

8. WATER, HYDROGEOLOGY AND HYDROLOGY

8.1 Introduction

This chapter of the EIAR comprises of an assessment of the likely impact of the proposed development on the surrounding surface water and hydrogeological environments (including flood risk, surface water drainage, foul drainage and water supply) as well as identifying proposed mitigation measures to minimise any impacts.

This chapter was prepared by Brendan Keogh (BA BAI PGradDip CEng MIEI) of DBFL Consulting Engineers. Brendan Keogh is a Chartered Professional Engineer with over 15 years experience in the design and construction of civil engineering projects. Projects have included works associated with the commercial, industrial, energy, residential and public infrastructure sectors.

8.2 Assessment Methodology

Assessment of the likely impacts of the proposed development on the surrounding surface water and hydrogeological environments included the following activities:

- Site inspection / walkover
- Review of existing topographic survey information
- Review of Irish Water's network plans (surface water drainage, foul drainage and water supply). Refer to Appendix D
- Ground investigations including trial pits, infiltration testing and environmental testing (waste acceptance criteria for landfills)
- Review of information available on the Environmental Protection Agency (EPA) online mapping service
- Review of information available on the Geological Survey of Ireland (GSI) online mapping service
- Review of Office of Public Works (OPW) National Flood Hazard Mapping and CFRAM Studies (Catchment Flood Risk Assessment and Management Studies)
- Consultation with Kildare County Council's Water Services Section
- Consultation with Irish Water
- Submission of a Pre-Connection Enquiry Application to Irish Water

As part of assessing the likely impact of the proposed development, surface water runoff, foul drainage discharge and water usage calculations were carried out in accordance with the following guidelines:

- Greater Dublin Strategic Drainage Study (GDSDS)
- Method outlined in Irish Water's Pre-Connection Enquiry Application (water demand and foul drainage discharge)

8.3 Receiving Environment

8.3.1 Hydrology

The primary hydrological features in the vicinity of the site is the River Liffey (approx. 2.0km south-east of the site). Refer to Figure 8.1 for the location of the River Liffey.

An existing 450mm diameter public surface water drain is located south west of the site at the entrance to Crodaun Forest Park (refer to Figure 8.2 and 8.3 below). This will provide a suitable surface water discharge point for the proposed development.

The site falls from the West towards its Eastern boundary at gradients ranging from 1/80 to 1/120. As such ground levels at the discharge point are somewhat elevated above the eastern side of the site. It is therefore proposed to slightly raise existing ground levels along the eastern side of the site in order to achieve a gravity drainage solution.

Figure 8.1 Extract from EPA Online Mapping Service (Site Boundary Indicative Only)

