clúid housing

80196-LEIXLIP-SOCIAL HOUSING DEVELOPMENT

DRAINAGE DESIGN REPORT

November 2023

NICHOLAS O'DWYER
an RSK company

CLUID HOUSING

LEIXLIP SOCIAL HOUSING DEVELOPMENT

DRAINAGE DESIGN REPORT

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November 2023

PROJECT NO. Project No.					
Revision	**Reason for Revision**	**Prepared by**	**Reviewed by**	**Approved by**	**Issue Date**
-	First Issue	FW	NS	NS	November 2023
A					
B					
C					
D					

CONTENTS

LIST OF FIGURES

1 INTRODUCTION

This Report deals with the wet services design (Water Supply, Foul Sewer Drainage and Surface Water Drainage) for the Leixlip housing development in Leixlip, Co. Kildare. The development consists of four buildings varying in height from one to two stories and will house 36 new residential units. The proposed residential units include one and two-bedroom apartments. A community center, communal garden, access road, parking, and a bin store will also be included in the development.

This report will address the following aspects of the development:

- Water Supply;
- Foul Sewer Drainage; and
- Surface Water Drainage;

This report should be read in conjunction with the following drawings:

Table 1-1 - Drainage Design Drawing List

Drawing Number	Drawing Title
80196-NOD-01-XX-DR-C-08001	Overall Site Location Plan
80196-NOD-01-XX-DR-C-08201	Combined Services Layout Plan
80196-NOD-01-XX-DR-C-08301	Foul Sewer Layout Plan
80196-NOD-01-XX-DR-C-08302	Foul Sewer Longitudinal Sections
80196-NOD-01-XX-DR-C-08310	Foul Sewer Standard Details Sheet 1
80196-NOD-01-XX-DR-C-08311	Foul Sewer Standard Details Sheet 2
80196-NOD-01-XX-DR-C-08312	Foul Sewer Standard Details Sheet 3
80196-NOD-01-XX-DR-C-08401	Surface Water Layout Plan
80196-NOD-01-XX-DR-C-08402	Surface Water Longitudinal Sections Sheet 1
80196-NOD-01-XX-DR-C-08403	Surface Water Longitudinal Sections Sheet 2
80196-NOD-01-XX-DR-C-08410	Surface Water Standard Details Sheet 1
80196-NOD-01-XX-DR-C-08411	Surface Water Standard Details Sheet 2
80196-NOD-01-XX-DR-C-08412	Surface Water Standard Details Sheet 3
80196-NOD-01-XX-DR-C-08501	Water Supply Plan layout
80196-NOD-01-XX-DR-C-08510	Water Supply Standard Details Sheet 1
80196-NOD-01-XX-DR-C-08511	Water Supply Standard Details Sheet 2
80196-NOD-01-XX-DR-C-08601	Roadway Access Layout and Details
80196-NOD-01-XX-DR-C-08801	Vehicle Tracking Passenger Vehicle
80196-NOD-01-XX-DR-C-08802	Vehicle Tracking Rigid Vehicles

2 SITE LOCATION

The site is located in Leixlip, Co. Kildare. The site is located at 53°21'53.37" north latitude and 6°29'8.99" west longitude. The site can be accessed via Mill Lane. Refer to Figure 2-1 below:

Figure 2-1 Locality Map

3 SITE DESCRIPTION

The proposed housing development is situated on a greenfield site in the centre of Leixlip, Co. Kildare. The site access is via a narrow-gated lane adjacent the former ESB building. The access point is located on the junction of Main Street and Mill Lane.

The site has a Trapezoidal shape with the widest portion measuring to approximately 90m to the West and East, and approximately 51m from North to South. A topographical survey was carried out by Murphy Geospatial in November 2022 and is attached in Appendix A.

The site includes several disused buildings adjacent to the road. The site is heavily overgrown to the North. The site appears relatively flat with a gentle slope from the North towards the South. Mature trees are located on the Northern boundary, whilst the site's Southern boundary borders the rear gardens of houses that face on to Mill Lane. The Eastern boundary borders rear gardens of houses that face on to Cypress Springs.

4 EXISTING SERVICES

The site hosts a ESB Telecoms site on the Western boundary of the site. The site contains a 30m high communications mast and associated infrastructure. Some overhead cables are located at the entrance of the site.

Irish records show a 225mm pipe running North to South through the site. Refer to Figure 4-1 below:

Figure 4-1 Irish Water drainage map extract showing 225mm pipe

A diversion application for the existing 225mm diameter Foul Sewer pipe that runs through the site was made during August 2023. The case number is DIV23200. A CCTV survey and associated Report was requested by Uisce Éireann that covers the full section of the existing 225mm pipe to be abandoned. We are currently awaiting the contractor's completion of the CCTV survey and accompanying report in order to determine the status of the diversion.

The location of other existing services in the site (if any) is unclear at the moment. The Contractor is expected to consider the surrounding environment, inclusive of existing services, and employ safe systems of work in line with the HSA requirements.

A public water main is available along Mill Lane. The exact tie-in location to the public water main is still to be confirmed.

Figure 4-2 below shows no historical ground features, quarries, wells, water courses and springs at the site to be concerned of. A large portion of the site is located within the National Monument Zone.

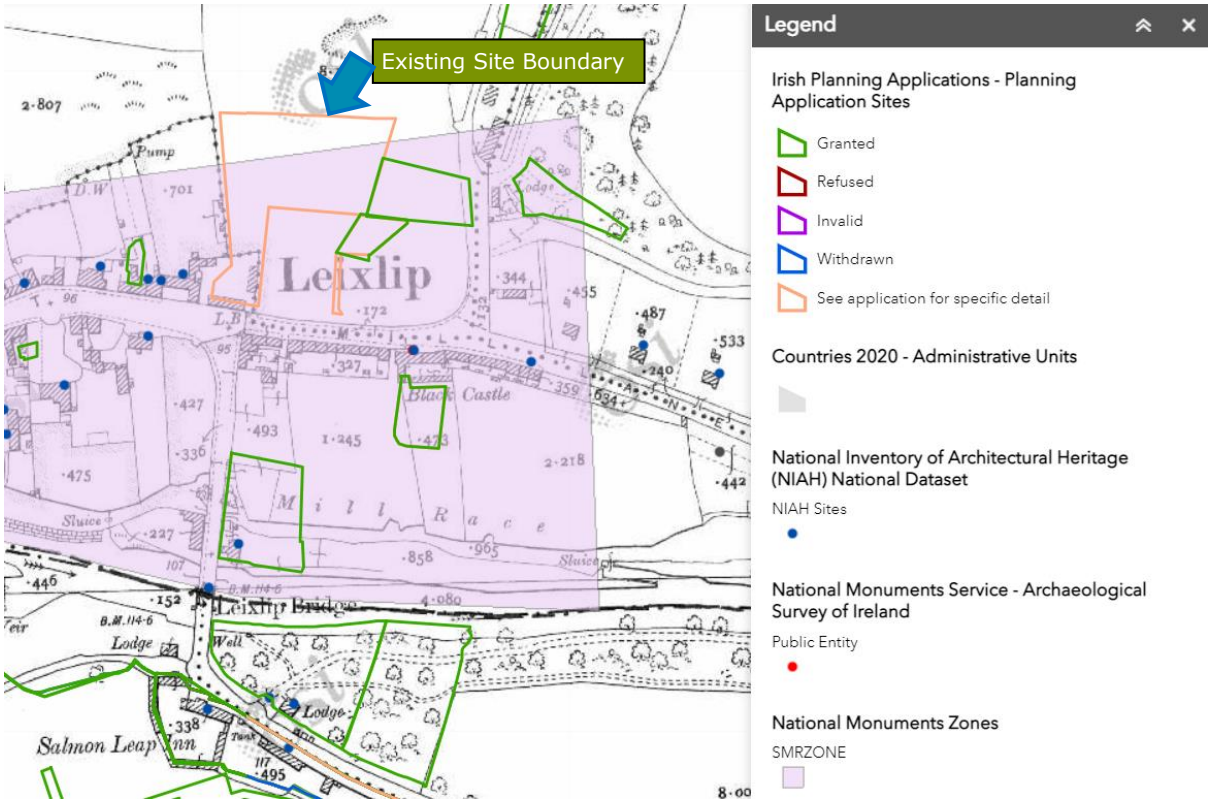
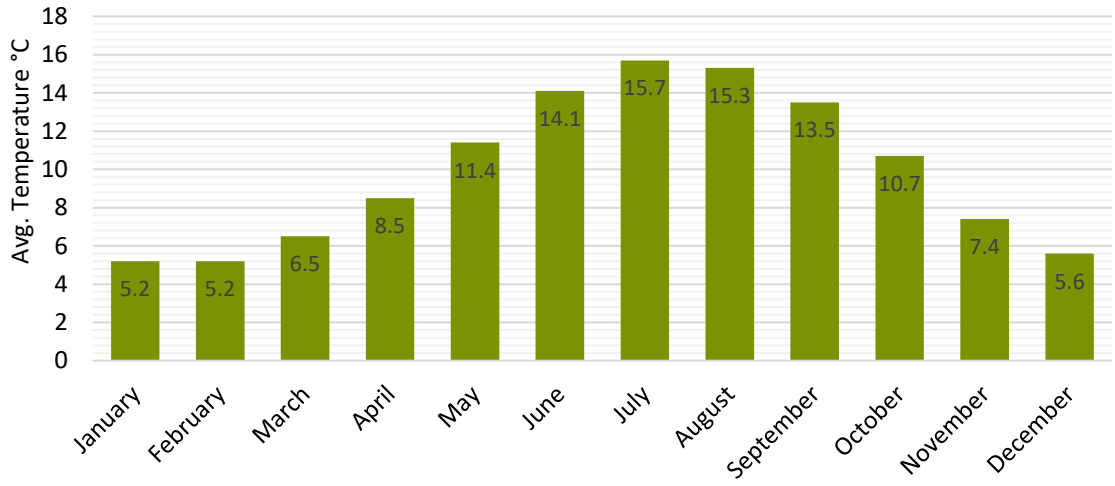


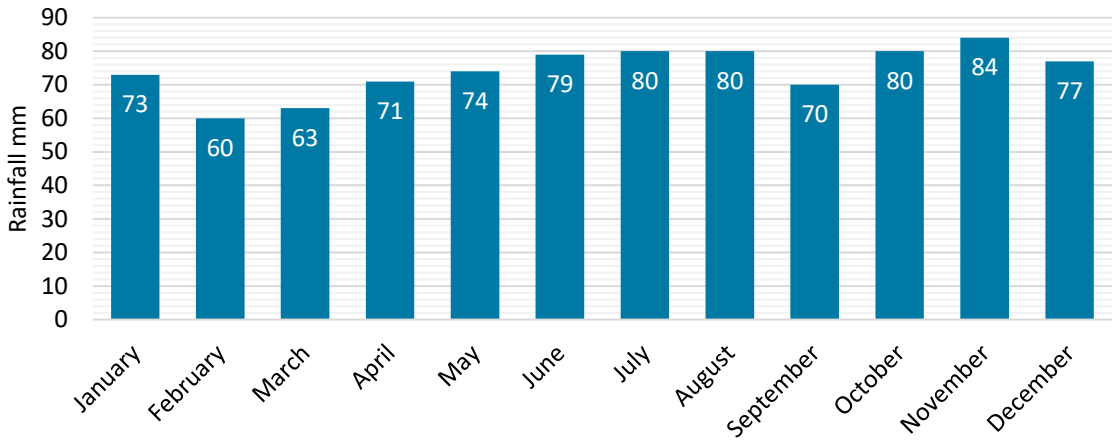
Figure 4-2 Historic map

4.1 Climate

The climate in Lexlip is warm and temperate. Leixlip experiences significant annual rainfall. Even the driest month still has a lot of rainfall. Leixlip's annual average temperature is 9.9°C and the annual rainfall is 891mm. Leixlip is located in the northern hemisphere. Summer begins at the end of June and ends in September. The months of summer are June, July, August, and September.



