HYDROLOGICAL & HYDROGEOLOGICAL QUALITATIVE RISK ASSESSMENT

for

PROPOSED STRATEGIC HOUSING DEVELOPMENT at BOHERBOY, SAGGART CO. DUBLIN

Technical Report Prepared For

Kelland Homes
&
Durkan Estates Ireland Ltd.

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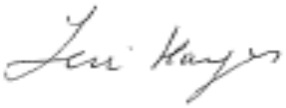
Signature		
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1.0 INTRODUCTION

1.1 Background

AWN have been requested by Kelland Homes and Durkan Estates Ireland, to carry out a Hydrological and Hydrogeological Qualitative Risk Assessment for a Strategic Housing Development at a site at Boherboy, Saggart, Co. Dublin.

To the immediate north of the site is the Carrigmore residential estate, to the west are agricultural lands and a single dwelling, to the east is the Corbally residential estate while to the south is the Boherboy Road. The proposed application represents the development of the entire Boherboy Neighbourhood as identified within the Fortunestown Local Area Plan (2012).

The development will consist of 655 no. dwellings, comprised of 257 no. 2, 3 & 4 bed, 2 & 3 storey detached, semi-detached & terraced houses, 152 no. 1, 2 & 3 bed duplex units in 12 no. 2 & 3 storey blocks, and 246 no. 1, 2 & 3 bed apartments in 9 no. buildings ranging in height from 2, 3-5, 4-5 and 5 storeys, and a 2 storey crèche (693m^2). Access to the development will by via one no. vehicular access point from the Boherboy Road, along with proposed upgrade works to Boherboy Road to include the provision of a roadside footpath along the front of the site at the Boherboy Road, continuing eastwards to the junction with the N81 Blessington Road (for an overall distance of c.370m). The proposed development also provides for pedestrian and cyclist connectivity to the adjoining District Park to the north-east, and vehicular connections to adjoining developments at Corbally Heath to the east and Carrigmore Green to the north.

The proposed development includes for all associated site development works, public open spaces, including alongside the Corbally Stream, which will accommodate the provision of pedestrian / cyclist links to the District Park to the north-east, hard and soft landscaping, undercroft & surface car parking, bicycle parking, bin storage, public lighting, ESB sub-stations. Surface water will be attenuated within the site, with outfall to existing watercourses, with foul sewer connected to a proposed new pumping station located at the northern end of the site, on an overall application site area of 18.3ha. In accordance with the Fortunestown Local Area Plan (2012) an area of approx. 1.44ha is reserved for a school site.

1.2 Hydrological Setting

The site area is currently greenfield with some remaining farm sheds/outbuildings. The existing ground topography forms a natural catchment with approximately 75% of the site draining towards the North-West and the remainder draining towards the North-East of the lands. The site drains to existing natural watercourses either side of the site. Refer to site location and local drainage in Figures 1.1 and 1.2 below.

Note: The Cooldown Stream is represented with a dashed line as it is an inactive stream

Figure 1.1 *Site Location in relation to local drainage*

Note: The Cooldown Stream is represented with a dashed line as it is an inactive stream

Figure 1.2 *Site Location in relation to local drainage (local scale)*

The nearest surface water receptors are located within the site and also in its immediate vicinity (along its northern, eastern and western boundaries). The Corbally Stream flows along the eastern and northern site boundaries. This stream outfalls into the Camac River c. 2.1Km to the north of the site. The Coldwater Stream begins and flows along the western site boundary and joins the Corbally Stream at the northwestern corner of the site. The Cooldown Stream begins and crosses through the site and also outfalls into the Corbally Stream at the northern boundary of the site (refer to Figure 1.2 above).

The Cooldown Stream is usually a dry ditch which divides the site and it is believed that is a man-made stream. It is an inactive stream which activates only when a heavy rainfall occurs. There are number of French drains within the site which drain into the Cooldown Stream. The run-off/infiltration into these drains discharges into the stream only in its northern third. The remaining portion of the stream generally remains dry.

The Camac River discharges to the River Liffey c. 12Km to the northeast of the site which finally outfalls into the South Dublin Bay SPA/SAC/pNHA which is c. 18km to the east of the site. Therefore, there is a hydrological link between the development site and this European Site. However, there is a signficant distance from any potential sources from the site to the European site receptor.

The EPA (2021) on-line database indicates there is no national protected areas in the immediate vicinity of the proposed development site. The nearest protected areas are the Lugmore Glen pNHA which is c. 1.5Km to the southeast of the site and the Glenasmole Valley SAC/pNHA located c. 4.3Km to the southeast of the site. There are no hydrological pathways between the site and these areas; therefore, there is no potential for impact on the water environment at these receptors.

1.3 Objective of Report

The scope of this desktop review is to assess the potential for any likely significant impacts on receiving waters and protected areas during construction or post-development, in the absence of taking account of any measures intended to avoid or reduce harmful effects of the proposed project (i.e. mitigation measures).

