualifying Interest otter populations of these European sites, which are hydrologically connected to the proposed development site, and is discussed in more detail in the Natura Impact Statement (NIS) in Section 5.1.3.1.

Pine Marten

Pine marten *Martes martes* are protected under the Wildlife Acts. Pine marten are also listed on Annex V of the EU Habitats Directive and are afforded strict protection under the Habitats Directive and the European Communities (Birds and Natural Habitats) Regulations, 2011. The NBDC database search returned two records of pine marten within *c.* 2km of the proposed development site (Appendix 7.2).

A potential pine marten den was identified within the woodland in the north-eastern section of the proposed development site (*c.* 170m from the footprint of the proposed development), amongst a large collection of limestone rocks and boulders, where holes and crevices were identified (Figure 7.9). A camera that was deployed opposite this pile of rocks identified a pine marten amongst the rocks on three separate occasions. On one occasion, an individual also appeared to leave it's scent on a rock near to a potential entrance. This is likely to be a potential pine marten den or refuge site; however, as pine marten are known to use multiple den sites, it is likely to be used sporadically (Vincent Wildlife Trust, 2020). The woodland and surrounding scrub habitat is suitable for foraging pine marten and would provide ample foraging opportunities for their varied diet of berries, insects, birds, small mammals, and frogs.

Pine martens are listed as a species of "least concern" conservation wise (Nelson *et al.*, 2019) due to the recent increases in populations numbers across the country. In consideration of this the presence of records of the species in the surrounding area, and the abundance of suitable habitat in the area, the local pine marten population is valued to be of local importance (higher value).

Other Mammals

Red squirrel *Sciurus vulgaris*, hedgehog *Erinaceus europaeus*, Irish hare *Lepus timidus hibernicus*, pygmy shrew *Sorex minutus* and Irish stoat *Mustela erminea hibernica* are protected under the Wildlife Acts. The NBDC database search identified one record of pygmy shrew and Irish stoat, two records of red squirrel, Irish hare and pine marten, and three records of hedgehog within *c.* 2km of the proposed development site (Appendix 7.2).

During the field surveys, an *ad-hoc* observation of an Irish hare was recorded in the grassland habitat adjacent to the woodland . No evidence or sightings of red squirrel, hedgehog, pygmy shrew, or Irish stoat was recorded within the proposed development site. However, the woodland located within the proposed development site (*c.* 40m from footprint of the proposed development) would provide suitable breeding and/or foraging habitat for all of the aforementioned species. Red squirrels are more commonly found within mixed woodlands and/or coniferous woodlands due to a more steady food source year round (Lawton *et al.*, 2020); however they can also be found within deciduous woodlands, specifically where oak *Quercus* sp. and/or hazel *Corylus avellana* tree species are present as red squirrel are known to forage acorns and hazelnuts. Pygmy shrews, hedgehogs and Irish stoat are found in a range of habitats; however they are predominantly present in habitats with a rich ground cover, and as such the woodland and scrub habitats within the site are considered suitable for these species. In addition, the dense hedgerows and stone walls present would also provide cover and commuting corridors for these species. Irish hare is also found in a range of habitats, from coastal dunes to mountain tops, and densities vary from year to year and habitat to habitat[20].

All small mammal species returned in the NBDC search are of “Least” conservation concern (Nelson *et al.*, 2019). They are widely distributed throughout Ireland. The habitats on site and in the surrounding environs are suitable for all of the aforenoted mammal species, and as such the mammal species are therefore valued as being of local importance (higher value).

[20] *Species Profile: Irish Hare, Vincent Wildlife Trust Ireland*. Accessed here: https://www.vincentwildlife.ie/species/irish-hare

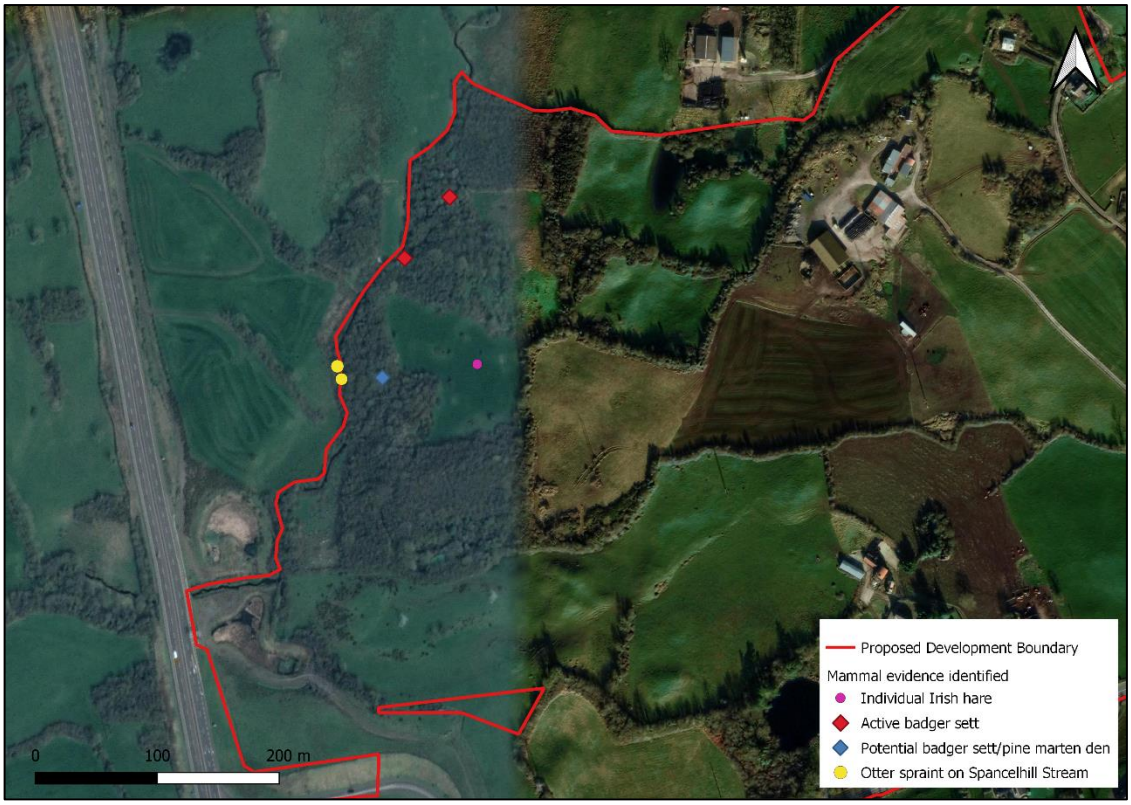

Figure 7.9. *Location of mammal signs recorded within the proposed development site*

Non-native Invasive Mammals

The NBDC database search returned no records for any fauna species listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations, 2011 within 2km of the proposed development site. There were no sightings or evidence of any of these species on site during surveys in 2018 or 2020 either.