With an average of 15.7°C, July is the warmest month. In January, the average temperature is 5.2°C. It is the lowest average temperature of the whole year.



The driest month is February. There is 60mm of precipitation in February. Most precipitation falls in November, with an average of 84mm.

5 SUB-SOIL CONDITIONS

A Geotechnical investigation report shall be completed by Priority Geotechnical Limited in the near future, which will provide details of sub soil conditions.

6 WATER SUPPLY

6.1 Scope Overview

To provide an adequate water distribution supply for water consumption by the proposed housing development.

6.2 Design Standards and Design Guidelines

- Irish Water – Code of Practice for Water Infrastructure

6.3 Proposed Design

The proposed development of 36 new residential units will be fed from the existing water supply main located on Mill Lane.

On 07 March 2023, Irish Water have issued a "CONFIRMATION OF FEASIBILITY" for our pre-connection enquiry (CDS23001664). The contents of the confirmation confirmed that there will not a requirement for upgrading the main line.

The post development peak demand has been calculated as 1.055 l/s and the average hour water demand has been calculated as 0.21 l/s. Calculations in support of this design are included in Appendix A.

The proposed watermain, connections and hydrants will all be installed in accordance with the Irish Water specification for developments. The ring main will be a minimum of 150mm diameter. Spurs and connections from the ring main will be 100mm diameter.

The proposed development shall require approximately 3 fire hydrants. The exact number and locations will be agreed upon with the fire consultant and fire officer.

It is proposed to install one off-line fire hydrant on the new proposed main to service the Southern elevations of the development and a second hydrant to service the Northern elevations. The third hydrant is proposed to be located within the vicinity of the bin store and existing telecoms site area. Note that this is subject to review by Irish Water, fire officer and fire consultant. Given the height and scale of the building, the fire officer may require assurance of a reliable water supply and pressure; this may be satisfied by carrying out a flow-pressure test on an existing hydrant on the public main and may require additional testing when the new main is constructed. If the water pressure is not found to be sufficient, then water storage for firefighting may be required for the site.

For layout and details of the proposed water services please refer to the following drawings.

80196-NOD-01-XX-DR-C-08501	Water Supply Plan layout
80196-NOD-01-XX-DR-C-08510	Water Supply Standard Details Sheet 1
80196-NOD-01-XX-DR-C-08511	Water Supply Standard Details Sheet 2

7 FOUL SEWER DRAINAGE

7.1 Scope Overview

To provide a collection system to receive, manage and dispose of foul sewer discharge associated with the proposed development.

7.2 Design Standards and Design Guidelines

- Irish Water – Code of Practice for Wastewater Infrastructure

7.3 Proposed Design

According to Irish records, a 225mm pipe runs through the site from north to south. During August 2023, a diversion application for the existing 225mm diameter Foul Sewer pipe that runs through the site was submitted. Following permission and approval from Irish Water, this pipe will be re-aligned to a new location within the access road and discharge into the existing Foul sewer manhole on Mill lane.

Total foul water discharge is based on a total population of 36 persons and having a rate of 150l/pop/day over a 24-hour period. The proposed maximum peak discharge from the site at 3 DWF will be 0.54 l/sec averaged over a 24-hour period.

For layout and details of the proposed Foul drainage please refer to the following drawings.

80196-NOD-01-XX-DR-C-08301	Foul Sewer Layout Plan
80196-NOD-01-XX-DR-C-08302	Foul Sewer Longitudinal Sections
80196-NOD-01-XX-DR-C-08310	Foul Sewer Standard Details Sheet 1
80196-NOD-01-XX-DR-C-08311	Foul Sewer Standard Details Sheet 2
80196-NOD-01-XX-DR-C-08312	Foul Sewer Standard Details Sheet 3

8 FLOOD RISK ASSESSMENT

Refer to appendix C for a detailed flood risk assessment.

9 SURFACE WATER DRAINAGE

9.1 Overview

The overall objective of the stormwater drainage is to provide well-drained operational areas to permit the safe movement of vehicles and efficient operation of the buildings under storm conditions. Terraces, hard stand areas, and roadways with concrete, paving, and gravel surfaces are all part of the proposed surface infrastructure.

The stormwater management for the proposed housing development will focus on the following:

- Prevent flooding of the proposed housing development due to possible flash floods coming from upstream catchments (external storm water system).
- Prevent flooding of the proposed site due to rainfall falling directly on the site (internal storm water system).
- To control and separate polluted and unpolluted water generated within the proposed housing development.

9.2 Design Standards and Design Guidelines

- CIRIA Sustainable Drainage Systems (SUDS) Manual 2015
- BS 8582:2013

9.3 Proposed Design

It is proposed to discharge surface water to the existing surface water manhole on the site using a combination of sustainable methods and storage facilities in accordance with the Great Dublin Strategic Drainage Study Policy.

The current green field portion of the site discharges surface water naturally towards the northern boundary of the site. The existing entrance of the site has existing surface water gullies that discharge towards the existing surface water drainage network on Mill Lane.

It is intended to collect and contain the surface water generated within the proposed development and then discharge into the existing surface water network within Mill Lane

Calculations for the quantity of run off and volume of surface water to be disposed off-site is for the 1 in 100-year storm event. The total maximum storage capacity required for the site is 240m³ for a 1 in 100-year storm event with a 20% increase allowance for Climate change. Calculations in support of this design are included in Appendix D

Attenuation of the surface water will be provided by mainly Stormtech underground storage systems and a mixed use of permeable paving.

For layout and details of the proposed Surface Water drainage please refer to the following drawings.

80196-NOD-01-XX-DR-C-08401	Surface Water Layout Plan
80196-NOD-01-XX-DR-C-08402	Surface Water Longitudinal Sections Sheet 1
80196-NOD-01-XX-DR-C-08403	Surface Water Longitudinal Sections Sheet 2
80196-NOD-01-XX-DR-C-08410	Surface Water Standard Details Sheet 1

9.4 Sustainable Drainage Systems (SuDS)

The Sustainable Urban Drainage Systems have been designed in accordance with the SUDS Manual and to suit the site constraints. SUDS incorporate a series of elements that have been developed to attenuate flows and mitigate pollution from runoff. The philosophy of SUDS is to replicate as close as possible the natural drainage from a site before the development, so reducing the impact on the receiving watercourse.
A detailed site investigation has yet to be received, and more in-depth examination of the ground condition will be performed, resulting in an upgrade to the planned surface water drainage design if required.

9.4.1 Proposed SUDS elements

- Permeable Paving for parking spaces

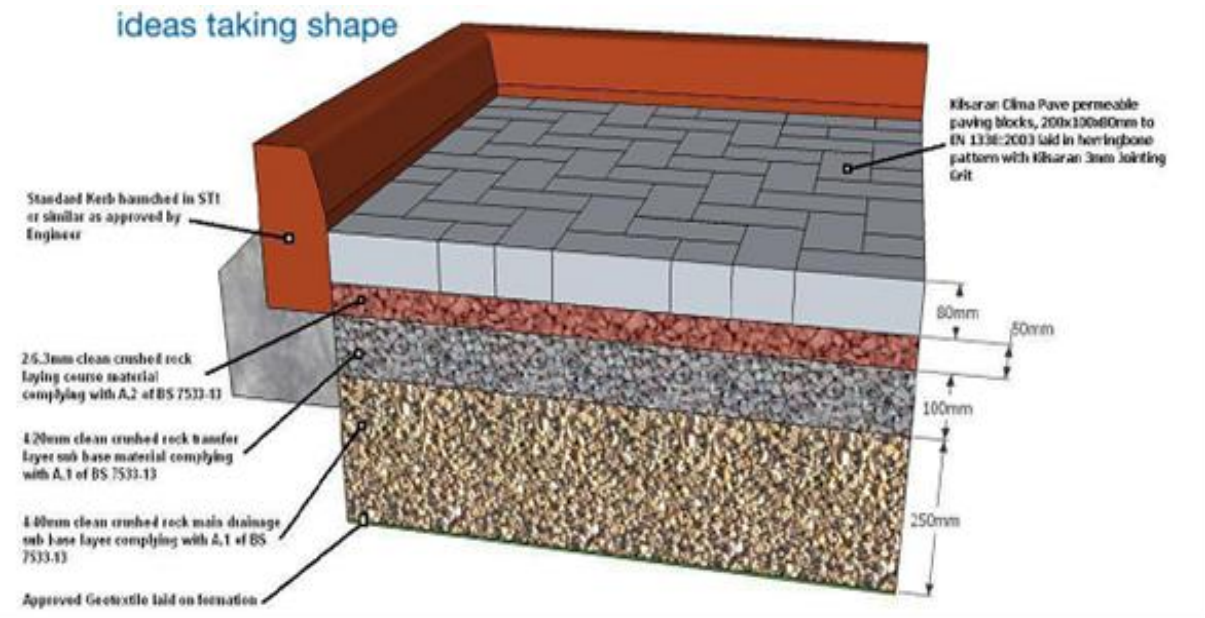


Figure 9-1: Typical permeable paving detail

Filter Drain network serving roads where open areas are adjacent the roads. Filter drains for the proposed development have been designed in accordance with current guidelines and regulations including the DOE "Recommendations for Site Development Works for Housing Areas", BS8301: 1985, IS EN752: 2008 "Drain & Sewer Systems outside Buildings" and the recommendations of the GDSDS.
Swales with porous piping in the open areas.

- Stormtech Soak-away providing significant attenuation storage:

Figure 9-2: Typical attenuation/soakaway structure

By combining several SUDS elements, a treatment train is formed which initially infiltrates the development runoff, removing pollutants as it soaks through the permeable paviours and filter drain material. Treatment storage is the second step and is provided by filtration through stone layers, either beneath permeable paving or as part of a filter drain. An additional stage of filtration would be provided by the stone layer at the base of the Stormtech facility. All these methods allow for groundwater recharge.

An outfall manhole containing a flow restriction would be employed to limit the overall site runoff (see below).