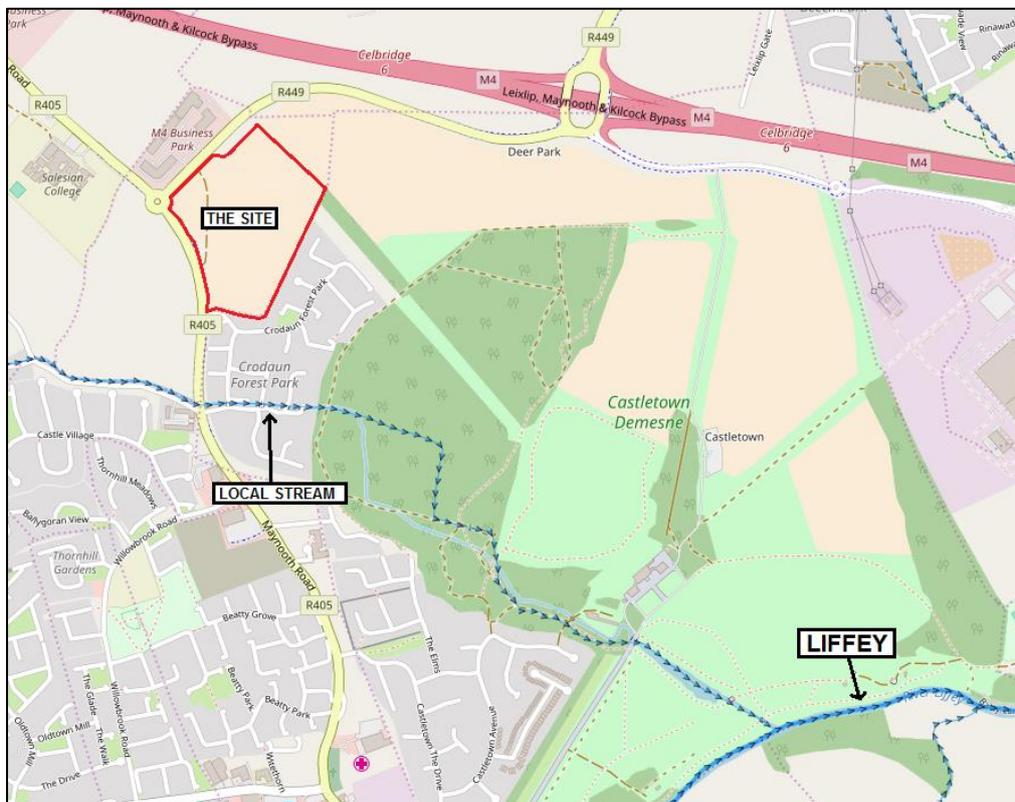


Figure 8.2 Extract from Irish Water Utility Plan

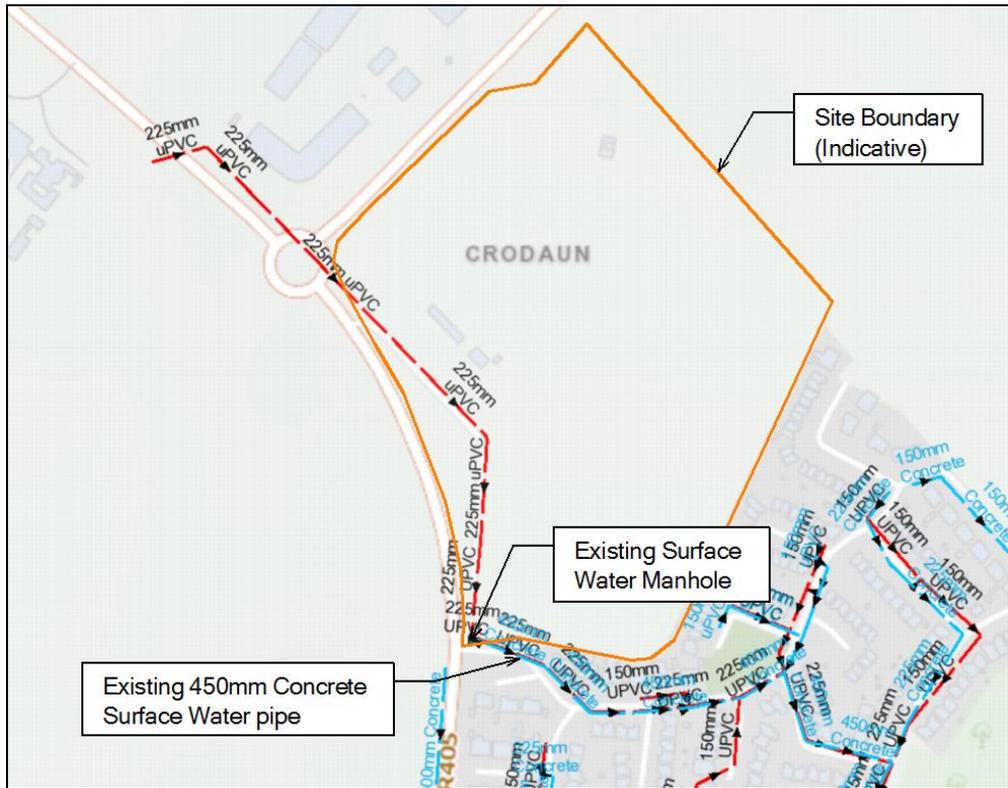
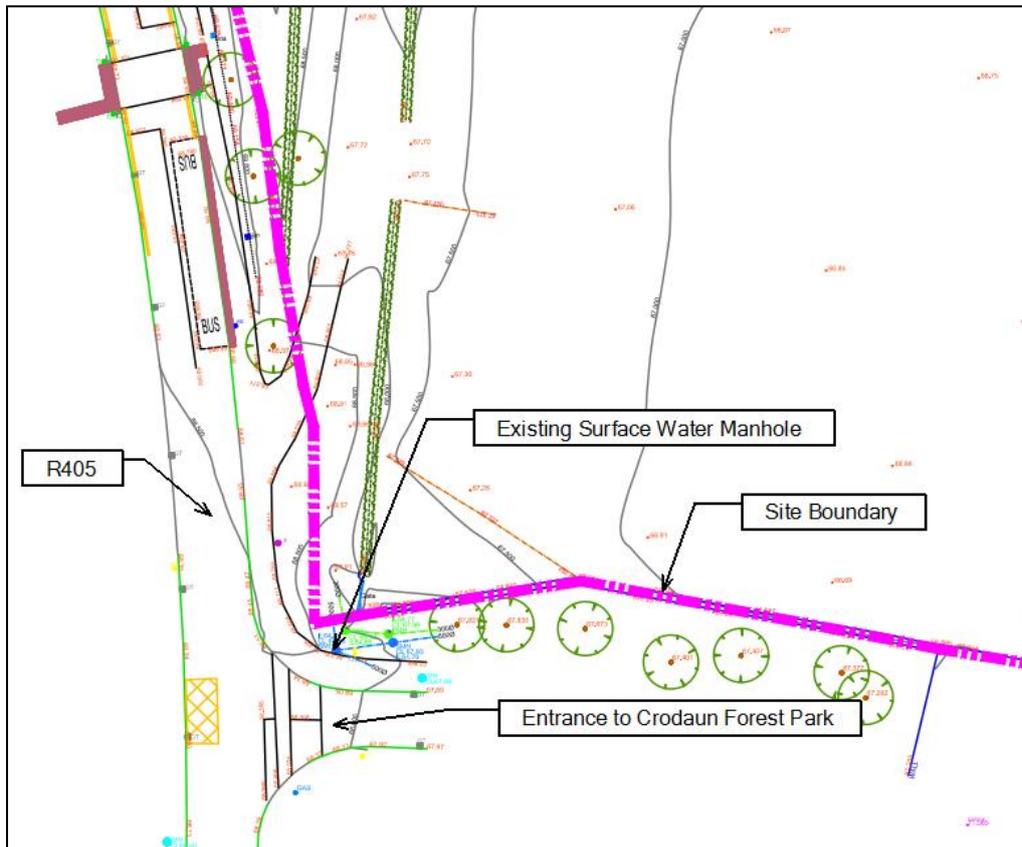


Figure 8.3 Extract from Topographical Survey



8.3.2 Hydrogeology

GSI's Groundwater Data Viewer indicates that the site is located on a "Bedrock Aquifer" and classifies the underlying aquifers as "Locally Important Aquifer – Bedrock which is moderately productive only in local zones".