A greater white-toothed shrew *Crocidura russula* was identified on the eastern bank of Toureen Lough within the proposed development boundary on the 19th March 2019. This species is listed as a 'medium impact' species, from the Invasive Species in Ireland prioritisation risk assessment. Two records of Bank Vole *Myoydes glareolus*, and European rabbit *Oryctolagus cuniculus,* also listed as *'medium impact'* species, were returned from the NBDC database study for records within *c.* 2km of the proposed development site. Records of 'high impact' species, fallow deer *Dama dama*, house mouse *Mus musculus*, and sika deer *Cervus nippon*, were also returned from the NBDC search. Rabbit and greater white-toothed shrew were the only species identified using the site during field surveys of the site.

7.3.3.2 Birds

Breeding Birds

All wild birds, and their nests and eggs, are protected under the Wildlife Acts. Some bird species are also listed on Annex I of the EU Birds Directive. The following birds were observed within or in the vicinity of the proposed development site:

- Green listed species (*i.e*. of low conservation concern): Blackbird *Tardus merula*, blackcap *Sylvia atricapilla*, blue tit *Cyanistes caeruleus*, buzzard *Buteo buteo*, coal tit *Periparus ater,* chaffinch *Fringilla coelebs*, chiffchaff *Phylloscopus collybita*, dunnock *Prunella modularis*, hooded crow *Corvus cornix*, , jackdaw *Corvus monedula*, , magpie *Pica pica*, pheasant *Phasianus colchicus,* robin *Erithacus rubecula,* rook *Corvus frugilegus*, song thrush *Turdus philomelos*, wood pigeon *Columba palumbus*, and wren *Troglodytes troglodytes*. Other species noted onsite but less frequently encountered included, bullfinch *Pyrrhula pyrrhula*, goldfinch *Carduelis carduelis, , and* lesser redpoll *Acanthis cabaret*.
- Amber list species (*i.e.* of medium conservation concern): house sparrow *Passer domesticus,* swallow *Hirundo rustica,* goldcrest *Regulus regulus*, linnet *Carduelis cannabina,* willow warbler *Phylloscopus trochilus,* short-eared owl *Asio flammeus* and starling *Sturnus vulgaris*
- Red list species (*i.e.* of high conservation concern): grey wagtail *Motacilla cinerea*

Grey wagtail are red-listed (*i.e.* of high conservation concern) due to declines in breeding populations. This species was recorded during multiple site visits near Toureen Lough and adjacent to the wetland area in the north western section of the proposed development site. Both male and female individuals were identified during the March wintering bird visit. Thirteen records of this species were identified within c. 2km of the site, with the most recent from 2011.

There are a number of habitats within the proposed development site that are suitable for breeding birds to nest in, including trees, barns, hedgerows and scrub. The proposed development site is likely to encompass and/or form part of the breeding territories of a number of bird species recorded during the surveys. Breeding behaviour of the majority of species was observed within the proposed development site, predominately along or close to hedgerows and the woodland areas within the site. Barn swallows were observed nesting in a barn in the north-eastern section of the proposed development site (*i.e.* building code: BB 5B), with three nests identified along the wooden rafters. A pair of buzzards were observed on numerous surveys throughout 2020 soaring and calling above the proposed development site. Whilst a nest was not identified, it is likely they are nesting nearby in the local area.

Whilst there were a number of farm buildings and barns within the site, there were no buildings suitable for barn owls, due to lack of potential nest places within the barns present *i.e.* a concave or level surface or cavity, that is elevated and well hidden[21]. No evidence of barn owls was identified within the proposed development site. A short-eared owl was identified during a bat survey carried out in 2019, flying over the east of the site.

Due to the presence of a potential breeding population of grey wagtail, a red-listed species, and lack of recent local records, grey wagtails are considered to be of county importance. The other breeding bird populations within the proposed development site are considered to be of local importance (higher value).

[21] Barn Owl Roosting and Nesting Places, The Barn Owl Trust (2015). Accessed here: https://www.barnowltrust.org.uk/how-to-manage-land-for-barn-owls/roosting-nesting-places/

Wintering Birds

The desk study records from the NBDC include 42 wintering waterfowl, gull and wader species. Including 10 species listed under Annex I of the Birds Directive within *c.* 2km of the proposed development site. These records are present in Appendix 7.2.

Table 7.8 below provides a summary of the findings of the winter bird surveys with respect to those species which are of highest conservation concern, and were recorded within winter bird survey sites:

- Special Conservation Interests (SCIs), for a wintering population, of nearby SPAs
- Species listed under Annex I of the Birds Directive (2008/144/EC)
- Red, Amber and Green BoCCI species listed for their wintering populations

Table 7.8 Details of wintering bird species found within the proposed development site

Common name/Latin name/BoCCI Code	Distribution in the study area	Peak count/Site/Date	Conservation Importance		
			BoCCI (Breeding)	Annex I	SCI
Black-headed gull *Chroicocephalus ridibundus* (BH)	Observed flying over site, did not land within site during three visits.	22 birds, flying high above the central area of the site and headed west, seventh visit	Amber (B/W)	-	✓
Coot *Fulica atra* (CO)	Observed on the wetland feature in the north of the site during one visit.	2 birds, on wetland/pond feature in the north, on first visit	Amber (B/W)	-	-
Common gull *Larus canus* (CM)	Observed circling c. 40m high above site during one visit. Did not land within site.	43 birds, in central area of site, on seventh visit.	Amber (B/W)	-	-
Gadwall *Mareca strepera (*GA)	Observed wading in wetland meadow adjacent to Toureen Lough during one visit , and on the wetland feature in the north during one visit.	2 birds, on Toureen Lough in October	Amber (B/W)	-	✓
Grey heron *Ardea cinereal* (H.)	Observed in the bank of Toureen Lough, during one visit.	1 bird, Toureen Lough, on fourth visit	Green (B/W)	-	-
Kestrel *Falco tinnunculus* (K.)	A female observed hunting high above the west of the site during sixth visit; one individual observed flying over north of the site during 3rd visit.	1 bird observed in the west adjacent to M18 Motorway, and 1 bird observed in the north.	Red (B)	-	-
Lesser black-backed gull *Larus fuscus* (LB)	Observed flying above the site in the west during second visit, did not land.	1 bird observed in the west in October	Amber (B)	-	-