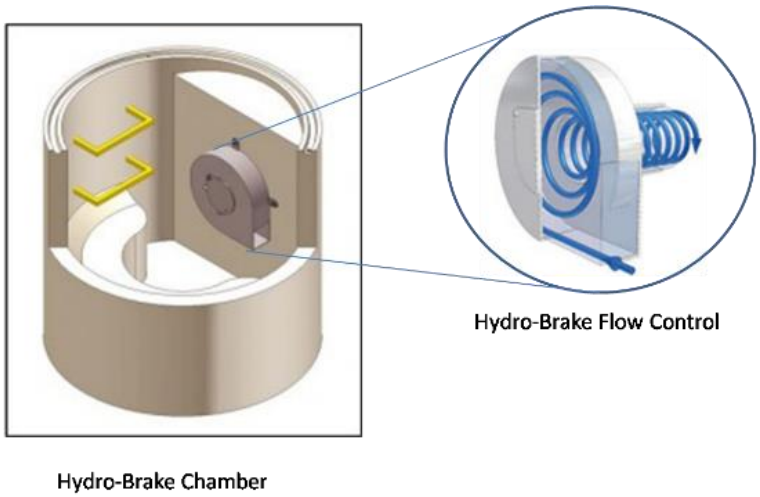


Figure 9-3: Flow restricting Hydro-Brake Chamber

APPENDIX A – WATER SUPPLY CALCULATIONS

PROJECT TITLE: Leixlip-Old ESB Site **JOB REFERENCE:** 80196

SUBJECT
Water Demand for Irish Water

DRAWING NO. 80196-NOD-01-XX-DR-C-08501 **CALCULATIONS BY** BV **CHECKED BY** MD **DATE** 2023/02/28

POST DEVELOPMENT DEMAND

Per-Capita Consumption[1]	150	litres/person/day
Average Occupancy Ratio[2]	2,7	person/unit

Residential Unit Type	Unit
Average Occupancy(persons)	2,7
Number of Units	36
Average Occupancy[5] (PE)	97,2

Average Residential Demand[6] **14 580** l/day

Commercial Unit Type	Shopping	Commercial	Pub/ Restaurant	Leisure/ Gym	Medical/ Care Home	Creche
Average Occupancy (per m2)	0	0	0	0	0	0
Area(m2)	0	0	0	0	0	0
Average Occupancy[5] (PE)	0	0	0	0	0	0
Average Usage(litres per person/day)	25	100	60	50	350	60
Daily Usage(*l*)	0	0	0	0	0	0

Average Commercial Demand[6] **0** l/day

Average Day/Week Demand Factor[3]	1,25
Peak Demand Factor[4]	5

WATER DEMAND SUMMARY

	Residential	Commercial	Total
Average Daily Demand	0,17 l/s	0,00 l/s	0,17 l/s
Average Day/Peak Week Demand[7]	0,21 l/s	0,00 l/s	0,21 l/s
Peak Hour Water Demand[8]	**1,055** l/s	**0,000** l/s	**1,055** l/s

Notes:

1. Per-Capita Consumption 150l/person/day as per Irish Water Code of Practice - (3.7.2)
2. Average Occupancy ratio of 2.7 persons per dwelling from Irish Water Code of Practice - (3.7.2)
3. Average Day/Week Demand Factor is 1.25 as per Irish Water Code of Practice - (3.7.2)
4. Peak Demand Factor is 5 as per Irish Water Code of Practice - (3.7.2)
5. Average Occupancy(or PE-Population Equivalent) = No. of Residential Units **X** Average Occupancy Ratio
6. Average Domestic Demand = Average Occupancy **X** Per-Capita Consumption
7. Average Day/Peak Week Demand = Average Daily Domestic Demand **X** Average Day/Week Demand Factor
8. Peak Hour Water Demand = Average Occupancy **X** Per-Capita Consumption **X** Average Day/Week Demand Factor **X** Peak Demand Factor

APPENDIX B – FOUL SEWER CALCULATIONS

PROJECT TITLE: Leixlip **JOB REFERENCE:** 80196

SUBJECT
Wastewater Load for Irish Water

DRAWING NO. 80196-NOD-01-XX-DR-C-08301 **CALCULATIONS BY:** BV **CHECKED BY:** MD **DATE** 2023/02/28

POST DEVELOPMENT DEMAND

Wastewater flow per head[1]	150 litres	Unit Consumption Allowance[3]		10 %
Average Occupancy Ratio[2]	2,7 person/unit	DWF Peak Factor[4]	Res. 3	Com. 4,5

Residential Unit	Unit
Average Occupancy(persons)	2,7
Number of Units	35
Average Occupancy (PE)	94,5

Residential Dry Weather Flow(DWF) Volume[5] **15 593** litres

Commercial Unit Type	Shopping	Commercial	Pub/ Restaurant	Leisure/ Gym	Medical/ Care Home	Creche
Average Occupancy (per m2)	0	0	0	0	0	0
Area(m2)	0	0	0	0	0	0
Average Occupancy[5] (PE)	0	0	0	0	0	0
Average Usage(litres per person/day)[9]	25	100	60	50	350	50
Daily Usage(/)	0	0	0	0	0	0

Commercial Dry Weather Flow(DWF) Volume[5] **0** litres

WASTEWATER LOADING SUMMARY

	Residential	Commercial	Total
Average Daily Discharge	0,18 l/s	0,00 l/s	0,18 l/s
Peak Discharge[6]	0,54 l/s	0,00 l/s	0,54 l/s

Notes:

1. Waste Water flow - 150 l/head as per Irish Water Code of Practice - (3.6)
2. Average Occupancy ratio of 2.7 persons per dwelling from Irish Water Code of Practice - (3.6)
3. 10% Unit Consumption Allowance as per Irish Water Code of Practice - (3.6.3)
4. DWF Peak Factor is 6 as per Irish Water Code of Practice - (3.6)
5. Dry Weather Flow = No. of Residential Units **X** Average Occupancy Ratio **X** Waste Water Flow **X** UCA[3]
6. Peak Discharge = Average Daily Discharge **X** DWF Peak Factor
7. The average concentrations of wastewater parameters taken from EPA "Wastewater Treatment Manuals, Treatment Systems for Small Communities, Business, Leisure Centres and Hotels".
8. Assumed Maximum concentration is equal to the average concentration plus 2 times the standard deviation (for the 95%ile) taken from EPA "Wastewater Treatment Manuals, Treatment Systems for Small Communities, Business, Leisure Centres and Hotels".

APPENDIX C – FLOOD RISK ASSESSMENT

STAGE 2 SITE SPECIFIC

FLOOD RISK ASSESSMENT

PROPOSED CLUID HOUSING, LEIXLIP, COUNTY KILDARE

AUGUST 2023

CHARTERED CIVIL ENGINEERS

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Email: phil@floodriskconsulting.com | Web: www.floodriskconsulting.com

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Contents

1.0 INTRODUCTION

1.1 This report has been prepared by Flood Risk Consulting (FRC). The brief for the study was to carry out a Stage 2 Site Specific Flood Risk Assessment (SSFRA), in regulation with The Planning System and Flood Risk Management: Guidelines for Planning Authorities (OPW, 2009) for the proposed Cluid Housing at Leixlip, County Kildare.

1.2 FRC understands that this Stage 2 report is required to inform the design and progress of the proposal.

1.3 Therefore, this SSFRA will seek to identify and assess the Flood Zones and predicted flood levels and extents at the proposed development, as based on current available CFRAM data.

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1.7 It should be noted that there are no circumstances in which the risk of flooding can be removed entirely. This report should not be considered a guarantee against future flooding events but instead aiming to evaluate the risk of flooding at the site and then propose mitigation measures that may reduce the impact of such flooding.

2.0 DESCRIPTION OF SITE

2.1 Plate 2.1 presents mapping of the proposed site (identified by the red marker on Google Maps).

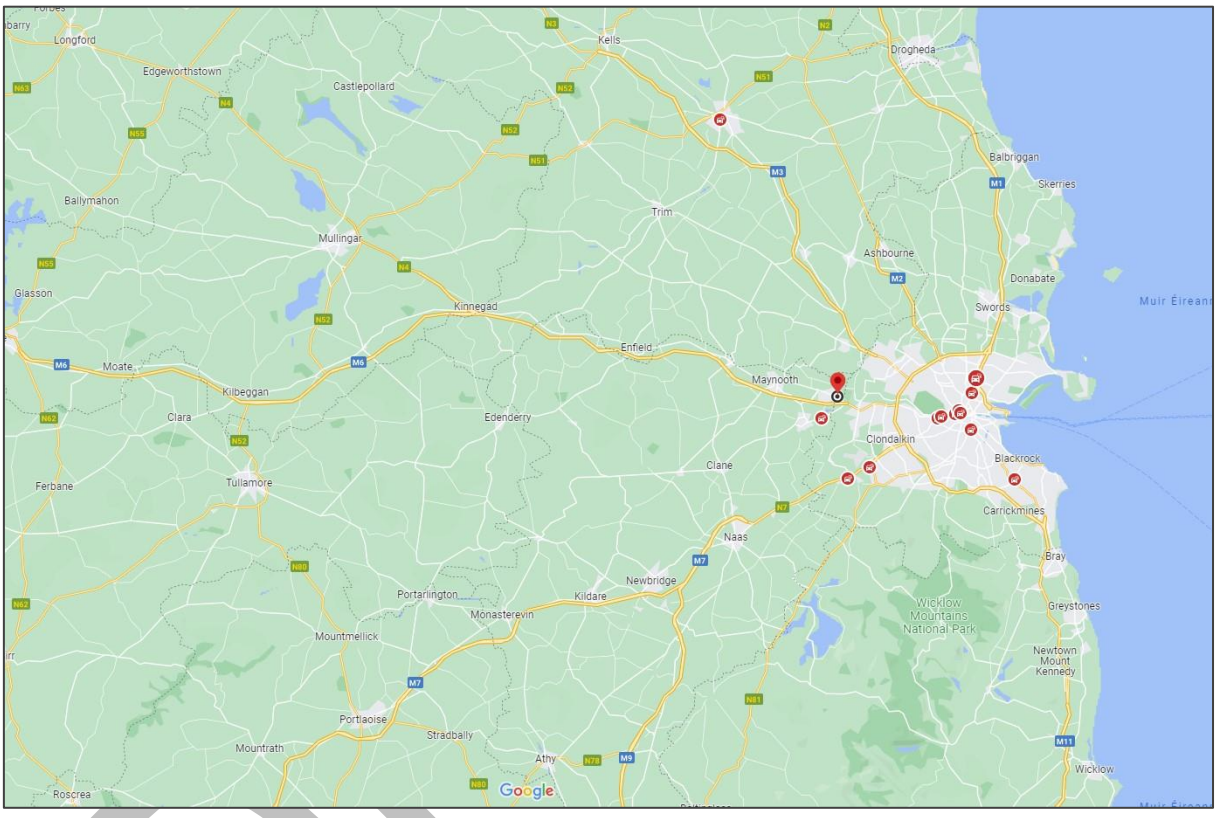

Plate 2.1: Mapping showing the location of the proposed site

2.2 Plate 2.2 presents lower scale Google mapping of the site relative to Dublin, where the site can be seen to be located within the urban area to the west of the city centre.

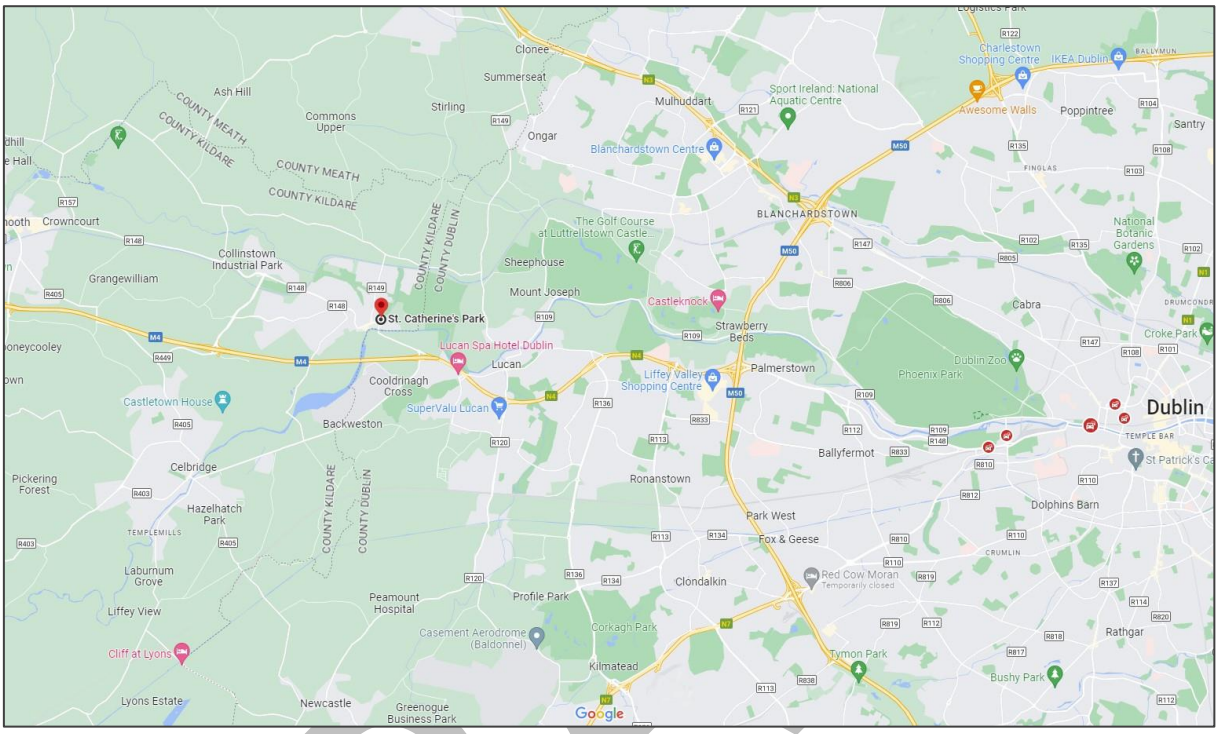

Plate 2.2: Lower scale Google mapping of the location of the proposed site

2.3 Plate 2.3 presents a site location map, as outlined in red. The site can be seen to be located to the rear of existing development along Mill Lane.