In particular, this review considers the likely impact of construction and operation impacts (construction run-off and domestic sewage) from the proposed development on water quality and overall water body status within the Corbally Stream, Camac River and ultimately Dublin Bay. The assessment relies on information regarding construction and design provided by Durkan Group as follows:

- Drainage and Water Infrastructure Engineering Report for a Residential Development at Boherboy, Saggart, Co. Dublin; Roger Mullarkey and Associates, August 2020.
- Report on Site-Specific Flood Risk Assessment. Residential Development, Boherboy, Saggart, Co. Dublin. Kilgallen & Partners Consulting Engineers. September 2020.
- Boherboy Saggart – Ground Investigation Report. Ground Investigations Ireland. February 2014.

This report was prepared by Marcelo Allende (BEng), and Teri Hayes (BSc MSc PGeol EurGeol). Marcelo is a Water Resources Engineer with over 15 years of experience in environmental consultancy and water resources studies. Marcelo is an Environmental Consultant with AWN Consulting, a member of the International

Association of Hydrogeologists (Irish Group) and a member of Engineers Ireland (MIEI). Teri is a hydrogeologist with over 25 years of experience in water resource management and impact assessment. She has a Masters in Hydrogeology and is a former President of the Irish Group of the Association of Hydrogeologists (IAH) and has provided advisory services on water related environmental and planning issues to both public and private sector bodies. She is qualified as a competent person as recognised by the EPA in relation to contaminated land assessment (IGI Register of competent persons www.igi.ie). Her specialist area of expertise is water resource management eco-hydrogeology, hydrological assessment and environmental impact assessment.

1.4 Description of Drainage

The nearest surface water receptors lie within the proposed development site and also in its immediate vicinity (along its northern, eastern and western boundaries, refer Figure 1.2 above). These are identified as follows:

- Corbally [Brownsbarn] Stream (EPA code: 09C10) which flows along the eastern and the northern site boundaries. This stream flows towards the north where it joins the Camac River c. 2.1Km from the site. The Camac River outfalls into the Liffey River at Kilmainham.

- Coldwater Stream (EPA code: 09C62) which flows along the western boundary of the site. This stream site joins the Corbally Stream at the north-western corner of the site.

- Cooldown Stream (EPA code: 09C60) which is an inactive stream that drains the site only in the event of heavy rains and flows through the centre of the site and also outfalls into the Corbally Stream at the northern boundary of the site.

With regard to the development site, there are number of French drains within the site which drain into the Cooldown Stream in its northern third. There are no public drainage services or foul water sewer located on the subject lands.

It is proposed that stormwater from the site, following interception and attenuation Sustainable Drainage Systems (SuDS), will be discharged into the Corbally Stream along the eastern and northern boundary. The appropriate SuDS features included in this proposal include the following;

- Filter drains to the rear of the housing;
- Permeable paving to all private parking areas;
- Rainwater butts (200l) to the rear downpipes of the houses;
- Filter Swales adjacent to roadways where feasible;
- Grassed/Landscaped Detention basin;
- Silt-trap/catchpit manholes;
- Hydrobrake limiting dicharge flow to greenfield rates;
- Petrol interceptor upstream of all outfall points.

The surface water drainage infrastructure for the development will collect the rainfall on the site and convey the storm water run-off via roadside swales, tree pits, bio-retention area, rear garden filter drains, gullies, underground pipes, manholes, catchpit manholes and direct the flows via void arched attenuation systems towards vortex flow restricting devices (Hydrobrake or similar) and petrol interceptors before outfalling to the Corbally Stream.

The surface water drainage infrastructure for the proposed development has been separated into 10 no.drainage catchments. 4 no. of these catchments outfall attenuated flows into the Corbally Stream along the eastern boundary and the other 6 no.catchments indirectly along the northern boundary in two outfall locations to the same stream along the northern boundary. The attenuation system comprises 9 no. attenuation tanks which will serve the 10 no. drainage catchments.

The Cooldown Stream will be culverted as part of the proposed development and it will be used as part of the drainage network. This stream is usually dry and works as a ditch within the site.

Regarding the foul water, it is proposed to service the subject site by providing a new gravity foul sewer across the SDCC park to the SE of the site connecting into the existing SDCC/IW foul infrastructure in Verschoyle Green. Irish Water have confirmed the available capacity within their infrastructure (refer to the Drainage and Water Infrastructure Engineering report, Appendix 12.12). The lower level north end of the site incorporates a pumping station to drain the apartment Blocks A & C via a rising main into the outfalling gravity pipe mentioned above.

This foul sewer eventually discharges to the Ringsend Waste Water Treatment Plant (WWTP) where it is treated and ultimately discharges into South Dublin Bay. The WWTP operates under an EPA licence D0034-01.

According to the Flood Risk Assessment carried out by Kilgallen & Partners (2020), most of the site is located within Flood Zone C (i.e., where the probability of flooding from rivers is less than 0.1% or 1 in 1000 years – probability of fluvial flooding is low risk). However, elements of the proposed development at the northern boundary encroach on the flood risk zones.

The finished levels for buildings and roads in the proposed development provide an appropriate freeboard above the 1% AEP water level in accordance with the Flood Risk Management Guidelines. The proposed development was subject to and passed the Development Management Justification Test.