GSI also classify the site's groundwater vulnerability as Moderate to High.

Figure 8.4 Extract from GSI Online Mapping Service – Groundwater Aquifers

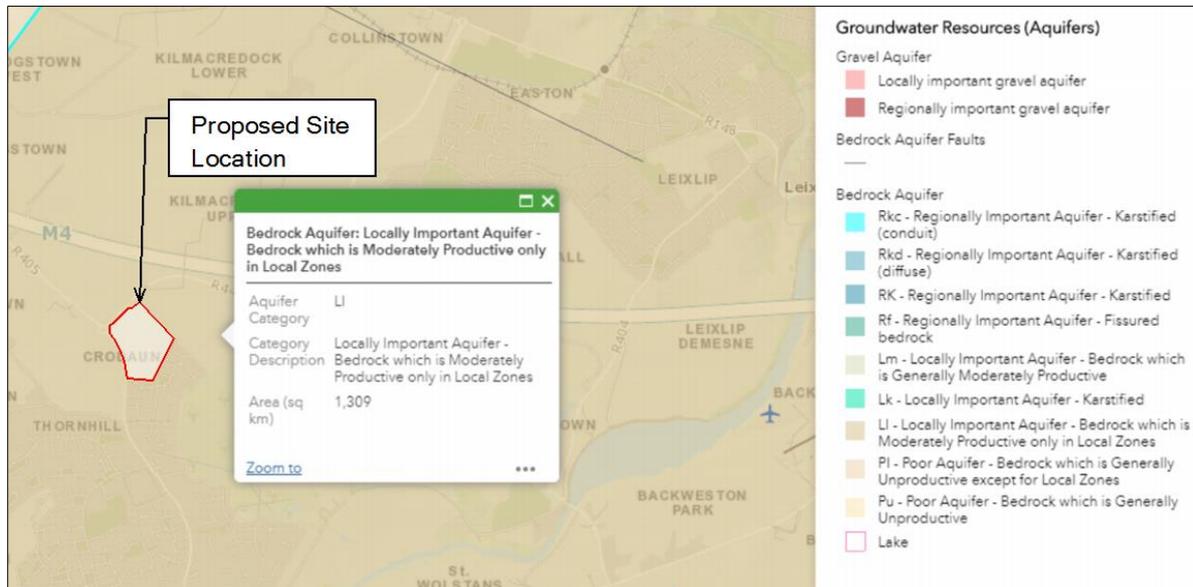
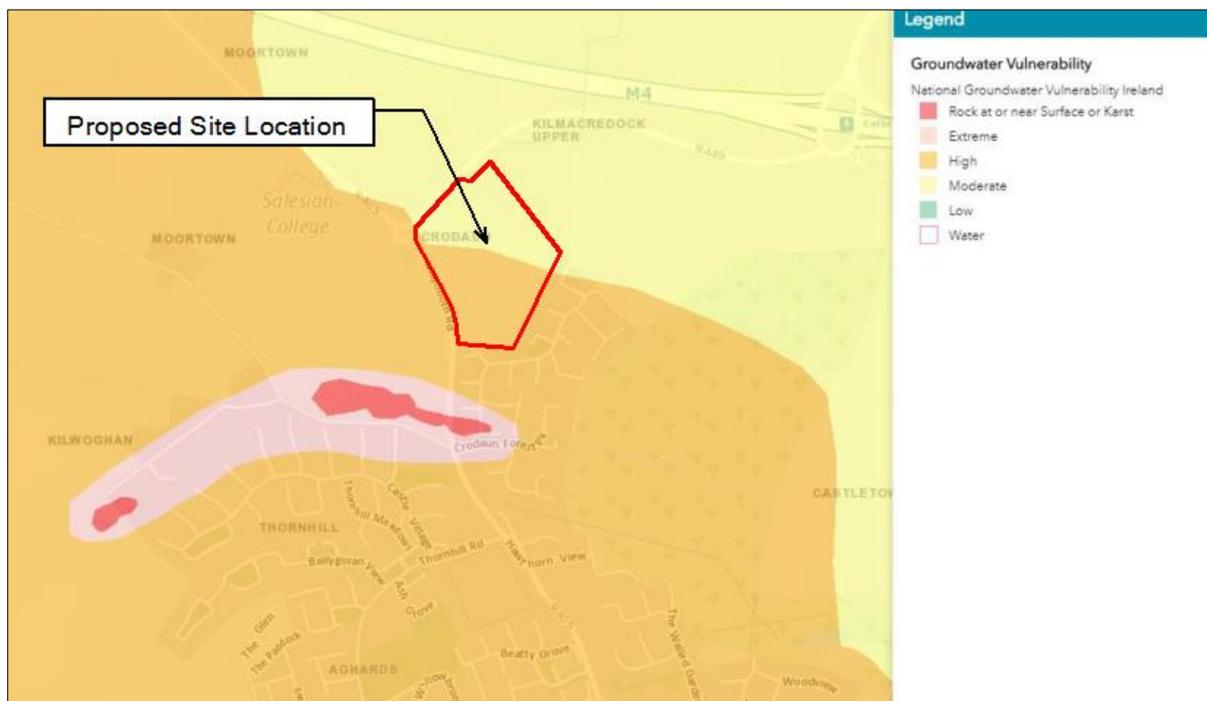


Figure 8.5 Extract from GSI Online Mapping Service – Groundwater Vulnerability



8.3.3 Flood Risk

A flood risk assessment has been undertaken by reviewing information from the Office of Public Works (OPW) National Flood Hazard Mapping (www.floods.ie), the Eastern CFRAM Study and the Celbridge Local Area Plan (LAP) 2017 to 2023.