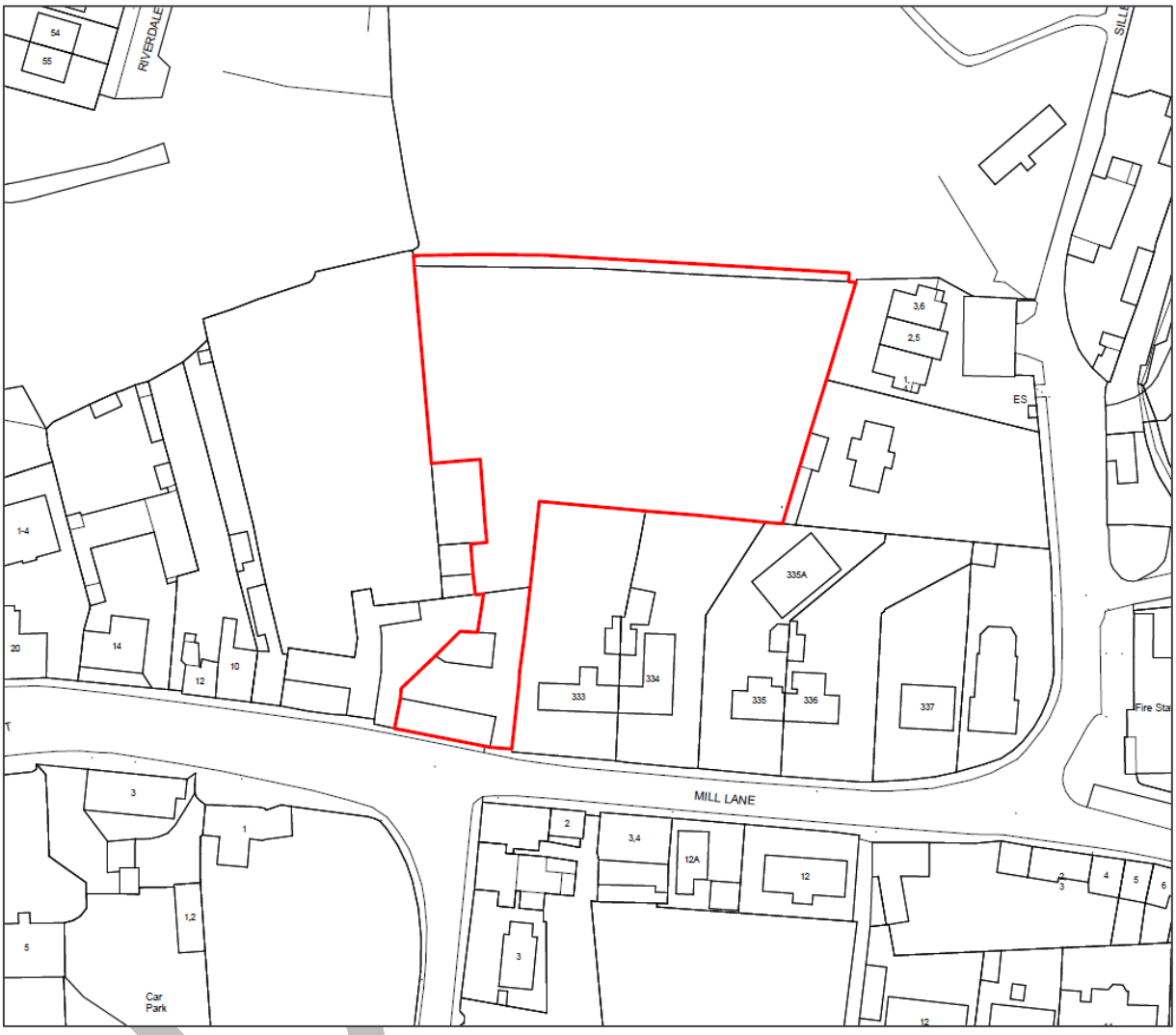

Plate 2.3: Site location map

2.4 Plate 2.4 presents EPA mapping of the watercourses in the area with the location of the approximate centroid of the proposed site indicated by the red triangle. The River Liffey passes a distance south of the site and the tributary Rye Water flows to the Liffey to the west of the site. A small tributary is also indicated to the east of the site.

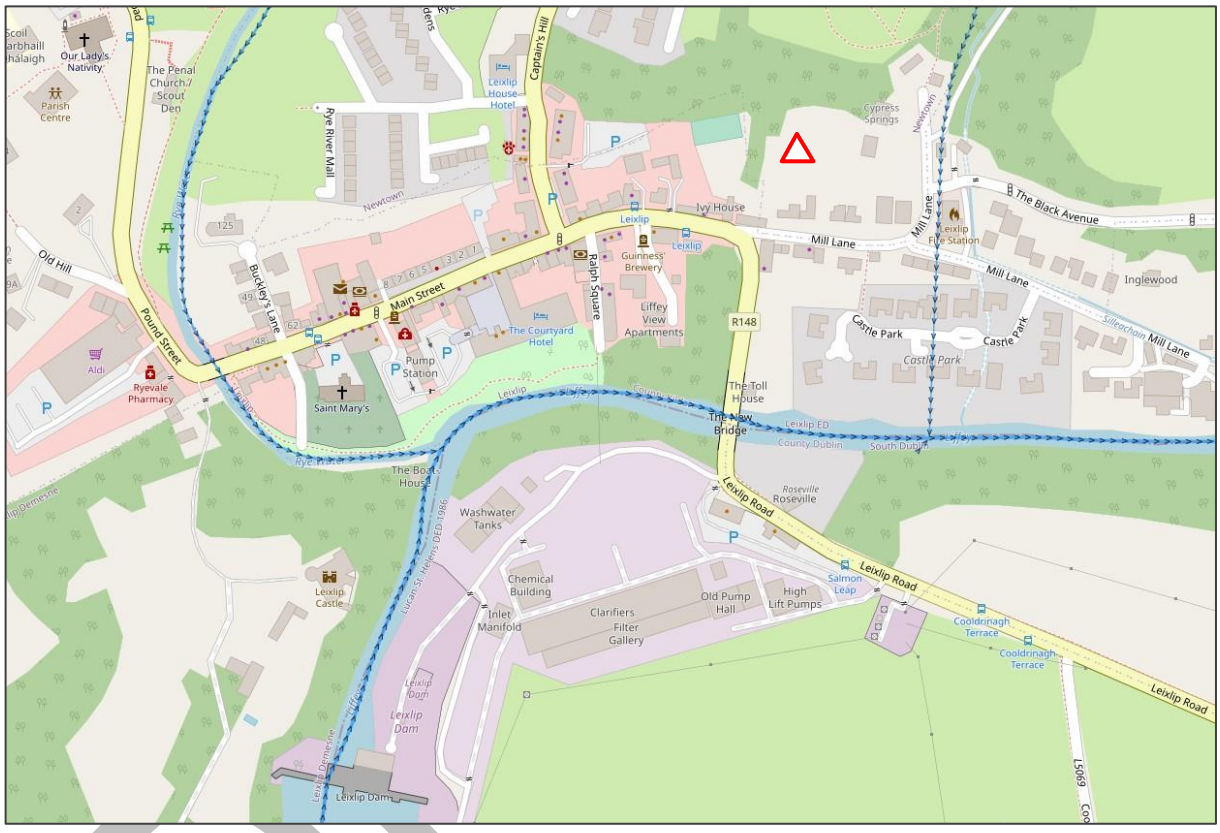

Plate 2.4: EPA mapping with OpenStreetMap background

2.5 Plate 2.5 presents OSI mapping of the area, with the proposed site location again approximately indicated by the red triangle. Contour lines (10m) on this mapping indicate that the area is generally falling south eastwards towards the River Liffey.

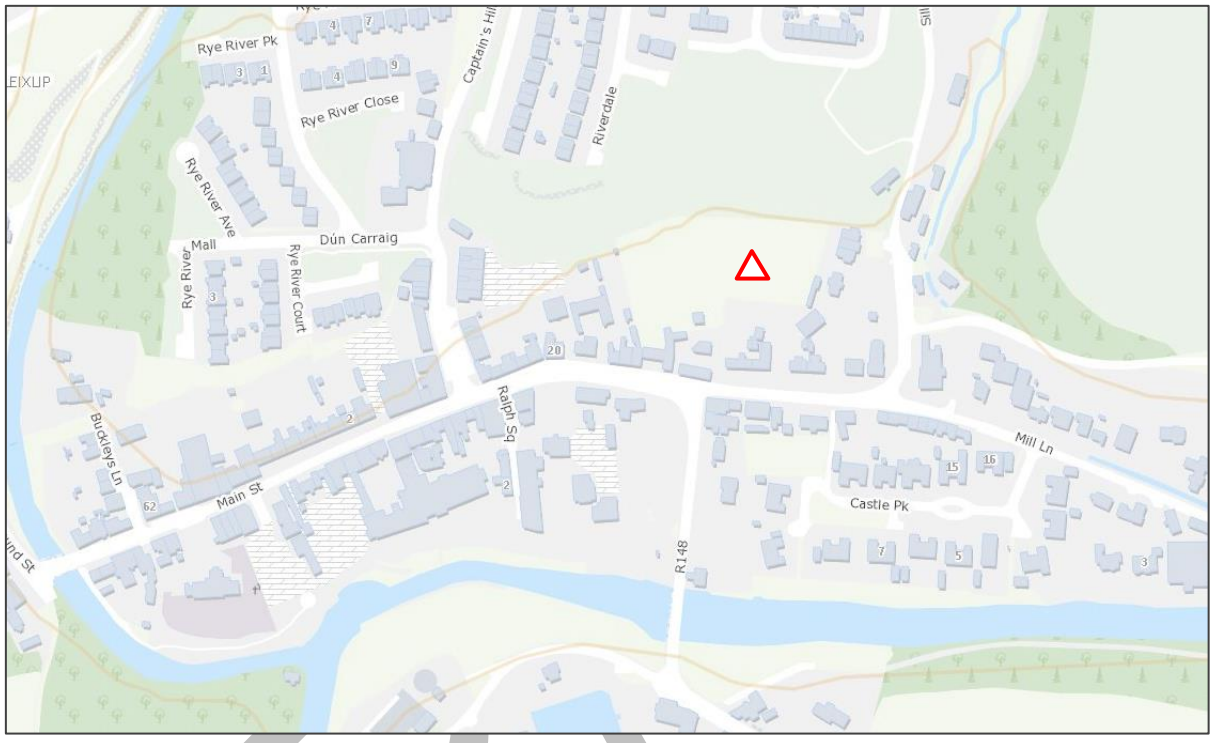

Plate 2.5: OSI mapping of the proposed site

2.6 Plate 2.6 presents historic Ordnance Survey mapping of the area, again with the site approximately identified by the red triangle. This plate illustrates the historic routes of the local watercourses.