Common name/Latin name/BoCCI Code	Distribution in the study area	Peak count/Site/Date	Conservation Importance		
			BoCCI (Breeding)	Annex I	SCI
Little egret *Gallinula chloropus (ET)*	Observed on banks of Toureen Lough during second visit.	1 bird observed in Toureen Lough in October.	Green (B/W)	✓	-
Snipe *Gallinago gallinago* (SN)	2 birds observed during fourth visit wading in attenuation pond in the west; 1 bird observed in attenuation pond during fifth visit; one bird observed in meadow adjacent to Toureen Lough and wading in attenuation pond during sixth visit.	2 birds in attenuation pond in December visit.	Red (B/W)	-	-
Teal *Anas crecca* (T.)	Observed on the wetland/pond feature in the north of the site during three visits.	10 birds, on the wetland feature in the north, on third visit in November	Amber (B/W)	-	✓
Tufted duck *Aythya fuligula* (TU)	Observed on wetland/pond feature in the north during second visit.	1 bird, on wetland/pond feature in the north, in Octobers visit.	Amber (B/W)	-	-
Mallard *Anas platyrhynchos* (MA)	Observed on Toureen Lough during three visits, on the wetland feature in the east during one visit and on the wetland feature in the north during one visit	2 birds, on Toureen Lough, and on feature in the north.	Amber (B/W)	-	✓

During wintering bird surveys carried out between September 2020 and March 2021, five SCI species from nearby European sites were identified within the lands; coot, mallard, gadwall, and teal being SCI species of Ballyallia Lough SPA c. 2.7km north west of the site, and black-headed gull and teal, SCI species for the River Shannon and River Fergus Estuaries SPA, located c. 5.1km south west of the site, and teal also being an SCI species for the River Shannon and River Fergus Estuaries SPA and Corofin Wetlands SPA, c. 10.7km north west of the site. Suitable habitat for these species was identified within the proposed development, and included; Toureen Lough, the M18 Motorway Attenuation Pond, the wetland habitats in the east of the lands (small section of this habitat within the red line boundary), and the wetland features in the north west. The lands provide some areas of suitable foraging habitat (e.g. open amenity, arable and improved agricultural grassland), for specific wintering birds such as geese and swans. However, these suitable habitats, while they are present on site, are grazed, mostly located in hilly areas giving limited sight lines, and therefore would have limited suitability for these species. There is ample habitat however for waterfowl and some wader species within the wetland habitats found in

the proposed development site. The habitats offer suitable foraging habitat and shelter for smaller overwintering species such as passerine species fieldfare *Turdus pilaris* and redwing *Turdus iliacus*, green-listed species which were both recorded during the wintering bird surveys carried out in October and November 2020. Peak numbers of 40 for redwing and 30 for fieldfare were observed, with both species identified in the north west of the site moving along the hedgerows. Grey wagtail was also identified during three visits, in the attenuation pond in the west, and feeding on cattle adjacent to the farm buildings in the south (BB 4A), farm buildings in the north (BB 6A), with a peak count of two individuals. Grey wagtail is a red-listed species (*i.e.* of high conservation concern)

The proposed development is within the normal foraging range of SCI species of the River Shannon and River Fergus Estuaries SPA, Ballyallia Lough SPA, the Slieve Aughty SPA, and the Corofin Wetlands SPA. The lands provide limited areas of suitable foraging habitat (*e.g.* open amenity grassland) due to the largely agricultural habitats on site, for specific wintering birds such as geese and swans. There is ample habitat however for waterfowl and some wader species within the wetland habitats found in the proposed development site.

The habitats offer suitable foraging habitat and shelter for smaller overwintering species such as passerine species fieldfare and redwing, which were both recorded during the wintering bird surveys carried out between September 2020 and March 2021.

Considering the above, the local populations of wintering birds (excluding SCI species), are considered to be of local importance (higher value). The SCI bird species populations are considered to be of international importance.

Hen harrier

The desktop search returned records for hen harrier and merlin *Falco columbarius*, both Annex I species on the Bird Directive, within c. 2km of the proposed development. Whilst there is no suitable summer breeding and foraging habitat within the proposed development (*i.e.* heather moorland, open non-afforested habitats, and young forestry plantations[1314]), suitable habitat for wintering hen harrier was identified within the marsh/reed habitat in the east of the site (Ardnamurry Lough), beyond the red line boundary of the proposed development site. The site was deemed unsuitable for merlin, as they are typically associated with forestry plantations and moor and heathlands (Lusby et al., 2017)[22].

Dedicated surveys for hen harrier were carried out monthly between September 2020 and March 2021(optimum time for winter roost survey[23]), in this area of suitable roosting habitat. No hen harriers were recorded within or near the proposed development site during these surveys. The nearest European site for which both these species are designated is the Slieve Aughty Mountains SPA, located c. 4.5km north west of the proposed development site.

[22] Lusby, J., Corkery, I., McGuiness, S., Fernández-Bellon, D., Toal, L., & Norriss, D. et al. (2017*). Breeding ecology and habitat selection of Merlin Falco columbarius in forested landscapes. Bird Study*, *64*(4), 445-454.

[23] *Irish Hen Harrier Winter Survey, Survey Guide*. Found here http://www.ihhws.ie/

7.3.3.3 Reptiles

The Wildlife Acts provide protection to Ireland's only reptile species, common lizard, *Zootoca vivipara*

The NBDC data search did not return any records for common lizard within *c.* 2km of the proposed development site. No evidence or sightings of common lizards were noted during surveys on site, however suitable habitat for reptiles does exist within the site. The majority of the field boundaries are composed of dry stone walls, which provide ample basking opportunities for reptiles, adjacent to hedgerows and scrub habitat for cover from predators. Within the woodland areas of the site, mounds of limestone rock can be found in various places, this may provide areas of refuge below ground during colder periods.

Local reptile populations are considered to be of local importance (higher value).

7.3.3.4 Amphibians

The Wildlife Acts provide protection to Ireland's two amphibian species, common frog *Rana temporaria* and smooth newt *Lissotriton vulgaris*.

The NBDC data search returned three records of amphibians within *c.* 2km of the site, all of which were common frog (Appendix 7.2). No evidence of amphibians was found within the lands; however suitable breeding and foraging/resting habitat was identified within the wetland features of the site, including: Toureen Lough, the wetland/fen area in the east of the site, and the marsh/fen area in the northern section of the proposed development site. Drainage ditches that may contain stagnant water during and after periods of heavy rain may also provide suitable breeding habitat for amphibians.