This assessment has been carried out in accordance with the procedures for a "Flood Risk Assessment" as outlined in the OPW's Guidelines for Planning Authorities – The Planning System and Flood Management (November 2009).

OPW's CFRAMS Drawings are included in Appendix E.

OPW Flood Hazard Mapping

OPW's Summary Local Area Report (Appendix E) summarises all flood events within 2.5 km of the site. No flood events are noted in the immediate vicinity of the site. No benefitting lands are identified in the vicinity of the site.

Eastern CFRAM Study

OPW's Eastern CFRAM Study indicates the extent of fluvial flooding in the Celbridge area.

Extracts from OPW's Eastern CFRAM Study (www.floodinfo.ie) shows Fluvial Flood Extent and Fluvial Flood Depth Plans and are included in Appendix E (Flood Hazard Information).

No fluvial flooding is indicated in the vicinity of the site.

The closest modelled node to the site is located 300m to the south (Node 09KILO00165).

The location of this node is shown on CFRAM Drawing E09CEL_EXFCD_F1_08 (Appendix E).

- Node 09KILO00165, 10% AEP fluvial flood level +61.80m
- Node 09KILO00165, 1% AEP fluvial flood level +61.92m
- Node 09KILO00165, 0.1% AEP fluvial flood level +61.96m
- Lowest Proposed FFL +66.8m

The lowest proposed FFL (+66.8m) is 4.84m above the predicted 0.1% AEP fluvial flood event associated with Node 09KILO00165 (+61.96m).

Celbridge Local Area Plan (2017-2023)

The Celbridge LAP 2017 to 2023 (Strategic Flood Risk Assessment) assesses flood risk indicators in relation to proposed land use (e.g. new residential, community & educational, open space & amenity etc.) and identifies land parcels that require a site specific flood risk assessment. It is noted that the proposed development lands do not fall into this category and have been identified as "new residential" and a "Key Development Area (KDA)" in the Celbridge Local Area Plan 2017-2023 – Land Use Zoning Objectives Map.

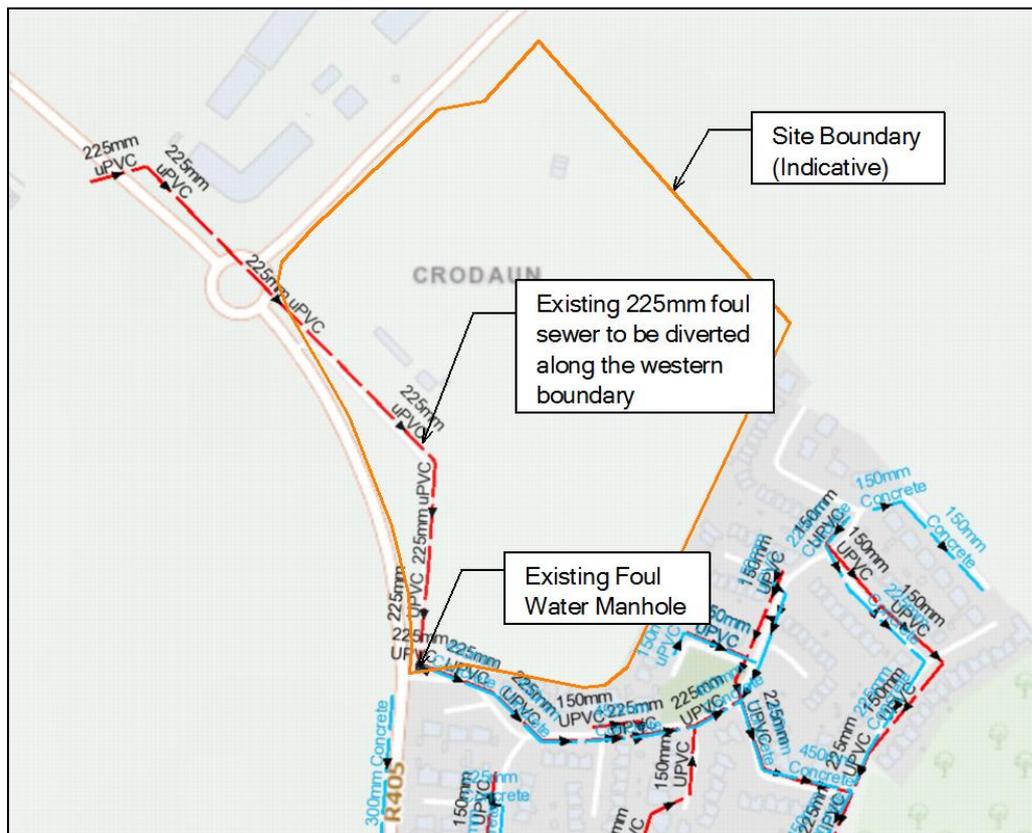
8.3.4 Foul Drainage

An existing 225mm diameter foul sewer is located along the site's western boundary (adjacent to the R405) which outfalls towards Celbridge Main Street. This existing infrastructure is expected to provide a suitable foul discharge point for the proposed development.