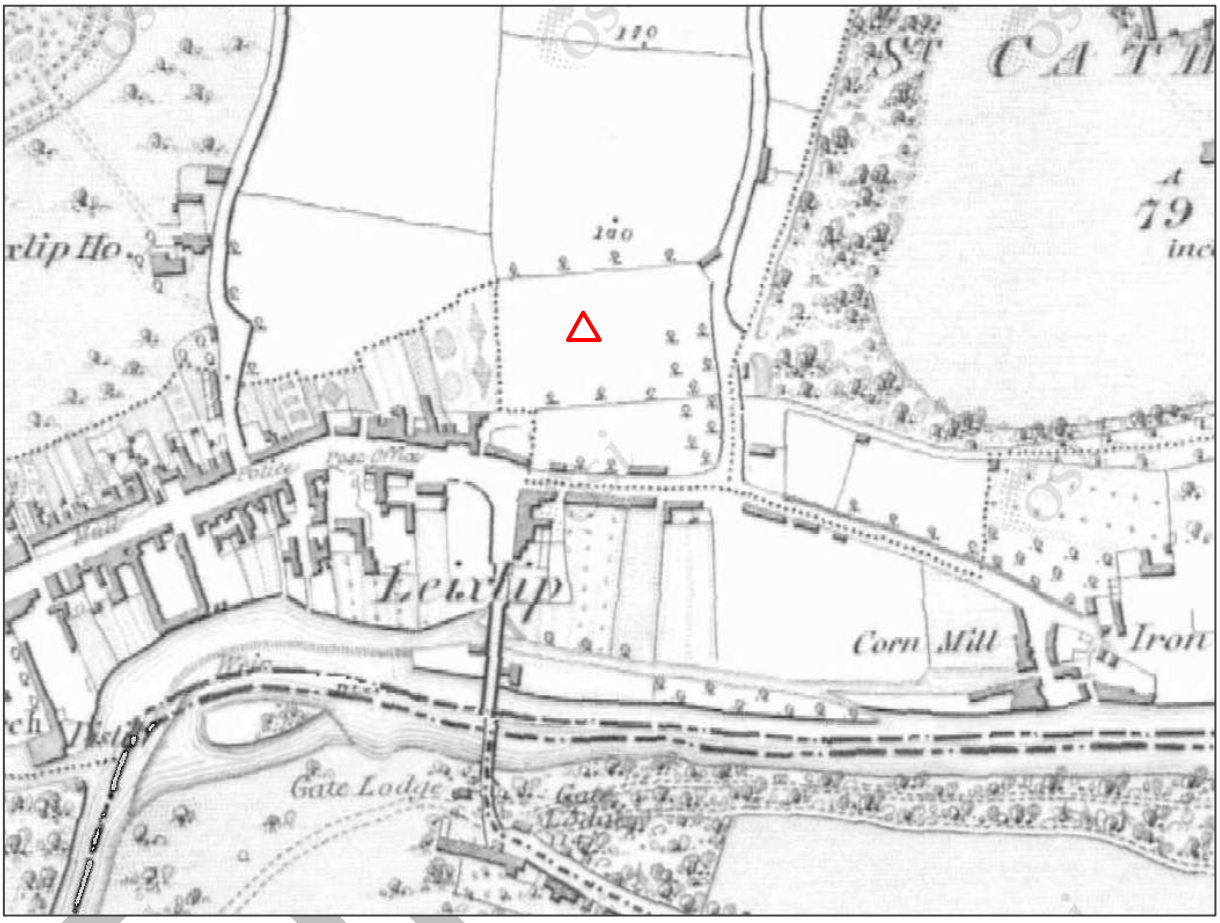

Plate 2.6: Historic Ordnance Survey mapping of the proposed site

2.7 Plate 2.7 presents aerial photography of the proposed site, with the location indicated by the red triangle. The lands of interest are shown to be generally undeveloped.

Plate 2.7: Aerial photography of the proposed site

2.8 Plate 2.8 presents an extract of OPW mapping of local water features and areas identified as Arterial Drainage Schemes (ADS) and Drainage Districts (DD) benefited lands. This mapping indicates that the site is not in an area of benefited lands under either scheme.

Plate 2.8: OPW ADS benefited lands

3.0 INFORMATION FROM FLOOD MAPS

3.1 CFRAM fluvial flood mapping was examined for the area, where an extract of flood extents are presented on Plate 3.1. This map suggests that the proposed site will be affected by the 1 in 1,000 year fluvial flooding event. It is assumed that the CFRAM hydraulic modelling is predicting overland flooding emanating from exceedance of the upstream watercourse channel.

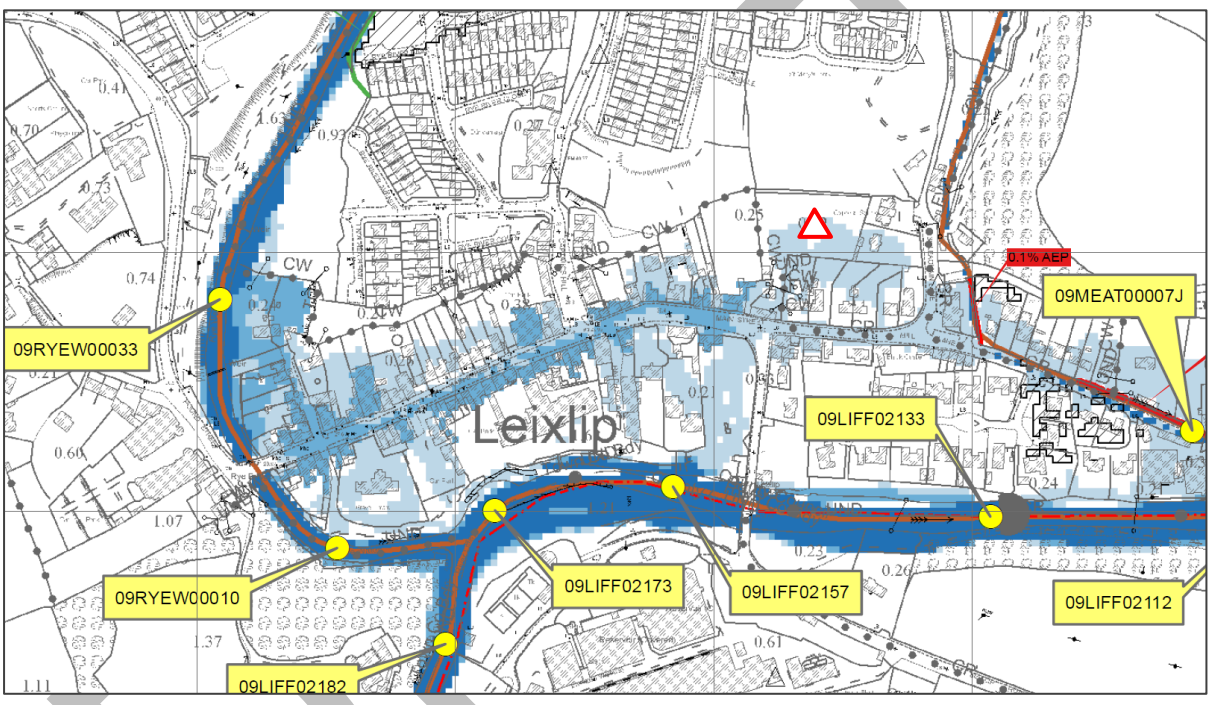

Plate 3.1: CFRAM fluvial flood extents mapping

3.2 Table 3.1 presents the flood levels indicated on the CFRAM mapping for the upstream western Rye Water, southern Liffey and downstream eastern tributary. Flood levels vary from west to east as per the topography and flow regime for the area, where high levels along the Rye Water to the west of the site result in the overland flooding which reaches the proposed site. The Q1000 flood level along the Liffey a distance south of the site is 25.90m OD. It should be noted that the predicted flood levels along the centrelines of the watercourses does not necessarily represent the predicted flood level beyond the watercourses. This is because once a river bursts its banks and flows across the out of bank area, the flood level may vary dependant on the local topography. Therefore, further consideration is deemed necessary to assess the overland floodplain levels at the site. Further assessment of the predicted fluvial flood levels at the site will be considered in Section 4.0 of this report.

Location	CFRAM Node	Q10 Flood Level	Q100 Flood Level	Q1000 Flood Level
West - Rye Water	09RYEW00033	27.41	27.84	28.24
South - Liffey	09LIFF02157	25.00	25.46	25.90
East - Tributary	09MEAT00007J	24.00	24.44	24.87

Table 3.1: CFRAM predicted flood levels upstream and downstream of the proposed site

3.3 Plate 3.2 presents the predicted flood depth CFRAM mapping at the proposed site during a Q100 flood event. Flooding in this instance is shown to emanate from the Rye Water west of the site, where overland flooding reaches close to the site's south western corner but does not extend across its footprint. The southern River Liffey and eastern small tributary are shown to remain generally in-bank in the vicinity of the site for this scenario.

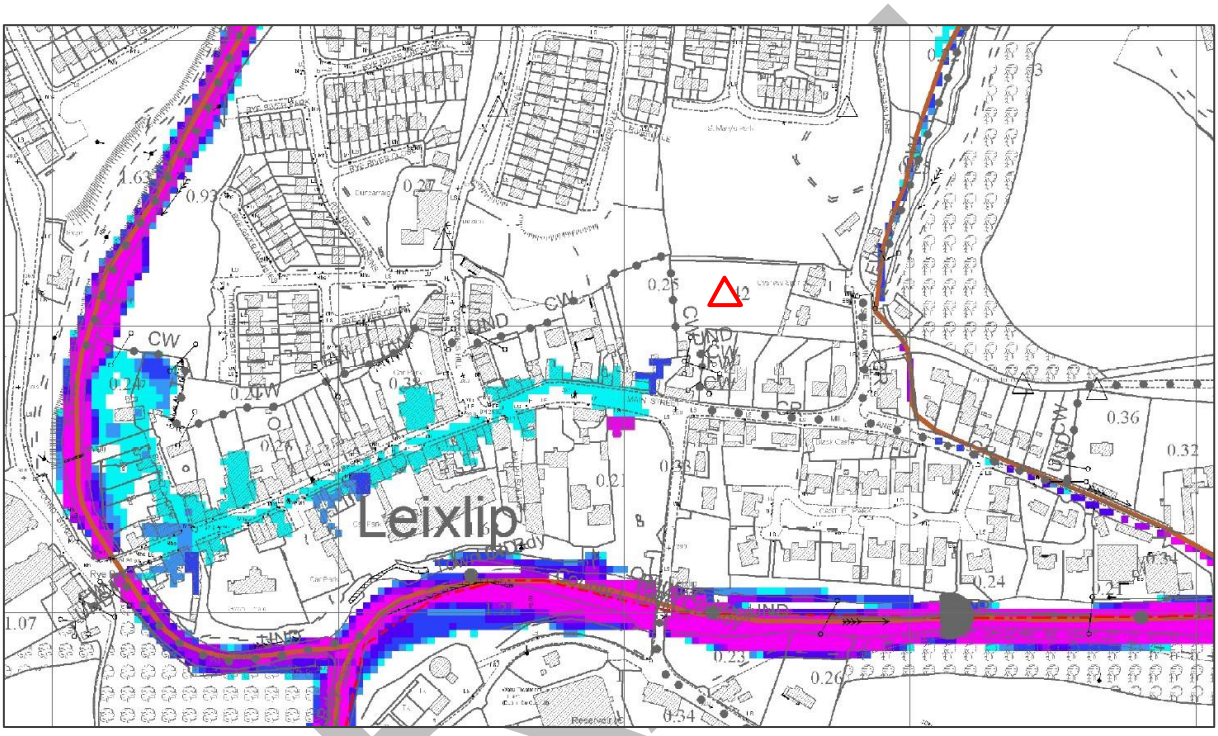

Plate 3.2: CFRAM Q100 fluvial flood depths at the site

3.4 Plate 3.3 presents the predicted flood depth CFRAM mapping at the proposed site during a Q1000 flood event. Flooding in this instance is shown across the majority of the site's footprint, with depths generally shallow, occurring up to 0.5m. As noted previously, no overland flood levels are provided on the CFRAM mapping.