Local amphibian populations are considered to be of local importance (higher value).

7.3.3.5 Bats

Bats, and their breeding and resting places, are protected under the Wildlife Acts. All bat species are also listed on Annex IV of the EU Habitats Directive (with the Lesser horseshoe bat also listed on Annex II) and are afforded strict protection under the Habitats Directive and the European Communities (Birds and Natural Habitats) Regulations, 2011. The NBDC database search returned records for the following bat species: lesser horseshoe bat *Rhinolophus hipposideros*, brown long-eared *Plecotus auritus*, Leisler's *Nyctalus leisleri*, common pipistrelle *Pipistrellus pipistrellus*, and soprano pipistrelle *Pipistrellus pygmaeus*.

The review of records held by Bat Conservation Ireland returned 125 records of bat roosts from within *c.* 10km of the proposed development site (Appendix 7.2). The closest bat roosts to the proposed development site were all lesser horseshoe bat, located *c.* 405m, *c.* 800m and *c.* 830m south of the proposed development site, respectively. The closest roost to the site for lesser horseshoe bat in Kilfelim, is a common pipistrelle and Leisler's bat roost. Six additional lesser horseshoe bat roosts lie within *c.* 2km of the proposed development site as well as one known Daubenton's bat roost located *c.* 2km south west of the proposed development site.

Bat survey details and results undertaken in 2020 is discussed below, bat surveys and results from 2018 can be found in Appendix 7.8. A summary of each of the survey types undertaken within the proposed development site is described below, followed

by a detailed description and evaluation of each of the species found within the proposed development site, with associated figures.

Building Inspection Surveys

All buildings within the lands were assessed externally for evidence of bats, with barns and shed also accessed internally and externally. Residential houses could not be accessed internally due to health and safety concerns associated with COVID-19. Summary results of each building surveyed, the suitability for roosting bats, and any evidence of bats identified can be found below in table 7.9 and in Appendix 7.4. A more detailed analysis for each species is described below in relation to building surveys.

Table 7.9 *Description of buildings within the proposed development site*

Building ID no.	Roost	Rating	Details of building and surrounding habitat
BB 1A	Yes	Low	Cattle shed with concrete block and corrugated metal walls and corrugated metal roof. Open on side of shed. Surrounding landscape - pasture fields to the north, east and west, and treelines to the south.
BB 1B	No	Low	Adjacent to 1A. Concrete external walls with corrugated roof. Not accessible inside due to safety concerns. Creamery machinery within. Same surroundings as 1A
BB 2	Yes	Moderate	Large residential house, brick walls with rendering, slate roof, two stories. Surrounded by treelines and hedgerows, and Torreen Lough closeby. Most likely more features present near roof but due to height of house difficult to assess fully.
BB 3	Yes	High	Residential house, bungalow, slate roof with concrete walls.
BB 4A	No	Low	Corrugated cow shed with part concrete walls, and wooden beams within. Pasture fields bordered by hedgerows/treelines. Adjacent to meadow with Tooreen Lough
BB 4B	No	Low	Stone/Stipling walls with corrugated roof, cow shed. Adjacent to 4A
BB 4C	No	Negligible	Tall barn building, very open with wooden beams, no walls on two sides, very exposed. Corrugated roof and sides
BB 4D	No	Low	Small building with stone walls, partly collapsed roof on one side and very open, small room at end with some potential
BB 5A	Yes	Moderate	Brick house with flat slated roof. Wooden sheds in garden, treelines and hedgerows adjacent to house, surrounding habitat pasture field
BB 5B	Yes	Low	Wood shed close to BB 5A, exposed on two sides, concrete block walls and corrugated metal roof. Wooden beams inside. Thick ivy on western end of shed. Surrounded by pasture fields, very exposed. Swallows nesting in here
BB 6A, 6B, 6C	No	Low	Three cattle barn sheds, all with corrugated steel roofs and concrete block walls. Very exposed buildings, mostly open with very little features. Suitable for foraging but little roosting features, any present would only house small numbers of bats. Hedgerows and treelines nearby, with pasture fields surrounding.
BB 7	No	Moderate	Residential unoccupied house. Very run down, concrete walls with slate roof. Dense ivy at northern gable end where stone shed used to be. Well connected to hedgerows and treelines nearby.
BB 8	Yes	Moderate	Modern residential building, stone walls with flat slated roof. Garage building behind house. Hedgerow surrounding building (*Leylandii* spp.), and main road along southern boundary.
BB 9	Yes	Moderate	Modern residential building, with stone walls and flat roof slates. Large slated shed/building (Edward casey kitchens

Building ID no.	Roost	Rating	Details of building and surrounding habitat
			workshop) beside house. Hedgerows and treelines along boundary, road along southern boundary.

Summary of Roost Emergence/Re-entry Activity Surveys

The details of emergence and re-entry surveys can be found in Appendix 7.5.

In summary, during these surveys 19 roosts were identified across 16 buildings located within the proposed development site. Full details of these roosts are provided in Table 7.10 and their locations are presented in Figure 7.10.

Table 7.10 *Summary of roosts recorded within the proposed development site (see Figure 7.10 for location of buildings)*

Building Code	Description of building	Species roosting	Number roosting and total roosts	Description of roost (s)
BB 1A	Cattle shed with corrugated iron roofing.	Soprano pipistrelle	One individual bat emerging from one roost.	Bat seen emerging from underneath corrugated metal sheeting.
BB 2	Residential house	Soprano pipistrelle	Four roosts with max 2 individuals in each.	Four roosts mainly located on the roof of building.
BB 3	Residential house	Soprano pipistrelle	Five roosts, with 30 individuals from one, nine from another and one to two from remaining.	Mainly located near chimney and under lead flashing. Also above porch.
BB 5A	Residential house	Soprano pipistrelle and common pipistrelle	Four roosts with max two bats in each	Located across the house, two under roof flashing, and under slates.
BB 5B	Wood shed	Brown long-eared	One roost with two individual bats	Observed emerging from dense ivy growing within shed.
BB 8	Residential house	Soprano pipistrelle	Three roosts, one with 13 bats, other two with one to two individual bats	One roost on the garage, and two within house by conservatory.
BB 9	Residential house	Soprano pipistrelle	One roost with max eight individuals.	Emerged above porch.