The proposed foul drainage discharge point is located adjacent to the South-West corner of the site. Ground levels in this area are somewhat elevated above the eastern side of the site. It is therefore proposed to raise existing ground levels at the northern and eastern sides of the site in order to achieve a gravity drainage solution (avoiding the need for a pumped solution).

The location of this existing foul sewer is shown on Irish Water's Network Plans (Figure 8.6 below and Appendix D and on the J&L Survey's Topographic Survey Plan (Appendix F).

Figure 8.6 Extract from Irish Water Network Plans



Pre-connection enquiry feedback has been received from Irish Water (refer to Appendix G).

"Based upon the details you have provided with your pre-connection enquiry and on the capacity currently available in the networks(s), as assessed by Irish Water, we wish to advise you that, subject to a valid connection agreement being put in place and the condition listed below, your proposed connection to the Irish Water network can be facilitated".

8.3.5 Surface Water Drainage

An existing 450mm diameter public surface water drain is located south west of the site (refer to Irish Water's Network Plans included in Appendix D). There is an existing surface water manhole located on this surface water drain adjacent to the South-West corner of the site / at the entrance to Crodaun Forest Park (Refer to Figure 8.2 and Figure 8.3 above). This is expected to provide a suitable surface water discharge point for the proposed development.

The topography of the site generally falls from west to east at gradients ranging from 1/80 to 1/120.

As mentioned earlier, as ground levels at the discharge point are elevated above the eastern side of the site, it is proposed to raise ground levels to achieve a gravity drainage solution.

8.3.6 Water Supply

The locations of the existing public water mains are shown on Irish Water's Network Plans (refer to Appendix D).

An existing 12" uPVC public watermain runs along the R405 (along the site's Western boundary).

Pre-connection enquiry feedback has been received from Irish Water. No issues are noted in relation to the existing public water supply network.

8.4 Characteristics of the Proposed Development

8.4.1 Hydrology

The proposed development is located approximately 300m north of the Ballygoran Stream, a local stream flowing into the River Liffey (refer to Figure 8.1).

No adverse effects on surrounding hydrology are anticipated as surface water flows are attenuated to greenfield runoff rates in conjunction with implementation of SUDS strategies such as permeable paving, green roofs and installation of a Class 1 full retention fuel / oil separator. Refer to DBFL's Infrastructure Design Report (170099-rep-001) for full details of the proposed SUDS methodologies.

8.4.2 Hydrogeology

During construction, the deepest excavations are expected to be required for installation of attenuation tanks.

At soakaway test locations and trial pits locations, excavations were carried out to depths ranging from 1.1m to 2.60m below existing ground level. Groundwater ingress was noted at one location only (at 2.0m below existing ground level). Groundwater was not encountered at any other locations.

It is not envisaged that the proposed development works will have any direct impact on the underlying hydrogeology.

8.4.3 Flood Risk

The Site-Specific Flood Risk Assessment for proposed development was undertaken in accordance with the requirements of "The Planning System and Flood Risk Management, Guidelines for Planning Authorities" and its Technical Appendices.

Following the Flood Risk Assessment, it was determined that the site is located in Flood Zone C as defined by the Guidelines. It concluded that the;

Proposed residential development is appropriate for the site's flood zone category.

The sequential approach outlined in the Guidelines has been adhered to and that the 'Avoid' principal has been achieved.

The proposed development is considered to have the required level of flood protection up to and including the 1% AEP flood event. Overland flow paths have been identified for pluvial flooding exceeding the capacity of the surface water drainage network.

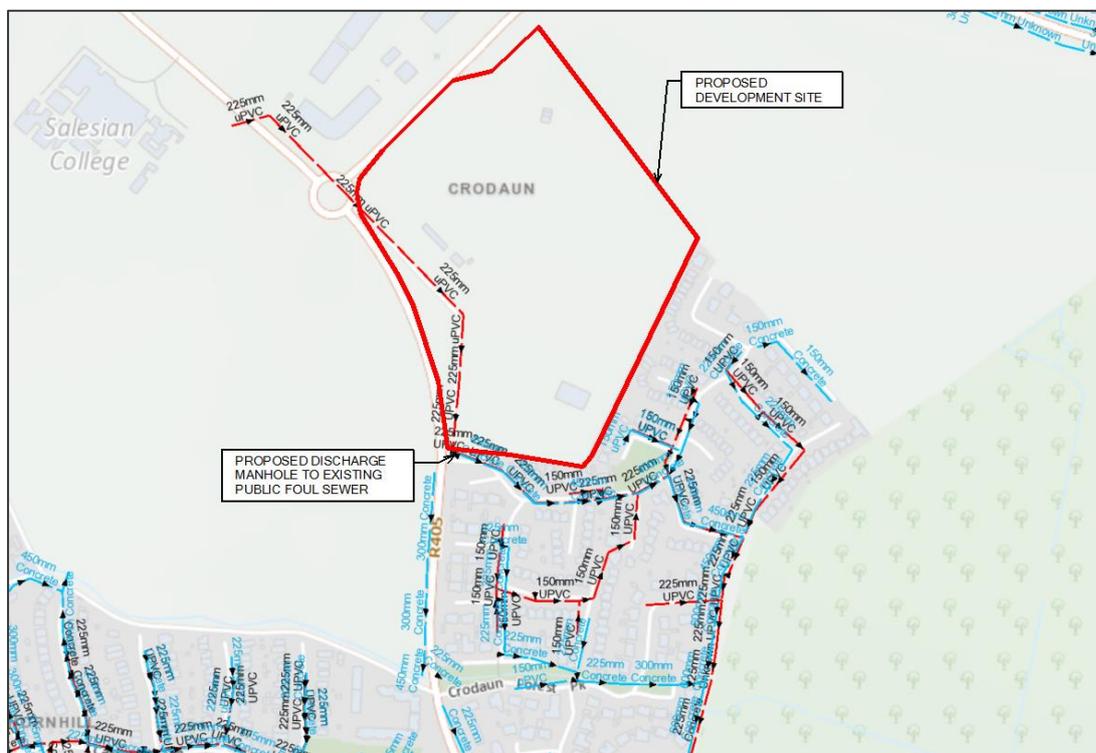
8.4.4 Foul Drainage

The Topography of the site generally falls from the western boundary to the east at gradients ranging from 1/80 to 1/120.