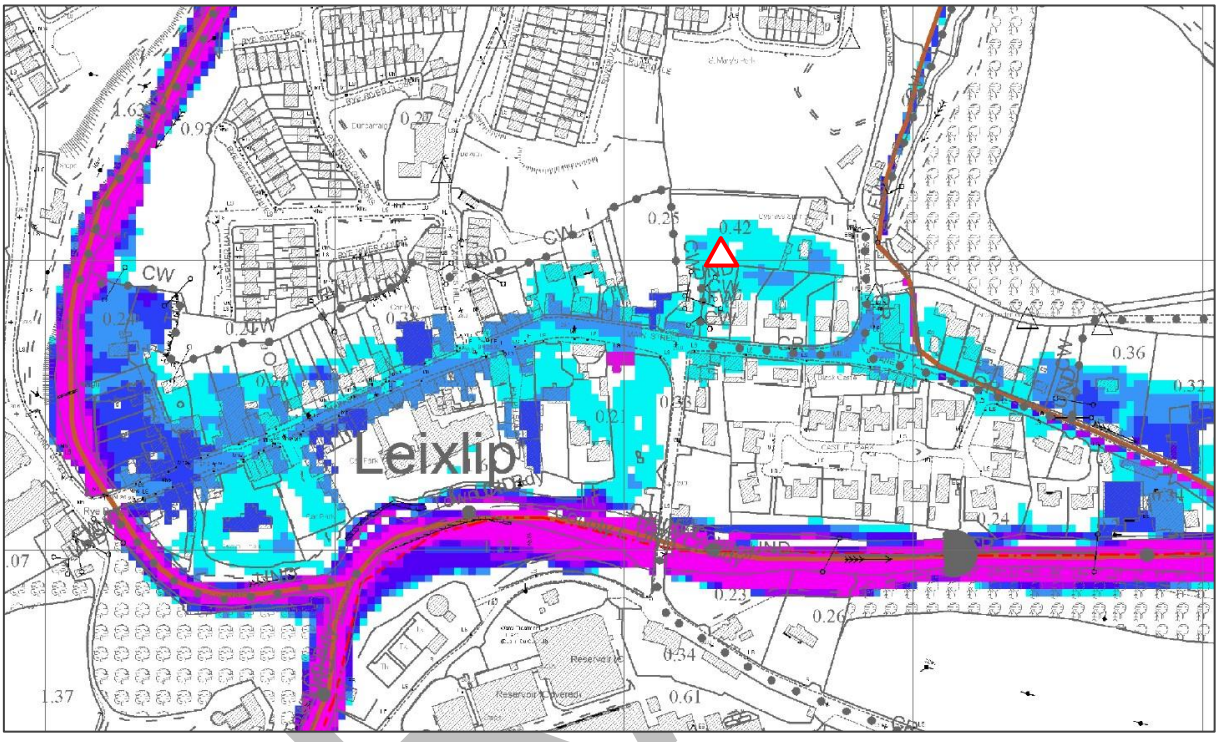

Plate 3.3: CFRAM Q1000 fluvial flood depths at the site

3.5 Plates 3.4 and 3.5 present extracts of CFRAM Q1000 fluvial flood extent mapping for the mid and high climate change scenarios respectively. The climate change allowances can be seen to increase the predicted flood extents within the site for the Q1000 event.

Plate 3.5: CFRAM Q1000 + mid climate change fluvial flood extents

Plate 3.5: CFRAM Q1000 + high climate change fluvial flood extents

3.6 Plate 3.6 presents an extract from Geological Survey Ireland (GSI) areas of predicted groundwater flooding, where the site is not shown to be within an area of predicted flooding from this source.

Plate 3.6: GSI predicted groundwater floodplain

3.7 An extract from the CFRAM pluvial predicted floodplains is presented on Plate 3.7. The site is not shown to be within an area of predicted flooding from this source.

Plate 3.7: CFRAM pluvial flood mapping

3.8 Plate 3.8 presents locations of recorded historical flooding (warning triangle and blue hatching) within the vicinity of the proposed site (identified by the red triangle). This plate shows that flood events have been recorded to the south and east of the site, though not within the footprint of the proposed development area.

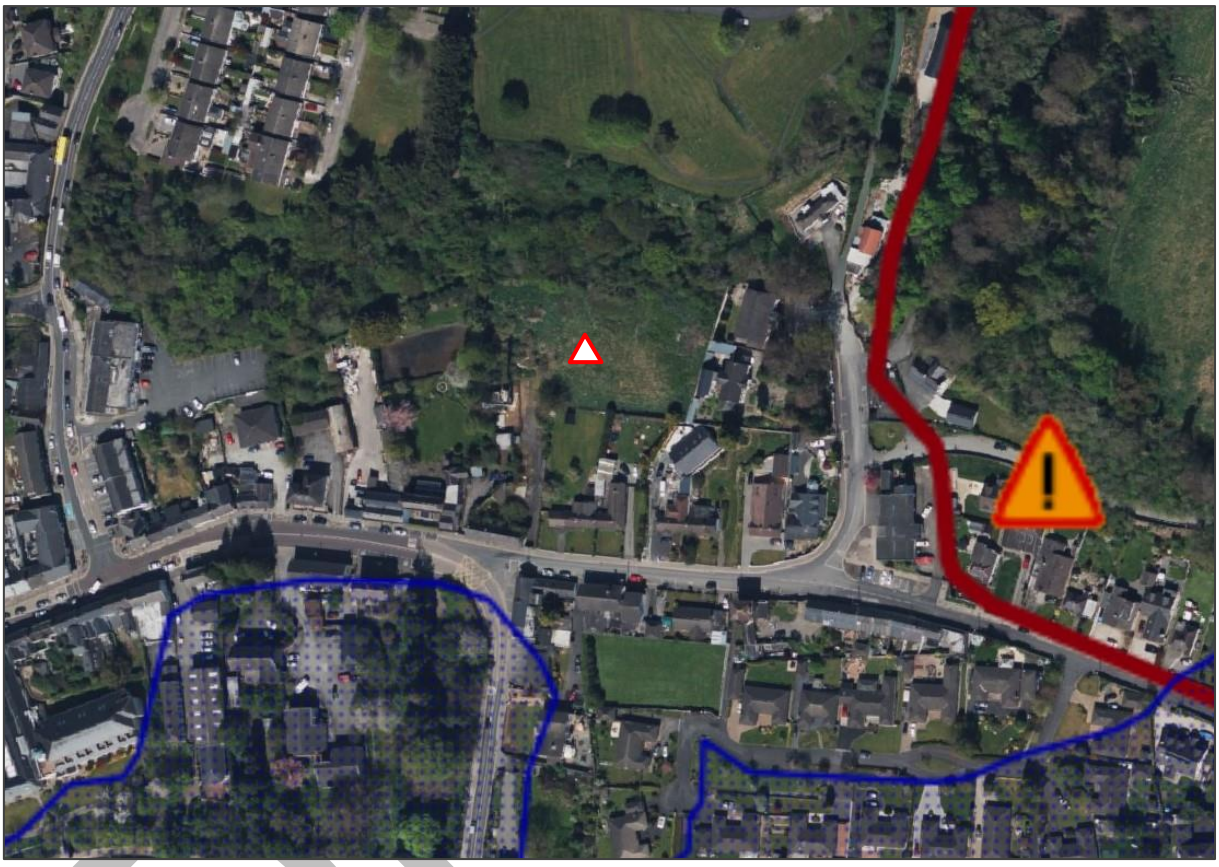

Plate 3.8: OPW Recorded historical flooding within the vicinity of the site

4.0 TOPOGRAPHICAL DATA

4.1 Plate 4.1 presents an extract of the open source OSI Lidar data available through the GSI web portal (site location indicated by red triangle). This indicates that open source Lidar data is available for the area of the proposed site and local floodplain extents. This data set provides DTM levels on a 2m grid and it is assumed that the CFRAM flood mapping was based on this OSI data.

Plate 4.1: OSI open data Lidar data

4.2 An extract of a topographical site survey of the site's southern portion is presented on Plate 4.2. Ground levels along the access from the southern road are shown to be circa 26.4m OD. Existing structures are located along the site frontage with the adjacent road.

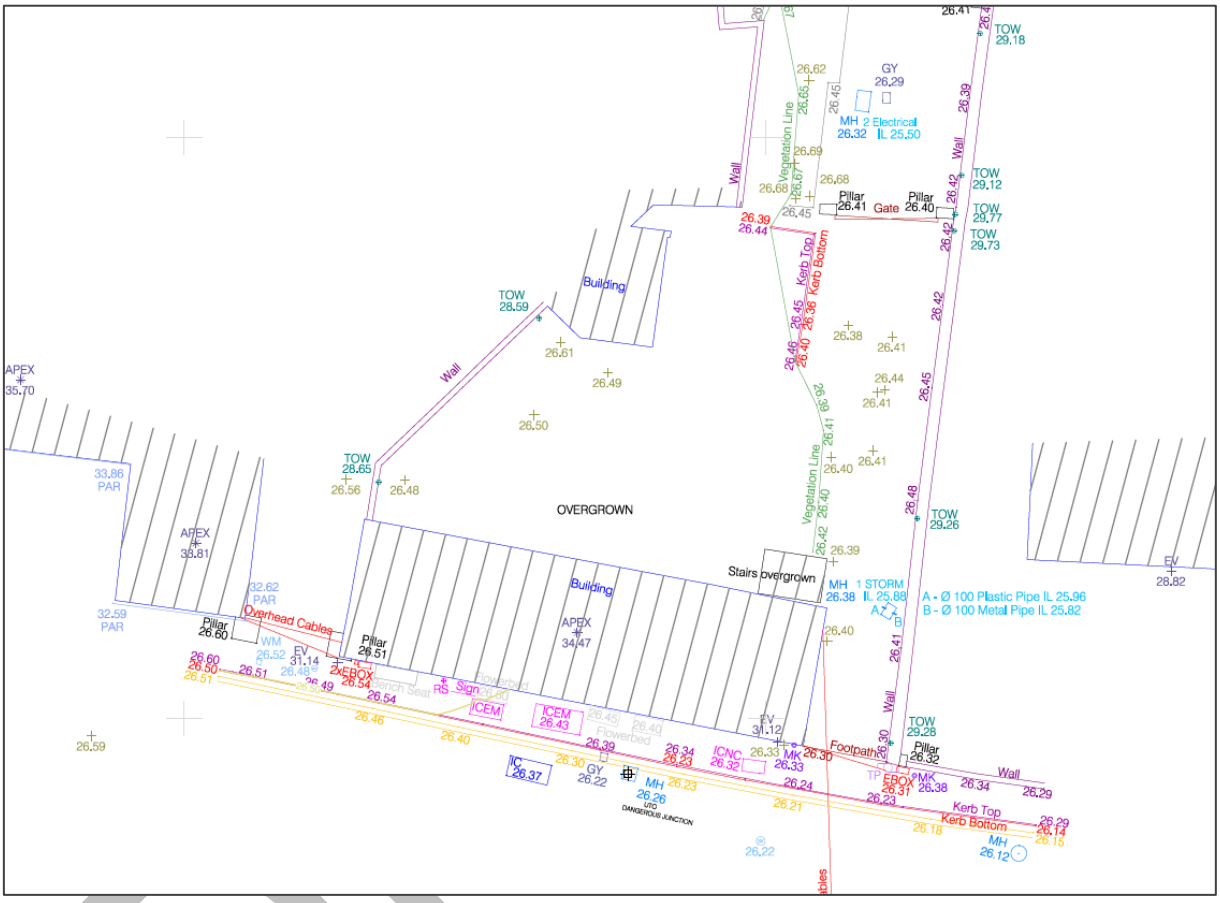

Plate 4.2: Survey of southern side of site

4.3 Plate 4.3 presents an extract of the survey of the northern main portion of the site. Higher ground, over 27m OD, is shown to the north west of the site, with levels across this portion of the site generally flat (circa 26.2m OD). A small isolated hollow area with levels below 26m OD is recorded slightly east of the centre of the site.