The proposed development will displace floodplain storage associated with the fluvial flood risk zones and in turn increase the floodplain upon completion of the proposed development in order to reduce the flood risk elsewhere. Site is not at risk from either pluvial or groundwater flooding.

2.0 ASSESSMENT OF BASELINE WATER QUALITY, RIVER FLOW AND WATER BODY STATUS

A reliable Conceptual Site Model (CSM) requires an understanding of the existing hydrological and hydrogeological setting. This is described below for the proposed development site and surrounding hydrological and hydrogeological environs.

2.1 Hydrological Catchment Description

The proposed development site lies within the Liffey and Dublin Bay Catchment (Hydrometric Area 09) and River Liffey sub-catchment (WFD name: Liffey_SC_090, Id 09_15) (EPA, 2021). WFD refers to the Water Framework Directive (Directive 2000/60/EC). The Corbally Stream (Figure 1.2) - a tributary of the Camac River – flows along the western and northern site boundary. From here the Corbally Stream 2.1Km in a northerly direction before converging with the Camac River which then flows northeast for a further ~10.7km before discharging into the Liffey Estuary upper transitional waterbody which in turn discharges into Dublin Bay coastal

waterbody which includes Special Area of Conservation (SAC)/proposed Natural Heritage Area (pNHA).

The EPA (2021) on-line mapping presents the available water quality status information for water bodies in Ireland. The Corbally Stream and the Camac River have a Water Framework Directive (WFD) status (2013-2018) of 'Moderate' and a WFD risk score of 'At risk of not achieving good status'. This moderate status is related to its biological status (invertebrate potential); all remaining chemical conditions have been classified as 'good' or 'high'. The most recent quality data in the Camac River (2019) also indicate that it is 'Slightly polluted'. The EPA does not collect water quality data for the Corbally Stream; however, it is likely to be in similar condition to the Camac.

The most recent surface water quality data for the Dublin Bay (2019-2021) indicate that they are 'Unpolluted'. Under the 2015 'Trophic Status Assessment Scheme' classification of the EPA, 'Unpolluted' means there have been no breaches of the EPA's threshold values for nutrient enrichment, accelerated plant growth, or disturbance of the level of dissolved oxygen normally present.

2.2 Aquifer Description and Superficial Deposits

Mapping from the Geological Society of Ireland (GSI, 2021 http://www.gsi.ie, accessed on 07-07-2021) indicates the bedrock underlying the site is part of the Pollaphuca Formation (code SLPLPH) which is made up of coarse greywacke & shale. The lithological description comprises coarse, graded greywackes, medium grey in colour, and dark grey shales, making up Bouma ae turbidite units. The northern portion of the site overlies the Lucan Formation (code CDLUCN) which is made up of dark limestone and shale (Calp). Refer to Figure 2.1 below.