The proposed foul drainage discharge point is located adjacent to the South-West corner of the site. Ground levels in this area are somewhat elevated above the eastern side of the site. It is therefore proposed to raise existing ground levels along the eastern side of the site in order to achieve a gravity drainage solution (avoiding the need for a pumped solution). In order to accommodate the proposed site layout diversion of this existing foul sewer which traverses the western portion of the site is required. This is then expected to provide a suitable foul discharge point for the proposed development.

The proposed foul drainage network will comprise of a series of 225mm diameter pipes. Each residential unit is to be serviced by individual 100mm diameter connections.

Figure 8.7 Extract from Irish Water Network Plan (Site Boundary Indicative Only)

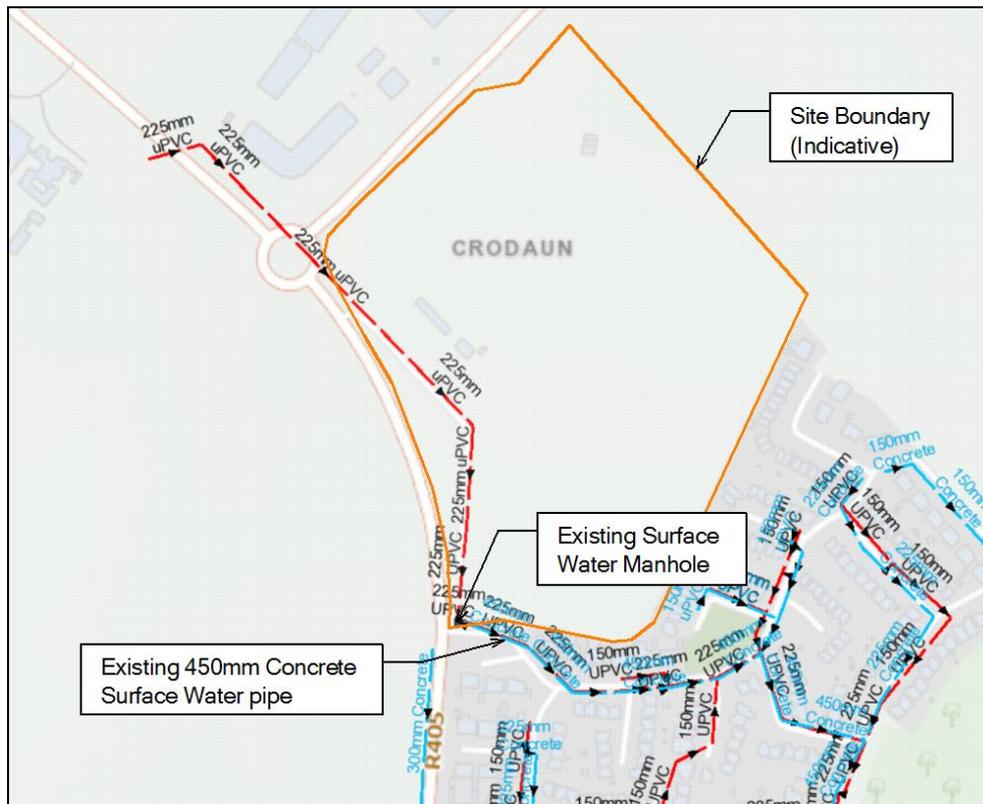


The foul drainage network for the proposed development has been designed in accordance with the Department of the Environment's Recommendations for Site Development Works for Housing Areas, the Department of the Environment's Building Regulations "Technical Guidance Document Part H Drainage and Waste Water Disposal", BS EN 752: 2008 Drain and Sewer Systems Outside Buildings, IS EN 12056: Part 2 (2000) Gravity Drainage Systems Inside Buildings and BS 8301:1985 Building Drainage.

A daily foul discharge volume of 168m³ has been calculated as outlined in Irish Water's Pre-Connection Enquiry Application Form.

A BOD (Biochemical Oxygen Demand) loading (based on 60g per person per day) of 63,750g has been calculated for the proposed development as outlined in the EPA Waste Water Treatment Manual.

8.4.5 Surface Water Drainage

Figure 8.8 Extract from Irish Water Network Plan (Site Boundary Indicative Only)

The existing 450mm diameter concrete surface water line is expected to provide a suitable surface water discharge point for the proposed development.

Surface water runoff from the site's road network will be directed to a proposed pipe network via conventional road gullies while surface water from roofs will be routed to the proposed surface water pipe network via the porous aggregates beneath permeable paved driveways (providing an additional element of attenuation).

Surface water discharge rates from the proposed surface water drainage network will be controlled by a vortex flow control device (Hydrobrake or equivalent) and associated underground attenuation tanks (Stormtech Chambers). Surface water discharge will also pass via a full retention fuel / oil separator (sized in accordance with permitted discharge from the site).