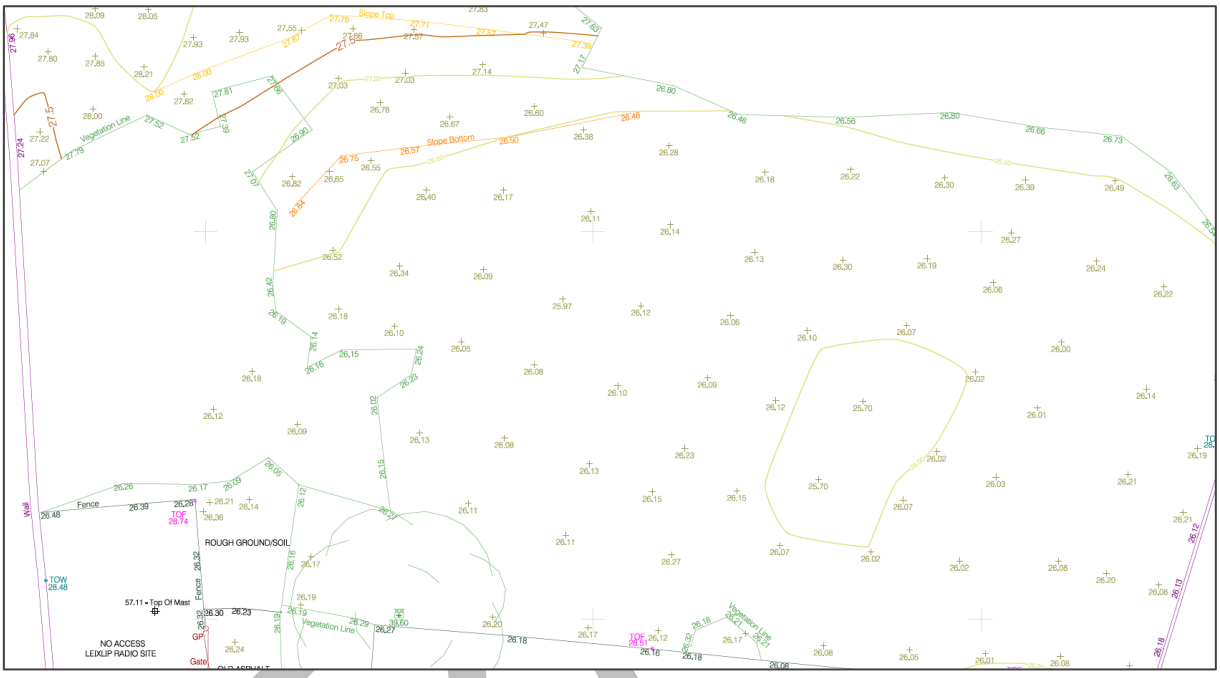

Plate 4.3: Survey of northern side of site

4.4 Drawing C201 presents the site red line and survey relative to the CFRAM fluvial extents mapping, where the medium blue hatching indicates the predicted Q100 floodplain and the light blue the Q1000. This drawing confirms that the site red line is outside of the predicted Q100 floodplain, while the Q1000 floodplain reaches across a portion of the site footprint.

4.5 Drawing C202 presents the OSI Lidar DTM information, spot levels and extracted 0.25m contours, relative to the CFRAM Q100 fluvial flood depth mapping (site outlined in red). This drawing again confirms that the floodplain does not reach the site in this instance. The DTM spot levels were observed to be in general agreement with the site survey, where the main northern portion of the site rises towards the north.

4.6 The CFRAM Q1000 fluvial flood depth mapping is presented on Drawing C203 with the OSI DTM overlaid. By comparing the floodplain outline and depths with the Lidar information the local overland flood levels were estimated. By this comparison method the Q1000 flood levels at the proposed site is estimated to range from **26.65m OD** to **26.25m OD** from south to north within this site's footprint, as shown on Drawing C203. The floodplain in this instance within the main northern portion of the site can be seen to generally follow the 26.25m OD contour line. It is noted that these estimated overland flood levels are lower than the Q1000 in-channel water levels for the Rye Water to the west of the site but above those of the southern Liffey River and eastern tributary. This is as expected given the overland flow regime for the area of the site, where out-of-bank waters appear to emanate from the Rye Water and flow eastward as dictated by the local topography.

4.7 The CFRAM Q1000 flood depths within the site shown on Drawing C203 can be seen to be generally in the shallow 0.0m – 0.25m band (cyan), with some isolated pockets within the site with depths up to 0.5m (light blue).

4.8 Q1000 flooding is predicted along Main Street beyond the site's red line at the southern entrance, but FRC's experience is that the planners will restrict their consideration to flood risk within the site rather than flooding on public roads beyond the site.

GENERAL DRAWING NOTES:

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2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ARCHITECT'S DRAWINGS AND OTHER ENGINEER'S DRAWINGS.
3. THE CONTRACTOR IS RESPONSIBLE FOR ENSURING THE STABILITY OF THE SITE AND WORKS, INCLUDING ADJOINING SITES AND WORKS, AND ALL SERVICES THROUGHOUT THE CONSTRUCTION.
4. THE CONTRACTOR MUST BRING TO THE ATTENTION OF ENGINEER IF ANY NOTES ON THIS, OR RELEVANT DRAWINGS ARE AT VARIANCE WITH THE ARCHITECT'S DRAWINGS OR SPECIFICATION, BEFORE ANY CONSTRUCTION WORK IS CARRIED OUT.

0.25

0.42

MAIN STREET

MILL LANE

335A

334

333

335

336

337

3,6

2,5

1,4

ES

10

12

1

2

3,4

12A

NO ACCESS
LEIXLIP RADIO SITE

OVERGROWN

Project
PROPOSED RESIDENTIAL DEVELOPMENT, CLUID HOUSING, AT LEIXLIP, CO KILDARE

Title
OPW CFRAM FLUVIAL EXTENTS FLOOD MAPPING RELATIVE TO PROPOSED SITE LOCATION & SURVEY

Drawing No.	Revision	Scale	Date
C201	*	1:500 @ A3	03.08.23

FLOOD RISK CONSULTING
Chartered Civil Engineers
a: 93 Hillsborough Rd, Lisburn, BT28 1JN
m: 028 9267 8881
w: www.floodriskconsulting.com
e: phil@floodriskconsulting.com

GENERAL DRAWING NOTES:

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0.25

0.42

3.6

2.5

1.4

FS

335A

334

333

335

336

337

12

10

2

3.4

12A

L3

L9

L8

MILL LANE

MAIN STREET

FLOOD RISK CONSULTING

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Project
PROPOSED RESIDENTIAL DEVELOPMENT, CLUID HOUSING, AT LEIXLIP, CO KILDARE

Title
OPW CFRAM Q100 FLOOD MAP RELATIVE TO DTM TOPOGRAPHY DATA

Drawing No.	Revision	Scale	Date
C202	*	1:500 @ A3	03.08.23

GENERAL DRAWING NOTES:

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KEY:

00.00 ESTIMATED Q1000 FLUVIAL FLOOD LEVELS

00.00 RECOMMENDED MINIMUM DEVELOPMENT LEVELS TO ALLOW FREEBOARD

00.0 0.25M CONTOURS EXTRACTED FROM OSI DTM

00.00 OSI DTM LEVEL (M OD)

FLOOD RISK CONSULTING

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Project
PROPOSED RESIDENTIAL DEVELOPMENT, CLUID HOUSING, AT LEIXLIP, CO KILDARE

Title
OPW CFRAM Q1000 FLOOD MAP RELATIVE TO DTM TOPOGRAPHY DATA

Drawing No.	Revision	Scale	Date
C203	*	1:500 @ A3	03.08.23

5.0 PROPOSED DEVELOPMENT

5.1 An extract of the proposed development plan is presented on Plate 5.1. The proposal consists of residential development with associated access, parking and features.

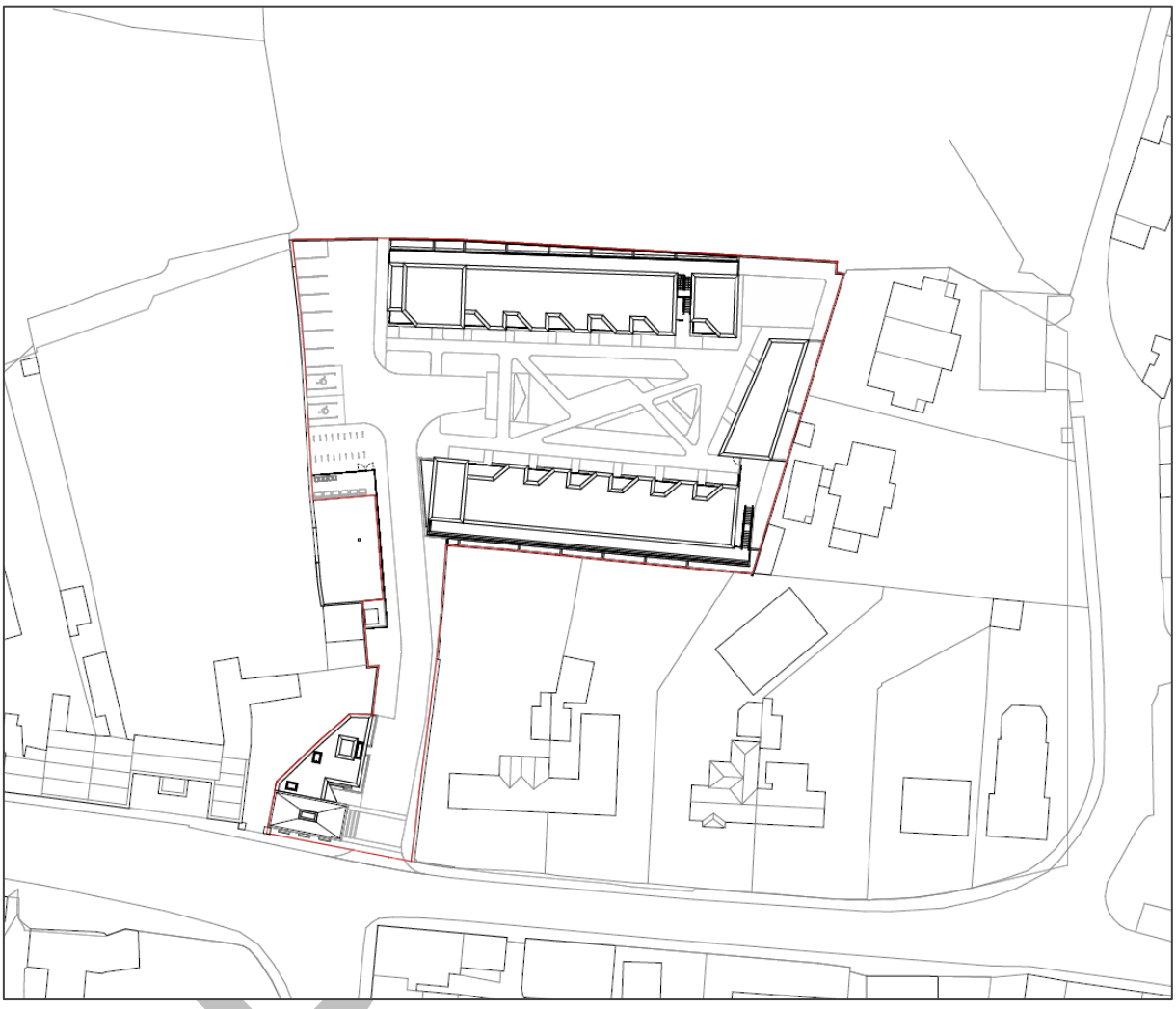

Plate 5.1: Proposed development plan

6.0 GUIDELINES ASSESSMENT OF THE PROPOSED DEVELOPMENT

6.1 *General*

6.1.1 This section will assess whether the proposed development satisfies the document 'The Planning System and Flood Risk Management; Guidelines for Planning Authorities (OPW, 2009)'. The above document shall be referred to within this report as the 'Guidelines'. The assessment has been undertaken by qualified professional civil engineers with experience in hydraulic engineering as required by the above document.