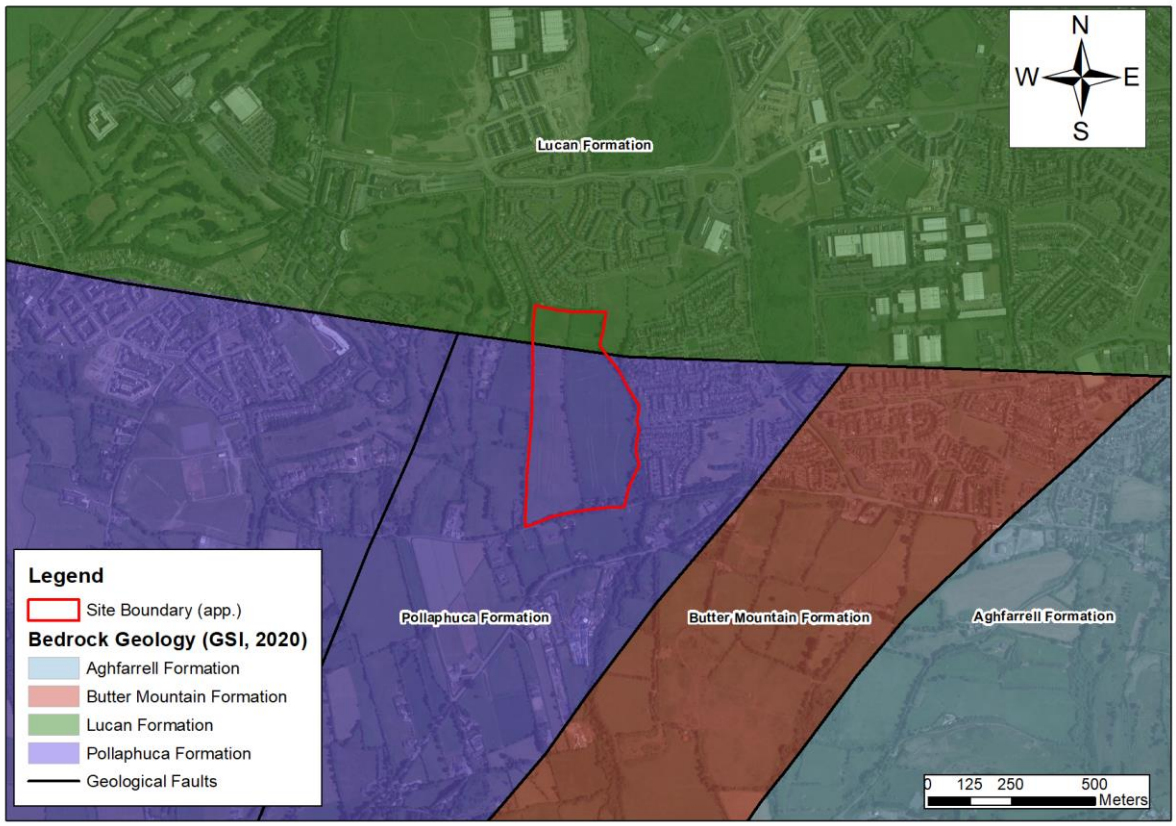

Figure 2.1 *Bedrock Geology map (Source: GSI, 2021)*

The GSI also classifies the principal aquifer types in Ireland as:

- Lk - Locally Important Aquifer - Karstified
- Ll - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive
- Pl - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
- Pu - Poor Aquifer - Bedrock which is Generally Unproductive
- Rkd - Regionally Important Aquifer (karstified diffuse)

Presently, from the GSI (2021) National Bedrock Aquifer Map, the GSI classifies the bedrock aquifer within the Pollaphuca Formation beneath the subject site as a *'Poor Aquifer – Bedrock which is Generally Unproductive except for Local Zones.* The bedrock aquifer within the Lucan Formation is classified by the GSI as '*Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones*'.

The proposed development is within the '*Kilcullen*' groundwater body (Pollaphuca Formation) and the '*Dublin*' groundwater body which are classified as '*Poorly productive bedrock*'. The most recent WFD groundwater status for both water bodies (2013-2018) is '*Good*' with a current WFD risk score of '*Not at risk*' for the '*Kilcullen*' and under review for the '*Dublin*' groundwater body.

Aquifer vulnerability is a term used to represent the intrinsic geological and hydrological characteristics that determine the ease with which groundwater may be contaminated generally by human activities. The GSI (2021) guidance presently classifies the bedrock aquifer vulnerability in the region of the subject site as '*Low*' to 'Moderate' which indicates a general overburden depth potential of >5m. This shows that the aquifer is naturally protected by low permeability glacial clays. The aquifer vulnerability class in the region of the site is presented as Insert 2.1 below.

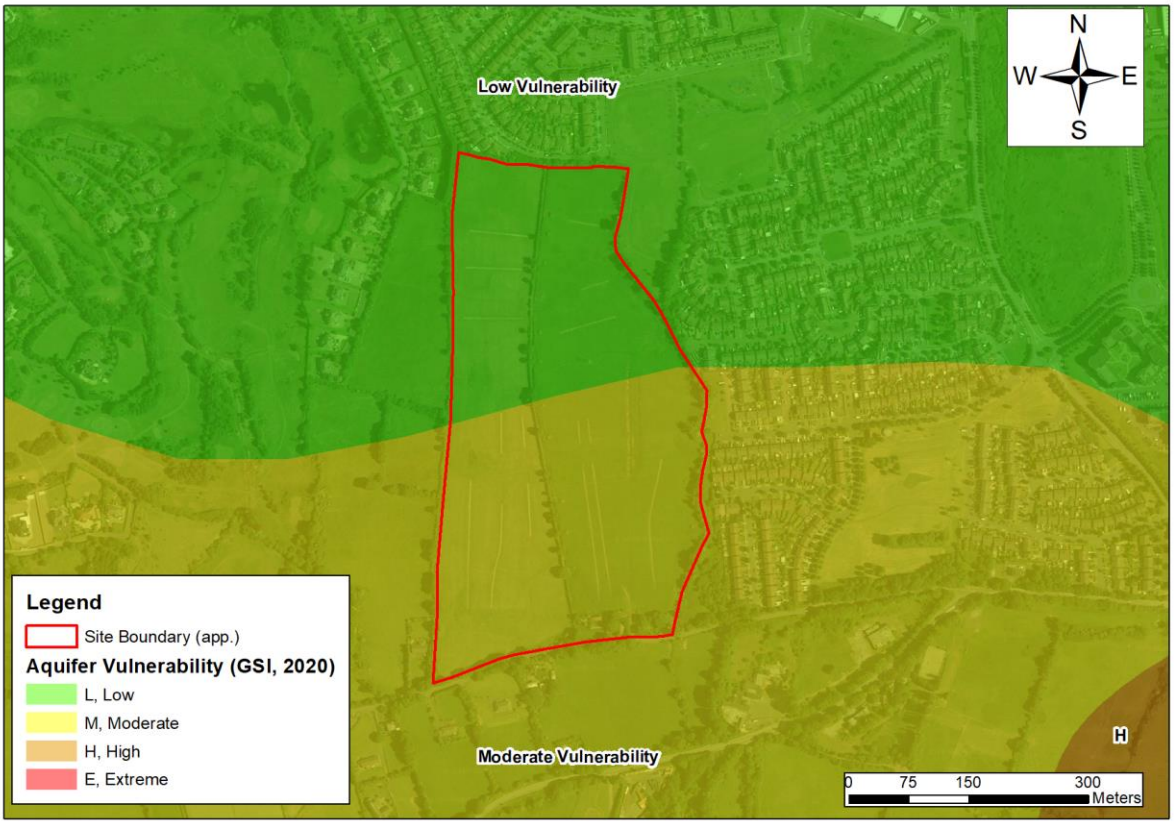

Figure 2.1 *Aquifer Vulnerability (Source: GSI, 2021)*

The GSI/ Teagasc (2020) mapping database of the quaternary sediments in the area of the subject site indicates the principal subsoil type in the residential area comprises Limestone till Carboniferous (TGr, i.e. Till derived from granites).