The majority of roosts recorded within the proposed development site were small, single pipistrelle roosts, likely to be either male and/or night roosts. Two potential soprano pipistrelle maternity colonies were identified at BB 3 and BB 8, with 30 and 13 individual bats observed emerging and/or re-entering the roosts during the surveys. All of the barns were considered to be of low potential, and this was evident from the results of the activity surveys (*i.e.* the lack of roosts identified in all except one). One barn (BB 1A) had one soprano pipistrelle re-entry, and another barn (BB 5B) was found to be a brown long-eared roost, with two individuals observed on the walls and rafters within the barn, and warming up before leaving the barn for foraging. All of the occupied residential houses within proposed development site had at least one roost, and BB 3 contained the highest number of roosts and bats recorded across the proposed development site.

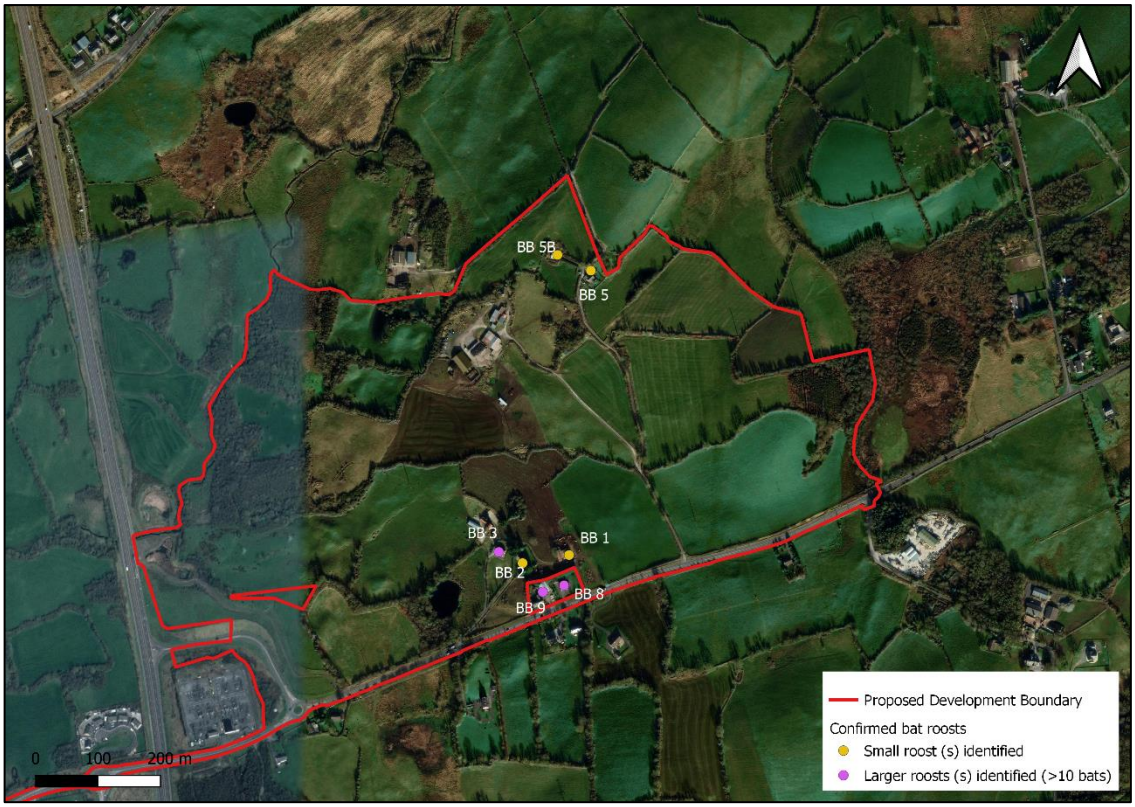

Figure 7.10 *Location of roost buildings within the proposed development site*

Summary of Transect Surveys

A range of bat survey types were carried out in 2018 and 2020, in order to determine what bat species were using the proposed development site and to establish the level of importance of the proposed development site for local bat species.

Bats recorded during these surveys were associated with the hedgerows and treelines, along field boundaries, foraging and/or commuting within the proposed development site. Specific areas had higher rates of activity as based on the total number of calls across all three transects for each species and diversity of bat species recorded. These areas included:

- Toureen Laneway, a double hedgerow track lined with mature trees, within the south-eastern section of the site (176 total number of calls recorded, 5 species);
- Toureen Lough in the south-western section of the site adjacent to R352, and the lands immediately around it (70 total number of calls recorded, four species);
- The woodland in the north-western section of the site, specifically the edges along treelines/hedgerows (186 total number of calls recorded, 5 species); and
- The hedgerows coming off Toureen Laneway, towards the eastern section of the site (60 total number of calls recorded, 4 species).

Areas that were walked but exhibited lower levels of activity included:

- Along the southern most boundary of the site, parallel to R352;
- The south western corner, south of the attenuation pond;
- North of BB 6A, 6B and 6C (Figure 7.4) along the northern boundary; and
- In the north eastern corner along the boundary with riparian woodland.

The most commonly recorded species across all three transect survey visits was soprano pipistrelle bat, followed by common pipistrelle, Leisler's bat, brown long-eared bat, *Myotis* spp., and lesser horseshoe bat.

Full details of these 2020 surveys are provided in Appendix 7.8 and the locations of the transect routes are presented in Figure 7.2. A summary for each species is provided below.

Surveys undertaken in 2018, had largely similar results to those in 2020, with the addition of a single lesser horseshoe bat call identified during the second visit in 2020 (Appendix 7.6, Figure 7.11). Brown long-eared bat was also identified during the 2020 transect surveys, whilst no calls were recorded for this species during the 2018 surveys. Three surveys were undertaken in 2020 however, including an all night survey, with just two dusk transects completed in 2018. Bat activity levels were similarly high in both years in the areas listed above.

Automated Static Detectors

In total, six bat species were recorded on automated static bat detectors deployed within the survey area, including: Leisler's bat, common pipistrelle bat, soprano pipistrelle bat, brown long-eared bat, lesser horseshoe bat and unidentified *Myotis* bats. Unidentified Pipistrelle bats were also identified[24].

Full details of the static detector results are provided in Table 7.11 and the locations of the transect routes are presented in Figure 7.2.

Table 7.11 *Results of bat activity surveys per location using automated static bat detectors*

Location	Habitat description	Deployment dates	Number of nights recorded	Species recorded [25] (overall total number of calls and average number of calls per night)
1	Automated detector placed within a hawthorn hedgerow located directly east of woodland area.	6th July 2020 – 28th July 2020	7	Lesser horseshoe bat (138) (19.71) Common pipistrelle (12) (1.71) *Myotis* sp. (52) (7.43) Soprano pipistrelle (11) (1.58) Leisler's bat (1) (0.14)
2	Automated detector placed within a hawthorn hedgerow south of woodland area,	6th July 2020 – 28th July 2020	16	Soprano pipistrelle (753) (47.06) Pipistrelle sp. (336) (21)

[24] In some instances, it can be difficult to differentiate between calls of both pipistrelle species, where their peak frequency approaches 50kHz, and in this instance we have assigned the generic category *Pipistrellus* species. Calls of this type have been incorporated into soprano and common pipistrelle results.