Surface water calculations are based on an allowable outflow / greenfield runoff rate of 2 l/sec/ha resulting in a total attenuation volume for the 4 no. Surface Water Drainage Catchments of approx. 1,850m³.

Proposed surface water drains have been designed in accordance with the Greater Dublin Strategic Drainage Study (GSDS), the Department of the Environment's Recommendations for Site Development Works for Housing Areas, the Department of the Environment's Building Regulations "Technical Guidance Document Part H Drainage and Waste Water Disposal" and BS EN 752: 2008 Drain and Sewer Systems Outside Buildings.

8.4.6 Water Supply

It is proposed to take a 160mm diameter connection off the existing 12" diameter public water supply line (located along the R405).

A 160mm diameter looped water main will be provided (generally along the site's arterial roads) with a number of 110mm diameters looped branch mains provided elsewhere (off the main 160mm diameter loop).

Individual houses will have their own connections (25mm O.D. PE pipe) to distribution water mains via service connections and meter / boundary boxes.

All connections, valves, hydrants, meters etc. have been design and are to be installed in accordance with Irish Water's Code of Practice / Standard Details and the Department of the Environment's Building Regulations "Technical Guidance Document Part B Fire Safety".

An average daily domestic demand of approx. 154m³ has been calculated as outlined in Irish Water's Pre-Connection Enquiry Application Form.

8.5 Potential Impact of the Proposed Development

8.5.1 Construction Phase

Potential impacts that may arise during the construction phase are noted below:

- Surface water runoff during the construction phase may contain increased silt levels (e.g. runoff across areas stripped of topsoil) or become polluted by construction activities.
- Discharge of rainwater pumped from excavations may also contain increased silt levels (potential impact on existing hydrology e.g. discharge to existing open drain).
- Accidental spills and leaks associated with storage of oils and fuels, leaks from construction machinery and spillage during refuelling and maintenance.
- Concrete runoff, particularly discharge of wash water from concrete trucks. (potential impact on existing hydrology e.g. infiltration to ground).
- Discharge of vehicle wheel wash water (potential impact on existing hydrology e.g. discharge to existing surface water drainage infrastructure).
- Improper discharge of foul drainage from contractor's compound (impact on existing hydrology e.g. cross-contamination of existing surface water drainage.).
- Cross contamination of potable water supply to construction compound.

8.5.2 Operational Phase

Potential operational phase impacts are noted below:

- Increased impermeable surface area will reduce local ground water recharge and potentially increase surface water runoff (if not attenuated to greenfield runoff rate).
- Accidental hydrocarbon leaks and subsequent discharge into piped surface water drainage network (e.g. along roads and in driveway areas).
- Increased discharge to foul drainage network (Daily Foul Discharge Volume = approx. 168 m³)
- Increased potable water consumption (Average Daily Domestic Demand = approx. 154m³)

8.5.3 'Do Nothing' Scenario

There are no predicted impacts should the proposed development not proceed.

8.6 Mitigation Measures

8.6.1 Construction Phase

The following measures are proposed during the construction phase to mitigate against risks to the surrounding hydrological environment.

- A site-specific Construction and Environment Management Plan will be developed and implemented during the construction phase. Site inductions will include reference to the procedures and best practice as outlined in the Construction and Environment Management Plan.
- Surface water runoff from areas stripped of topsoil and surface water collected in excavations will be directed to on-site settlement ponds where measures will be implemented to capture and treat sediment laden runoff prior to discharge of surface water at a controlled rate.
- Weather conditions and typical seasonal weather variations will also be taken account of when planning stripping of topsoil and excavations with an objective of minimizing soil erosion.
- In order to mitigate against spillages contaminating the surrounding surface water and hydrogeological environments, all oils, fuels, paints and other chemicals should be stored in a secure bunded hardstand area. Refuelling and servicing of construction machinery will take place in a designated hardstand area which is also remote from any surface water inlets (where not possible to carry out such activities off site).
- Concrete batching will take place off site and wash down and wash out of concrete trucks will take place off site (at authorised concrete batching plant in full compliance with relevant planning and environmental consents).
- Discharge from any vehicle wheel wash areas is to be directed to on-site settlement ponds.
- The construction compound will include adequate staff welfare facilities including foul drainage and potable water supply. Foul drainage discharge from the construction compound will be tankered off site to a licensed facility until a connection to the public foul drainage network has been established.
- The construction compound's potable water supply shall be protected from contamination by any construction activities or materials.

8.6.2 Operational Phase

The design of proposed site levels (roads, FFL etc.) has been carried out to ensure the proposed development is elevated and set in such a way as to avoid concentrating additional surface water flow in a particular location.

Following the Site Specific Flood Risk Assessment, it has been determined that the entire site / zoned developable area is located in Flood Zone C as defined by the Guidelines (i.e. proposed development is considered to have the required level of flood protection up to and including the 1% AEP flood event.)

Surface water runoff from the site will be attenuated to the greenfield runoff rate as outlined in the Greater Dublin Strategic Drainage Study (GSDSDS). Surface water discharge rates will be controlled by a Hydrobrake type vortex control device in conjunction with below ground attenuation storage.