This has been confirmed by local site investigations carried out by Ground Investigations Ireland (GII, 2014). Trial pits and 4 no. infiltration tests undertaken confirmed the existence of cohesive sediments of low permeability (sandy gravelly clay) up to 3 m in depth and some lens of granular deposits were identified to the south of the site. Bedrock was not encountered during the aforementioned site works.

3.0 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) is developed based on a good understanding of the hydrological and hydrogeological environment, plausible sources of impact and knowledge of receptor requirements. This in turn allows possible Source Pathway Receptor (S-P-R) linkages to be identified. If no S-P-R linkages are identified, then there is no risk to identified receptors.

3.1 Assessment of Plausible Sources

Potential sources during both the construction and operational phases are considered. For the purposes of undertaking the potential of any hydrological/ hydrogeological S-P-R linkages, all potential sources of contamination are considered *without taking account of* any measures intended to avoid or reduce harmful effects of the proposed project (mitigation measures) i.e. a worst-case scenario. Construction sources (short-term) and operational sources (long-term) are considered below.

<u>Construction Phase</u>

The following sources are considered plausible for the proposed construction site:

(i) Hydrocarbons or any hazardous chemicals will be stored in specific bunded areas. Refuelling of plant and machinery will also be carried out in bunded areas to minimise risk of any potential being discharged from the site. As a worst-case scenario, a rupture of a 1,000 litre tank to ground is considered in this analysis which disregards the effect of bunding. This would be a single short-term event.

(ii) Leakage may occur from construction site equipment. As a worst-case scenario an unmitigated leak of 300 litres is considered. This would be a single short-term event.

(iii) Use of wet cement is a requirement during construction. Run-off water from recent cemented areas will result in highly alkaline water with high pH. As this would only occur during particular phases of work this is again considered as a single short-term event rather than an ongoing event. If concrete mixing is carried out on site, the mixing plant will be sited in a designated area with an impervious surface.

(iv) Construction requires soil excavation and removal. Unmitigated run-off could contain a high concentration of suspended solids and contaminants such as hydrocarbons during earthworks, given the presence of contamination beneath the site according to site investigations. These could be considered intermittent short-term events, i.e. if adequate mitigation measures which are already incorporated in the Construction Environmental Management Plan (CEMP) and the Construction Surface Water Management Plan fail.

(v) For the working areas close to the open water courses mentioned above, there is a potential for increased silt runoff during a short period if adequate mitigation measures not undertaken. Mitigation measures to minimise the suspension and mobilisation of sediment downstream of the working area would include silt barriers or diversions to create dry working areas. Where feasible, works should allow the river to recover for at least 14 hours on a daily basis meaning that the period of in river work should be about 10 hours maximum. A dry working area should be created for pouring of concrete. All vehicles should be regularly checked for oil leaks, and ruptured hose pipes.

Operational Phase

The following sources are considered plausible post construction:

(i) The development site includes car parking areas at the ground level. Leakage of petrol/ diesel fuel may occur from these areas, run-off may contain a worst-case scenario of 70 litres for example. Any corresponding risk here would be mitigated by the interception storage system which comprises permeable paving, intensive biodiverse areas and paved green roofing.

(ii) The stormwater drainage system follows SuDS measures, which are composed of roadside swales, tree pits, bio-retention area, rear garden filter drains, gullies, underground pipes, manholes, catchpit manholes and direct the flows via void arched attenuation systems towards vortex flow restricting devices (Hydrobrake or similar) and petrol interceptors before discharging into the Corbally Stream following the characteristics of a greenfield run-off. It

should be noted that the worst-case scenario (70 litres) disregards the effect of SuDS and petrol interceptors.

(iii) The development will be fully serviced with separate foul and stormwater sewers which will have adequate capacity for the facility as it was confirmed by Irish Water and it is required by its licencing requirements. Discharge from the site to the public foul sewer will be sewage and grey water only due to the residential nature of the proposed development. The foul discharge from the site will join the public sewer and will be treated at the Irish Water Ringsend Wastewater Treatment Plant (WWTP) prior to subsequent discharge to Dublin Bay. This WWTP is required to operate under an EPA licence and meet environmental legislative requirements as set out in such licence. It is noted that an application for a new upgrade to this facility is currently in planning.