[25] The number of bat calls is provided beside each species in brackets. To note, this does not necessarily correspond to the exact number of bats using the lands; however, it does provide an indication of usage by a particular bat species at that location

Location	Habitat description	Deployment dates	Number of nights recorded	Species recorded [25] (overall total number of calls and average number of calls per night)
	within the west of the subject lands.			Common pipistrelle (39) (2.44) *Myotis* sp. (20) (1.25) Lesser horseshoe bat (2) (0.13) Leisler's bat (2) (0.13)
3	Automated detector was deployed west of Toureen Laneway attached to a hawthorn tree on lower field boundary	6th July 2020 – 28th July 2020	2	Common pipistrelle (5) Soprano pipistrelle (2) Brown long-eared (1)
		21st September 2020 – 20th October 2020	12	Common pipistrelle (426) (35.5) Soprano pipistrelle (210) (17.5) *Myotis* sp. (2) (0.17) Lesser horseshoe bat (1) (0.08)
4	Automated detector was deployed on an ash tree along Toureen Laneway	6th July 2020 – 28th July 2020	14	Soprano pipistrelle (1,146) (81.86) Common pipistrelle (858) (61.29) *Pipistrellus* sp. (335) (23.93) Leisler's bat (221) (15.79) Brown long-eared (96) (6.86) *Myotis* sp. (65) (4.64)
5	Automated detector deployed on oak tree on the edge of scrub habitat in the east of the site.	6th July 2020 – 28th July 2020	18	Soprano pipistrelle (1,399) (77.11) Lesser horseshoe bat (409) (22.72) Common pipistrelle (178) (9.89) *Pipistrellus* sp. (93) (5.17) *Myotis* sp. (77) (4.28) Leisler's bat (8) (0.44) Brown long-eared (6) (0.33)
6	Detector was deployed within a hawthorn hedgerow north of barn buildings in the south of the site.	7th July 2020 – 28th July 2020	20	Soprano pipistrelle (610) (30.5) Common pipistrelle (337) (16.85) Leisler's bat (65) (3.25) Brown long-eared (29) (1.45) *Myotis* sp. (20) (1) *Pipistrellus* sp. (17) (0.85) Lesser horseshoe bat (15) (0.75)

Location	Habitat description	Deployment dates	Number of nights recorded	Species recorded [25] (overall total number of calls and average number of calls per night)
7	Automated detector was deployed within a hedgerow along a field boundary adjacent to Toureen Laneway, in the north of the site.	7th July 2020 – 27th July 2020	4	Soprano pipistrelle (12) Common pipistrelle (3) Ble (1)
		21st September 2020 – 20th October 2020	8	Lesser horseshoe bat (101) (12.63) *Pipistrellus* sp. (51) (6.38) *Myotis* sp. (22) (2.75) Leisler's bat (18) (2.25) Soprano pipistrelle (15) (1.88) Common pipistrelle (14) (1.75) Ble (3) (0.38)
8	Automated detector was placed within hedgerow/Treeline adjacent to Toureen Lough	28th July 2020 – 17th August 2020	4	Soprano pipistrelle (1726) (431.5) *Pipistrellus* sp. (264) (66) Common pipistrelle (25) (6.25) Leisler's bat (21) (5.25) *Myotis* sp. (8) (2) Ble (3) (0.75) Lesser horseshoe bat (2) (0.5)
9	Automated detector was placed within hedgerow adjacent to attenuation pond in the west of the site.	28th July 2020 – 27th July 2020	20	Lesser horseshoe bat (36) (1.8) *Myotis* sp. (7) (0.35) Leisler's bat (2) (0.1) Ble (2) (0.1)
10	Automated detector was placed on a hawthorn tree behind the barn buildings in the north of the site.	30th July 2020 – 18th August 2020	16	Soprano pipistrelle (3,431) (214.44) Common pipistrelle (1,279) (79.94) *Pipistrellus* sp. (812) (50.75) Leisler's bat (244) (15.25) Lesser horseshoe bat (42) (2.63) Brown long-eared (36) (2.25) *Myotis* sp. (30) (1.88)

Location	Habitat description	Deployment dates	Number of nights recorded	Species recorded [25] (overall total number of calls and average number of calls per night)
11	Automated detector was deployed on a blackthorn tree in the very north east boundary corner of the site.	21st September 2020 – 20th October 2020	8	Common pipistrelle (1,440) (180) Soprano pipistrelle (1,215) (151.88) *Pipistrellus* sp. (246) (30.75) Leisler's bat (107) (13.38) Brown long-eared (23) (2.88) Lesser horseshoe bat (8) (1) *Myotis* sp. (7) (0.88)
12	Automated detector was deployed on a hazel tree within a hedgerow in the north eastern boundary of the site.	21st September 2020 – 20th October 2020	18	Soprano pipistrelle (1,135) (63.05) Common pipistrelle (321) (17.83) Ble (87) (4.83) Leisler's bat (66) (3.67) *Pipistrellus* sp. (31) (1.72) Lesser horseshoe bat (28) (1.56) Myotis sp. (13) (0.72)
13	Automated detector was deployed on the eastern boundary within a hedgerow adjacent to riparian woodland.	21st September 2020 – 20th October 2020	9	Soprano pipistrelle (181) (20.11) *Myotis* sp. (77) (8.56) Common pipistrelle (59) (6.56) Lesser horseshoe bat (34) (3.78) Ble (16) (1.78) Leisler's bat (3) (0.33) *Pipistrellus* sp. (1) (0.11)
14	Automated detector was deployed on a hazel tree in the north west adjacent to the woodland and fen areas.	28th July – 18th August 2020	22	Common pipistrelle (562) (25.55) Soprano pipistrelle (422) (19.18) Leisler's bat (155) (7.05) Lesser horseshoe bat (29) (1.32) Brown long-eared (25) (1.14) *Pipistrellus* sp. (5) (0.23) *Myotis* sp. (2) (0.09)

Location	Habitat description	Deployment dates	Number of nights recorded	Species recorded [25] (overall total number of calls and average number of calls per night)
15	Automated detector was deployed in the south eastern corner adjacent to marsh and wet grassland habitats	18th August – 21st September 2020	7	Soprano pipistrelle (755) (107.86) Common pipistrelle (422) (60.29) *Myotis* sp. (68) (9.71) Brown long-eared (12) (1.71) Leisler's bat (2) (0.29) *Pipistrellus* sp. (2) (0.29) Lesser horseshoe bat (2) (0.29)

Evaluation per bat species

Lesser horseshoe bat

Transect surveys

One lesser horseshoe bat call was recorded during the second transect survey in July 2020, in the south of the proposed development site. No other calls of this species were identified during these surveys. This species was not identified during transect surveys in 2018.