The following methodologies are being implemented as part of a SuDS surface water treatment train approach:

- Permeable paving in driveway areas
- Surface water runoff from roofs will be routed to the proposed surface water pipe network via the porous aggregates beneath permeable paved driveways
- Attenuation of the 30 and 100 year return period storms
- Installation of a Hydrobrake (limiting surface water discharge from the site to 2 l/sec/ha)
- Surface water discharge will also pass via a fuel / oil separator (sized in accordance with permitted discharge from the site)

A contract will be entered into with a suitably qualified contractor from maintenance of the attenuation system, Hydrobrake and full retention fuel / oil separator noted above.

No specific mitigation measures are proposed in relation to foul drainage however, all new foul drainage lines will be pressure tested and be subject to a CCTV survey in order to identify any possible defects prior to being made operational.

No specific mitigation measures are proposed in relation to water supply, however, water conservation measures such as dual flush water cisterns and low flow taps will be included in the design.

The potential impact of climate change has been allowed for as follows;

- Pluvial flood risk - attenuation storage design allows for a 20% increase in rainfall intensities, as directed by Kildare County Council's Water Services Engineer.
- Pluvial flood risk - drainage system design allows for a 20% increase in flows, as recommended by the GSDSDS.
- Provision of min. freeboard (500mm) from 1% AEP as required by GSDSDS (mitigation against impact of climate change).

8.7 Residual Impact of the Proposed Development

This section describes the predicted impact of the proposed development following the implementation of the remedial and mitigation measures, as set out above.

8.7.1 Construction Phase

Implementation of the measures outlined in Section 8.6.1 will ensure that the potential impacts of the proposed development on water and the hydrogeological environment do not occur during the construction phase. The predicted impact, post mitigation measures, will be negligible.

8.7.2 Operational Phase

As surface water drainage design has been carried out in accordance with the GSDSDS and SuDS methodologies are being implemented as part of a treatment train approach, predicted impacts on the water and hydrogeological environment arising from the operational phase will be negligible.

8.8 Monitoring

Proposed monitoring during the construction phase in relation to the water and hydrogeological environment are as follows:

- Adherence to Outline Construction Management Plan
- Inspection of fuel / oil storage areas.
- Monitoring cleanliness of adjacent road network, implementation of dust suppression and vehicle wheel wash facilities.
- Monitoring sediment control measures (sediment retention ponds, surface water inlet protection etc.)
- Monitoring of discharge from sediment retention ponds (e.g. pH, sediment content)

During the operational phase an inspection and maintenance contract is to be implemented in relation to the proposed Class 1 full retention fuel / oil separators.

8.9 Reinstatement

Oil, fuel etc. storage areas are to be decommissioned on completion of the construction phase. Any remaining liquids are to be removed from site and disposed of at an appropriate licenced facility. Kildare County Council's Environmental Control Section is to be notified of the proposed destination for disposal of any liquid fuels.

All sediment control measures (e.g. sediment retention ponds) are to be decommissioned on completion of the construction phase. Such areas are to be reinstated in accordance with the landscape architects plan and engineer's drawings.

8.10 Interactions and Potential Cumulative Impacts

8.10.1 Interactions

Soils and Hydrology

Surface water runoff during the construction phase may lead to erosion and contain increased silt levels (e.g. runoff across areas stripped of topsoil) or become polluted by construction activities. Runoff from exposed soils or contaminated leachate has the potential to affect water receptors

Increased impermeable surface area will reduce local ground water recharge and potentially increase surface water runoff (if not attenuated to greenfield runoff rate).

Biodiversity

Contamination of water receptors has the potential to affect aquatic ecology.

With the implementation of the aforementioned mitigation measures, the likelihood of such events occurring would be local and not significant.

8.10.2 Unplanned Events

The following accidents & disasters involving hydrology could potentially give rise to a serious incident putting people at risk:

- Accidental spills and leaks may result in contamination of water
- Flooding due to extreme event or unsuitable drainage measures

With the implementation of the aforementioned mitigation measures, the likelihood of such events occurring would be local and not significant.

8.10.3 Risks to Human Health

The following risk to human health can occur during construction:

- Cross contamination of potable water supply to construction compound.

With the implementation of the aforementioned mitigation measures, the likelihood of such events occurring would be local and not significant.

8.11 References

Greater Dublin Strategic Drainage Study (2005) – Fingal County Council, Dublin City Council, Dún Laoghaire-Rathdown County Council, South Dublin County Council, Wicklow County Council, Kildare County Council, Meath County Council

The Greater Dublin Region Code of Practice for Drainage Works (2012) – Fingal County Council, Dublin City Council, Dún Laoghaire-Rathdown County Council, South Dublin County Council, Wicklow County Council, Kildare County Council, Meath County Council

Celbridge Local Area Plan 2017-2023 Kildare County Council

Code of Practice for Water Infrastructure (2017) – Irish Water

Code of Practice for Wastewater Infrastructure (2017) – Irish Water

Ground Investigation Report (IGSL, Issue Date November 2018, report no. 21281).

Environmental Protection Agency (EPA) Online Mapping Service

Geological Survey of Ireland (GSI) online mapping service

Office of Public Works (OPW) National Flood Hazard Maps

OPW's Eastern Catchment Flood Risk Assessment and Management (CFRAM) Studies

OPW (November 2009) Guidelines for Planning Authorities – The Planning System and Flood Risk Management.

Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements. Institute of Geologists of Ireland (2013)

Guidelines on the information to be contained in environmental impact assessment reports. Environmental Protection Agency (Draft 2017).

170099-rep-001 Infrastructure Design Report submitted by DBFL.

170099-rep-002 Site Specific Flood Risk Assessment submitted by DBFL