This plant operates under an EPA licence (D0034-01) and is currently in the process of being upgraded to a PE of 2.4million to meet the increased demand of the Dublin area. The most recent Annual Environmental Report (AER 2020) shows it is currently operating for a PE peak loading of 2.27million while originally designed for 1.64million. However, the current maximum hydraulic load (832,269 m3/day) is less than the Peak hydraulic capacity as constructed (959,040 m3/day) i.e. prior to any upgrade works. These upgrade works (described in section 3.4 below) have commenced and comprise a number of phases and are ongoing and expected to be fully completed by 2025.

(iv) There is no bulk fuel or chemical storage included in the development design.

3.2 Assessment of Pathways

The following pathways have been considered within this assessment with the impact assessment presented in Section 3.4:

The potential for offsite migration due to any construction discharges is moderate as there would be pathway through land ditches/ streams within or surrounding the site.

(i) Vertical migration to the underlying limestone is minimised due to the recorded '*Low*' and '*Moderate*' vulnerability present at the site resulting in good aquifer protection from any localised diesel/ fuel oil spills during either construction or operational phases. The site is underlain by coarse greywacke & shale limestone which is a '*Poor Aquifer*' characterised by discrete local fracturing with little connectivity rather than large connected fractures which are more indicative of Regional Aquifers. As such, flow paths are generally local.

(ii) There is a direct hydrological linkage for construction and operation run-off or any small hydrocarbon leaks from the site to the Corbally Stream. The Corbally stream discharges to the Camac River which ultimately discharges to the Liffey Estuary or Dublin Bay.

(iii) There is no 'direct' pathway for foul sewage to any receiving water body. There is however an 'indirect pathway' through the public sewer which ultimately discharges to the Irish Water WWTP at Ringsend prior to discharge to Dublin Bay post treatment.

3.3 Assessment of Receptors

The receptors considered in this assessment include the following:

(i) Underlying limestone aquifer;
(ii) Corbally Stream and Camac River; and
(iii) Liffey Estuary Lower and Dublin Bay.

3.4 Assessment of Source Pathway Receptor Linkages

Table 3.1 below summarises the plausible pollutant linkages (S-P-R) considered as part of the assessment and a review of the assessed risk is also summarised below.

The potential for impact on the aquifer is low based on the absence of any bulk chemical storage on site. The overburden thickness, low permeability nature of till and a lack of fracture connectivity within the limestone will minimise the rate of off-site migration for any indirect discharges to ground at the site. As such there is no potential for a change in the groundwater body status or significant source pathway linkage through the aquifer to any Natura 2000 site.

There is no direct open-water pathway between the site and Dublin Bay. However, there is an indirect pathway through the stormwater drainage which directly discharges into the Corbally Stream. Should any silt-laden stormwater from construction or hydrocarbon-contaminated water from a construction vehicle leak/tank leak manage to enter into the mentioned watercourse. The suspended solids will naturally settle within the stream; however, in the event of a worst case hydrocarbon leak of 1,000 litres this would be diluted to background levels (water quality objectives as outlined in S.I. No. 272 of 2009, S.I. No. 386 of 2015 and S.I. No. 77 of 2019) by the time the stormwater reaches the nearest Natura 2000 Sites (18 km downgradient).

During operation, the potential for a release is low as there is no bulk fuel/chemical storage and no silt laden run-off. Stormwater will be collected by a drainage system which includes SuDS measures, a 6,125m^3 attenuation system composed of a serious of bunded tanks and the discharge flows through an oil/ petrol interceptor prior to discharge off-site. In addition, the potential for hydrocarbon discharge is quite minimal based on an individual vehicle (70 litres) leak being the only source for hydrocarbon release. However, even if the operation of the proposed SuDS and interceptor systems are excluded from consideration, there is no likely impact above water quality objectives as outlined in S.I. No. 272 of 2009 and S.I. No. 77 of 2019) in the worst case scenarios described above at section 3.2. The volume of contaminant release is low and combined with the significant attenuation within the Corbally River, hydrocarbons will dilute to background levels with no likely impact above water quality objectives as outlined in S.I. No. 272 of 2009, S.I. No. 386 of 2015 and S.I. No. 77 of 2019 at any Natura 2000 sites.

It can be concluded that the in-combination effects of surface water arising from the Proposed Development taken together with that of other developments (Fortunestown Centre, Cheeverstown, Saggart Cooldown Commons) will not be significant based on the low potential chemical and sediment loading. Therefore, based on the possible loading of any hazardous material during construction and operation there is subsequently no potential for impact on downgradient Natura 2000 habitats (Dublin Bay, which is located 18 km from the site).

The peak wastewater discharge is calculated at 19.27 litres/sec (9.82 l/s from domestic sources, 3.25 l/s from commercial sources and 6.2 l/s from the school).

The sewage discharge will be licensed by Irish Water, collected in the public sewer and treated at Irish Water's WWTP at Ringsend prior to discharge to Dublin Bay. Sewage will be separated from stormwater on the site, and collected in the public sewer, and treated ultimately Irish Water's WWTP at Ringsend prior to discharge to Dublin Bay. As outlined in section 3.1 (iv), upgrade works have commenced in 2018 and are expected to be fully completed by 2025. The upgrade works will result in treatment of sewage to a higher quality than current, thereby ensuring effluent discharge to Dublin Bay will comply with the Urban Wastewater Treatment Directive by Q4 2023.