Static detector surveys

Lesser horseshoe bat calls were identified on 14 out of 15 of the deployed static detectors, with varying degrees of activity. Highest numbers of calls per night were recorded in the east at the boundary of scrub/woodland habitat, in the west along a hedgerow bordering the woodland area, and along a hedgerow adjacent to Toureen Laneway, all of which are bordered by pasture fields. This is the ideal habitat for lesser horseshoe bat, and is considered to be important for commuting and foraging for this species within the proposed development site, as is the case for all other bat species identified within the proposed development site. Full details of the number of calls per night and number of nights static bat detectors were deployed are presented in Table 7.11, and in Figure 7.11 and Figure 7.12 below.

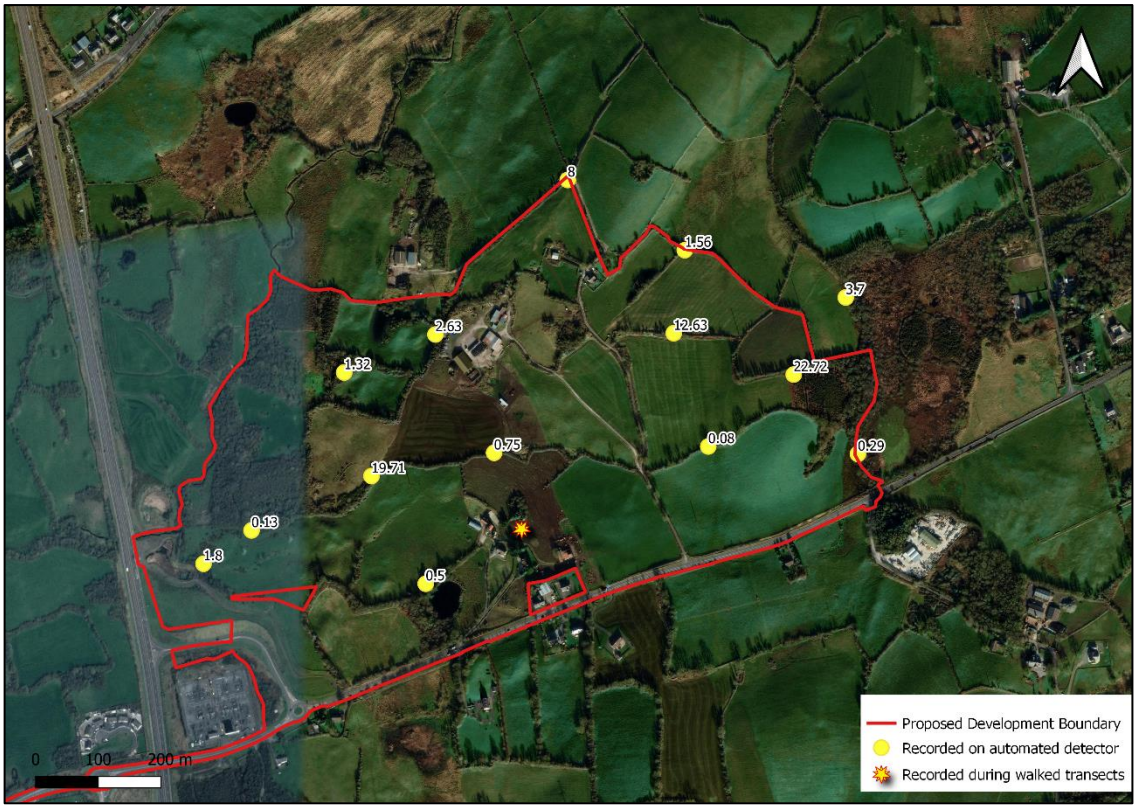

Figure 7.11 *Location of lesser horseshoe bat calls recorded during both walked transects and automated static bat detector deployment, along with the average number of lesser horseshoe bat calls recorded per night during the static deployment only*