The project is being progressed in stages to ensure that the plant continues to treat wastewater to the current treatment levels throughout the delivery of the upgrade. The project comprises three key elements and underpinning these is a substantial programme of ancillary works:

- Provision of additional secondary treatment capacity with nutrient reduction (400,000 population equivalent);
- Upgrade of the 24 existing secondary treatment tanks to provide additional capacity and nutrient reduction, which is essential to protect the nutrient-sensitive Dublin Bay area; and
- Provision of a new phosphorous recovery process.

In February 2018, the work commenced on the first element, the construction of a new 400,000 population equivalent extension at the Ringsend Wastewater Treatment Plant. These works are at an advanced stage with testing and commissioning stages expected to be completed in the second half of 2021.

The 2019 planning permission facilitated upgrading works to meet nitrogen and phosphorus standards set out in the licence, which are temporarily exceeded currently. Works on the first of four contracts to retrofit the existing treatment tanks with aerobic granular sludge technology commenced in November 2020. Award of the second contract is due in Q3 2021 and the third and fourth contracts are scheduled to commence in late 2021 and mid 2023 respectively.

The application for the upgrade of the WWTP in 2012 and the revised upgrade in 2018 was supported by a detailed EIAR. As outlined in the EIAR, modelling of water quality in Dublin Bay has shown that the upgrades (which are now currently underway) will result in improved water quality within Dublin Bay. The 2018 EIAR predicts that the improvement in effluent quality achieved by the upgrade will compensate for the increase in flow through the plant. The ABP inspector's report summarises the positive findings of the modelling for the post WWTP upgrade scenario on Dublin Bay water quality in sections 12.3.5 and 12.3.12 of his report and the overall positive impact for human health and the environment in his conclusions in section 12.9.1.

In addition, the EIAR report acknowledges that under the do-nothing scenario "the areas in the Tolka Estuary and North Bull Island channel will continue to be affected by the cumulative nutrient loads from the river Liffey and Tolka and the effluent from the Ringsend WWTP", which could result in a deterioration of the biological status of Dublin Bay (Irish Water, 2018). Nevertheless, these negative impacts of nutrient over-enrichment are considered "unlikely" (Irish Water, 2018). This is because historical data suggests that pollution in Dublin Bay has had little or no effect on the composition and richness of the benthic macroinvertebrate fauna. Therefore, the do-nothing scenario predicts that nutrient and suspended solid loads from the WWTP will "continue at the same levels and the impact of these loadings should maintain

the same level of effects on marine biodiversity". Therefore, it can be concluded that significant effects on the current status of the European sites within Dublin Bay from the current operation of Ringsend WWTP are unlikely. This conclusion is not dependent upon any future works to be undertaken at Ringsend.

Even without treatment at the Ringsend WWTP, the peak effluent discharge, calculated for the proposed development as 19.27 litres/sec (which would equate to 0.174% of the licensed discharge at Ringsend WWTP [peak hydraulic capacity]), would not impact on the overall water quality within Dublin Bay and therefore would not have an impact on the current Water Body Status (as defined within the Water Framework Directive). This assessment is supported by hydrodynamic and chemical modelling within Dublin Bay which has shown that there is significant dilution for contaminants of concern (DIN and MRP) available quite close to the outfall for the treatment plant (Ringsend WWTP 2012 EIS, Ringsend WWTP 2018 EIAR; refer to Section 12.4.22, ABP-301798-18 Inspector's report). The most recent water quality assessment of Dublin Bay WFD Waterbody undertaken by the EPA (Water Quality in 2020: An Indicator Report, 2021) also shows that Dublin Bay on the whole, currently has an 'Unpolluted' water quality status (refer to www.catchments.ie).

It should be noted that while the Ringsend WWTP upgrades are ongoing, overflows have occurred following periods of heavy rainfall. These overflows occur as a result of the impact on treatment capacity during heavy rainfall events due to surges primarily caused by the historical combined drainage system in Dublin. As the Proposed Development will not contribute any additional stormwater drainage to the WWTP, the development will therefore have no impact on the water quality in any overflow situation apart from a minor contribution from foul sewage.

With regard to bathing waters in Dublin Bay, the Proposed Development will have no impact on the water quality in any overflow situation apart from a minor contribution (0.174% of the peak hydraulic capacity at Ringsend WWTP) from foul sewage.

The assessment has also considered the effect of cumulative events, such as release of sediment laden water combined with a hydrocarbon leak on site (1,000 litres as a worst case scenario during the construction phase). As there is adequate assimilation and dilution between the site and the Natura 2000 sites (Dublin Bay, which is c. 18 Km from the site), it is concluded that no perceptible impact on water quality would occur at the Natura 2000 sites as a result of the construction or operation of this Proposed Development. It can also be concluded that the cumulative or in-combination effects of effluent arising from the Proposed Development with that of other proposed developments or planned development pursuant to statutory plans in the greater Dublin, Meath and Kildare areas discharging to Ringsend WWTP will not be significant having regard to the size of the calculated discharge from the Proposed Development (19.27 litres/sec, which includes domestic, commercial and school design wastewater flows, refer to the Drainage and Water Infrastructure Engineering report, Appendix 12.4) and having regard to the following:

- Recent water quality assessment for Irish Sea Dublin and Dublin Bay shows that they currently continue to meet the criteria for 'Unpolluted' water quality status (EPA, data until July 2021).
- The Ringsend WWTP upgrade which is currently being constructed will result in improved water quality by Q4 2023 to ensure compliance with Water Framework Directive requirements.