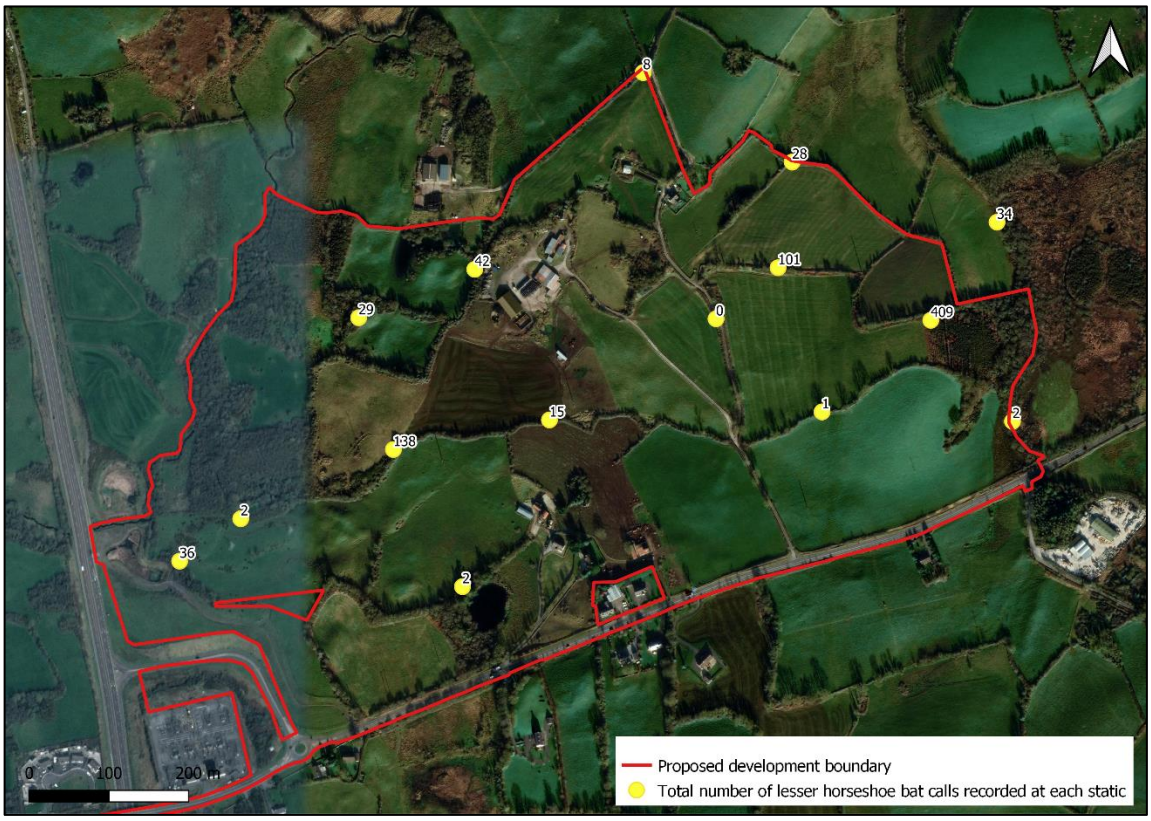

Figure 7.12 *Total number of lesser horseshoe bat calls recorded at each static*

Roost emergence/re-entry activity surveys

Lesser horseshoe bat was not recording during any of the post-emergence/re-entry surveys undertaken at the buildings within the proposed development site, and as such no roosts were recorded of this species within the proposed development boundary. Lesser horseshoe bat are restricted in terms of their choice of roosting site, as they cannot land on walls and crawl in and instead they must fly through an opening large enough to accommodate it's wingspan (Kelleher, 2006)[26]. As a result, lesser horseshoe bats are typically cave-dwelling species, however in Ireland, this species will also use buildings for their summer roosts, and caves for hibernation roosts[27]. Old stone buildings with slate roofs are ideal roosting sites as they usually offer a warm area near the apex of the roof in which to rear young. There are no caves or suitable roost buildings located within or near the proposed development site, with the closest cave in Ballyallia, located *c.* 2.8km north west of the site, and the nearest known roost located *c.* 405m south of the proposed development site[28].

Evaluation

Overall, activity levels of lesser horseshoe bat were considered to be moderate in relation to other bat species activity across the proposed development site. The hedgerows and treelines bordered by pasture grassland located within the eastern section of the site, were the most frequented by this species with the highest levels of activity experienced here. Areas located close to the woodland also had a high number of calls per night. The results from surveys carried out in 2018 by Scott Cawley Ltd., were similar to the results of the 2020 surveys[29]. The results from the other areas within the site are very similar to the 2020 survey results, with hedgerows near the woodland having the highest number of calls per night of lesser horseshoe bat during both seasons of surveys.

Unlike other species, lesser horseshoe bats do not have a wide distribution throughout the country with its core area restricted to six western counties (*i.e.* Clare, Cork, Galway, Kerry, Limerick and Mayo) and it has the smallest predicted core area of any other species (Roche *et al.*, 2014).

Lesser horseshoe bat are known to forage a few kilometres from the roost, relying on linear landscape features to commute to and from these roosts, and avoiding flying out in the open (Roche *et al.*, 2014). As evident from the results of the desk study, numerous small lesser horseshoe roosts exist in the vicinity of the subject lands and it is likely that they use the subject lands for foraging or the linear vegetation features for commuting to and from their roosts. Nearby European site designated for lesser horseshoe bats include Old Domestic Buildings (Keevagh) SAC, located *c.* 4.3km away, Dromore Woods and Loughs SAC, located c. 4.2km north east, and Old Domestic Buildings, Rylane SAC, located c. 5.9km east, it is possible individual bats foraging within the proposed development site are connected with these SAC populations.

[26] Kelleher, C. (2006). *Summer Roost Preferences of Lesser Horseshoe bat Rhinolophus hipposideros in Ireland.* The Irish Naturalists' Journal, Vol. 18, No.6, pp. 229-231.

[27] McAney, K. (2014) *An overview of Rhinolophus hipposideros in Ireland (1994–2014)* Vespertilio 17: 115–125, 2014

[28] University of Bristol Speleological Society – Irish caves locations. Available from http://www.ubss.org.uk

[29] The proposed development boundary has been extended slightly eastwards in 2020, and therefore the eastern most area of the site had not been surveyed previously in 2018.

Given the small range of the species, the quantity and proximity of confirmed lesser horseshoe bat roosts around the site as well as the species' sensitivity to habitat change and removal of linear vegetation features, and the potential connection of populations of lesser horseshoe bats to a number of European sites designated for this species, the local population of lesser horseshoe bat have been classified as being of international importance.

Soprano Pipistrelle Bat

Transect Surveys

Full details from each transect survey are provided above in Appendix 7.6 and locations of each of the recorded soprano pipistrelle calls are shown on Figure 7.13-7.14. Soprano pipistrelle was the most commonly occurring species recorded during all three transect visits during surveys undertaken in July and August 2020. This was also the case in surveys carried out in 2018. This species was identified across the site with a high number of associated calls. Area of high activity were: along Toureen Laneway, which traverses the site from the R352 in the south to the north; along the hedgerows associated with this laneway; at Toureen Lough and the farm buildings adjacent to this; and, the woodland in the north west. Lower levels of activity associated with this species were identified: along the southern boundary; parallel to the R352; and also along the north eastern boundary of the site. The levels of activity recorded and the corresponding areas, were both very similar to the results of the 2018 surveys, with the highest number of soprano pipistrelle calls within the proposed development boundary recorded at Toureen Lough, Toureen Laneway, and the woodland. Activity levels were recorded along well-established hedgerows and treelines, and linear features, which provide suitable commuting and/or foraging routes for bats to the wider environment beyond the proposed development site.

Static Detector Surveys

Soprano pipistrelle calls were identified on 14 of the 15 static detectors deployed in 2020. In 2018 static detector deployments, this species was recorded on all 14 detectors deployed. The level of activity recorded on these statics was generally high, as was the case during transect surveys. The highest number of calls recorded per night and the highest total number of calls recorded, were both at Toureen Lough. Very high levels of activity were also recorded at: the woodland in the north west; Toureen Laneway; the marsh area adjacent to barn buildings (BB 6) in north; and the scrub habitat and hedgerows adjacent in the east. These results were similar to the results of the 2018 surveys, with very similar levels of activity recorded at all static deployment locations (or closest location or detector). Full details of the number of calls per night and number of nights static bat detectors were deployed are presented in Table 7.11, and in Figure 7.13 and 7.14 below.