- All new developments are required to comply with SuDS which ensures management of run-off rate within the catchment of Ringsend WWTP.
- The natural characteristics of Dublin Bay result in enriched water rapidly mixing and degrading such that the plume has no appreciable effect on water quality at Natura sites.

As the Proposed Development will have no additional stormwater run-off during a stormwater event over and above the current level, surface water run-off from the development in the operational phase will therefore have no impact on the current water quality in any overflow situation at Dublin Bay.

It should also be noted that the bathing status has no direct relevance to the water quality status of the Natura sites due to rapid mixing and dilution resulting in no measurable change in water quality within the overall water body.

Finally, in a worst-case scenario of an unmitigated leak and not considering the operation of the SuDS and interceptor already included in the design, no perceptible risk to any Natura Sites 2000 is anticipated given the distance from source to Dublin Bay protected areas (c. 18 Km). Potential contaminant loading will be attenuated, diluted and dispersed near source area.

Table 3.1 below presents a summary of the risk assessment undertaken.

Source	Pathways	Receptors considered	Risk of Impact
Construction Impacts (Summary)			
Unmitigated leak from an oil tank to ground/ unmitigated leak from construction vehicle (1,000 litres worst case scenario).	Bedrock protected by >5m low permeability overburden. Migration within weathered/ less competent limestone is low (limestone has discrete local fracturing rather than large connected fractures).	Limestone bedrock aquifer (locally Important aquifer)	Low risk of localised impact to shallow weathered limestone due to protective overburden. No likely impact on the status of the aquifer due to volume of leak indicated, natural attenuation within overburden and discrete nature of fracturing reducing off site migration.
Discharge to ground of runoff water with High pH from cement process	Overland flow/ direct pathway through stormwater drainage to Corbally Stream, Coldwater Stream and Cooldown Stream water courses	Corbally Stream/ Camac River	
Unmitigated run-off containing a high concentration of suspended solids	Direct pathway to Dublin Bay through Corbally Stream/ Camac River/ Liffey Estuary	Dublin Bay	No perceptible risk – Distance from source too great (18 km) and potential contaminant loading will be attenuated diluted and dispersed near source area.
Operational Impacts (Summary)			
Foul effluent discharge to sewer	Indirect pathway to Dublin Bay through public sewer	Dublin Bay	No perceptible risk – Even without treatment at Ringsend WWTP, the average effluent discharge (19.27 litres/sec which would equate to 0.174% of the licensed discharge at Ringsend WWTP), would not impact on the overall water quality within Dublin Bay and therefore would not have an impact on the current Water Body Status (as defined within the Water Framework Directive).
Unmitigated discharge to ground of hydrocarbons from car leak (70 litres worst case scenario)	Direct pathway through stormwater drainage to Corbally Stream water course	Corbally Stream/ Camac River and Dublin Bay	Low risk – Potential contaminant loading is low (70 l fuel) will be attenuated and diluted within 0.5 km of site even if the design measures of the attenuation system and petrol interceptor prior to discharge into the Corbally Stream

Table 3.1 Pollutant Linkage Assessment *(without mitigation)*

4.0 CONCLUSIONS

A conceptual site model (CSM) has been prepared following a desk top review of the site and surrounding environs. Based on this CSM, plausible Source-Pathway-Receptor linkages have been assessed assuming an absence of any measures intended to avoid or reduce harmful effects of the proposed project (i.e. mitigation measures) in place at the proposed development site.

During construction and operation phases there is a direct source pathway linkage between the proposed development site and open water (i.e. Liffey Catchment or Dublin Bay). There is a mostly dry "inactive" stream within the site (Cooldown Stream) and the projected stormwater drainage will discharge to the Corbally Stream. However, due to the very low contaminant loading and distance to the Natura sites (c.18 km), there is no potential for impact on water quality at the Natura sites.

Even disregarding the operation of design measures including an attenuation system and petrol interceptors on site, it is concluded that there is will be imperceptible impacts from the proposed development to the water bodies due to emissions from the site stormwater drainage infrastructure to the wider drainage network. It should be noted the proposal also includes an attenuation system and petrol interceptors as part of best practice project design, and these features will provide additional filtration from the site to the drainage network.

It is concluded that there are no pollutant linkages as a result of the construction or operation of the Proposed Development which could result in a water quality impact which could alter the habitat requirements of the Natura sites within Dublin Bay.

Finally, and in line with good practice, appropriate and effective mitigation measures will be included in the construction design, management of construction programme and during the operational phase of the proposed development. With regard the construction phase, adequate mitigation measures will be incorporated in the Construction Environmental Management Plan (CEMP). These specific measures will provide further protection to the receiving soil and water environments. However, the protection of downstream European sites is in no way reliant on these measures and they have not been taken into account in this assessment.

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