6.1.2 Some of the core objectives of these Guidelines are to avoid inappropriate development in areas at risk of flooding, to avoid new developments increasing flood risk elsewhere (including that which may arise from surface water runoff) and avoiding the unnecessary restriction of national, regional, or local economic and social growth.

6.1.3 In achieving the aims and objectives of the Guidelines, the key principles that should be adopted should be to:

- Avoid the risk, where possible,
- Substitute less vulnerable areas, where avoidance is not possible, and
- Mitigate and manage the risk, where avoidance and substitution are not possible.

6.1.4 With reference to the last bullet point, Paragraph 1.11 of the Guidelines states that "proper planning and sustainable development may at the same time require in exceptional circumstances some development in areas of flood risk, provided that the issue of flood risk is managed properly.

6.1.5 Flood risk is a combination of the likelihood of flooding and the potential consequences arising. The Guidelines therefore recommend a staged approach to flood risk assessment that covers both the likelihood of flooding and the potential consequences.

6.1.6 The likelihood of flooding is normally defined as the percentage probability of a flood of a given magnitude or severity occurring. The consequences of flooding depend on the hazards associated with the flooding (e.g., depth of water, speed of flow, rate of onset) and the vulnerability of people, property and the environment potentially affected by a flood (e.g. the age profile of the population, the type of development, presence, and reliability of mitigation measures etc).

6.1.7 A staged approach is therefore recommended within the Guidelines, carrying out only such appraisal and or assessment as is needed for the purposes of decision-making at the site-specific level. The stages of appraisal and assessment are:

- Stage 1 Flood risk identification – to identify whether there may be any flooding or surface water management issues related to the proposed site
- Stage 2 Initial flood risk assessment – to confirm sources of flooding that may affect a proposed development site, to appraise the adequacy of existing information and to scope the extent of the risk of flooding which may involve preparing indicative flood zone maps. Where hydraulic models exist the potential impact of a development on flooding elsewhere and of the scope of possible mitigation measures can be assessed. In addition, the requirements of the detailed assessment should be scoped; and
- Stage 3 Detailed flood risk assessment – to assess flood risk issues in sufficient detail and to provide a quantitative appraisal of potential flood risk to a proposed or existing development, of its potential impact on flood risk elsewhere and of the effectiveness of any proposed mitigation measures.

6.1.8 At regional level the focus will be on Stage 1 (identification of flood risk), where, in general, the need for more detailed flood risk assessments is flagged for city/country and local area plans. In order to allow this Stage 1 identification to occur, flood zones must be considered. Flood zones are geographical areas within which the likelihood of flooding is in a particular range. There are three types of levels of flood zones:

- Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding);
- Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1,000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1,000 year and 0.5% or 1 in 200 for coastal flooding);
- Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1,000 for both river and coastal flooding). Flood Zone C covers all areas of the plan which are not in zones A or B.

6.1.9 In addition to identifying the above zones, there is a great deal of uncertainty in relation to the potential effects of climate change, and therefore a precautionary approach should be adopted. An example of a precautionary approach is to ensure that floor levels are sufficient to cope with the effects of climate change over the lifetime of the development.

6.2 *Flood Zones*

6.2.1 Flood Zone A

6.2.1.1 Most types of development would be considered inappropriate in Flood Zone A. However, water-compatible development, amenity open space, outdoor sports and recreation and essential facilities such as changing rooms would be considered appropriate in this zone.

6.2.1.2 Apart from the above types of development, the Guidelines state that development in this zone should be avoided and/or only considered in exceptional circumstances, such as in city and town centres, or in the case of essential infrastructure that cannot be located elsewhere, and where the Justification Test has been applied.

6.2.2 Flood Zone B

6.2.2.1 The Guidelines state that highly vulnerable development, such as hospitals, schools, residential care homes, caravan and mobile home parks, Garda, fire and ambulance stations, dwelling houses and primary strategic transport and utilities infrastructure, would generally be considered inappropriate in Flood Zone B, unless the Justification Test can be met.

6.2.2.2 Less vulnerable development, such as retail, leisure, warehousing, commercial, industrial, and non-residential institutions, land, and buildings used for holiday or short-let caravans and camping, land and buildings used for agriculture and forestry, waste treatment and secondary strategic transport and **utilities infrastructure** would be considered appropriate for this zone.

6.2.3 Flood Zone C

6.2.3.1 Development in this zone is appropriate from a flood risk perspective (subject to assessment of flood hazard from sources other than rivers and the coast) but would need to meet the normal range of other proper planning and sustainable development considerations.

6.3 *Sequential approach*

6.3.1 A risk-based sequential approach is therefore required to manage flood risk. The sequential approach includes the following:

- Avoid development in areas at risk of flooding
- Inappropriate types of development that would create unacceptable risks from flooding should not be planned for or permitted
- Exceptions to the restrictions of development due to potential flood risks are provided for through the use of a Justification Test, where the planning need and the sustainable management of flood risk to an acceptable level must be demonstrated.

6.3.2 Plate 5.1 presents Fig 3.1 from The Guidelines, which sets out the broad philosophy underpinning the sequential approach.

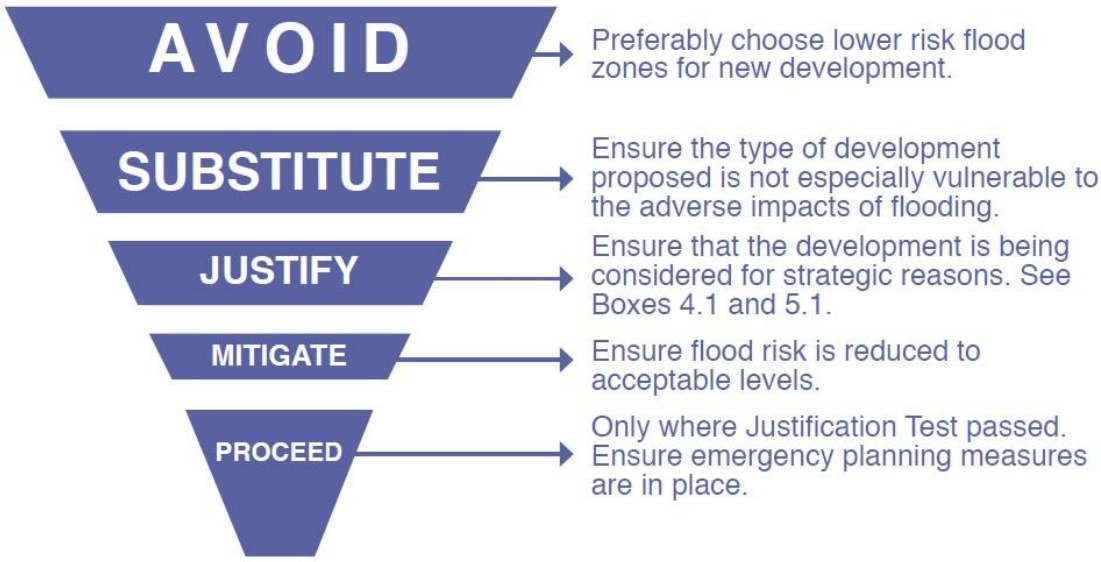

Fig. 3.1: Sequential approach principles in flood risk management

Plate 6.1: Broad philosophy underpinning the sequential approach

6.3.3 A sequential approach to planning is a key tool in ensuring that development, particularly new development, is first and foremost directed towards land that is at low risk of flooding.

6.3.4 Table 6.1 illustrates those types of development that would be appropriate to each flood zone and those that would be required to meet the Justification Test.

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development	Justification test	Justification Test	Appropriate
Less vulnerable development	Justification test	Appropriate	Appropriate
Water-compatible development, open space, and recreation	Appropriate	Appropriate	Appropriate

Table 6.1: Types of development that are appropriate for each flood zone

6.3.5 The Justification Test has been designed to rigorously assess the appropriateness, or otherwise, of particular developments that are being considered in areas of moderate or high flood risk. The test is comprised of two processes: the Plan-making Justification Test and the Development Management Justification Test. The Development Management Justification Test is the process that is relevant to this FRA report, as it is used at the planning application stage where it is intended to develop land at moderate or high risk of flooding for uses or development vulnerable to flooding that would generally be inappropriate for that land.

6.3.6 Section 5.0 of the Guidelines states that where flood risk may be an issue for any proposed development, a site-specific FRA should quantify the risks and the effects of any necessary mitigation, together with the measures needed or proposed to manage residual risks. This site-specific FRA will therefore seek to consider mitigation measures and to manage residual risk at the proposed development.

6.3.7 The Justification Test as outlined in Box 5.1 of the Guidelines is presented on Plate 5.2. Therefore, in order for a proposed development to pass the Justification Test, the site-specific FRA must;

1. ensure that the proposed development will not increase flood risk elsewhere,
2. Include measures, proportional to the nature of the development and associated flood risk, to minimise flood risk to people, property, the economy, and the environment as far as reasonably possible.

Box 5.1 Justification Test for development management (to be submitted by the applicant)

When considering proposals for development, which may be vulnerable to flooding, and that would generally be inappropriate as set out in Table 3.2, the following criteria must be satisfied:

1. The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.
2. The proposal has been subject to an appropriate flood risk assessment that demonstrates:
   - (i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;
   - (ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;
   - (iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and
   - (iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.

The acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.

Note: See section 5.27 in relation to major development on zoned lands where sequential approach has not been applied in the operative development plan.

Refer to section 5.28 in relation to minor and infill developments.

Plate 6.2: Box 5.1 of the Guidelines

6.4 *Application of the Justification Test to the proposed development*

6.4.1 *Should the justification test be applied to the proposed development?*

6.4.1.1 The proposed development is located outside of Flood Zone A but within Flood Zone B, as indicated by CFRAM mapping. Therefore, justification and agreement with the planners will be required for highly vulnerable residential development within Flood Zone B. Given that the CFRAM project has covered the local water features in the vicinity of the site, it is believed to be suitable to adopt as the fluvial flood mapping for the proposal.

6.4.1.2 The Kildare County Development Plan Strategic Flood Risk Assessment (SFRA) recommends that high vulnerability development be located to Flood Zone C to appropriately avoid the flood risk. Council policy provides allowance for the location of lower vulnerability development within Flood Zone B, where only water-compatible development is generally permissible within Flood Zone A.

6.4.1.3 Kildare County Council planning requirements stipulates that proposed highly vulnerable development provide a minimum freeboard of 500mm above the Q1000 flood levels. The CFRAM floodplain extents were compared with the Lidar DTM data of the area and FRC has estimated that the Q1000 flood levels within the site vary from **26.65m OD** to **26.25m OD** from south to north. The acceptability of the proposal located partially within Flood Zone B is a decision for the planning authority. Subject to the planning authority granting permission for the residential proposal within the Q1000 floodplain, this report will consider flood risk to and from the development.

6.4.2 *Ensuring the proposed development will not increase flood risk elsewhere*

6.4.2.1 Risk to coastal and fluvial flooding elsewhere

6.4.2.1.1 Flood Zone A does not reach into the proposed site footprint, therefore the proposal will have no impact of the Q100 floodplain and no further consideration is given to this flood risk. The Kildare County Council planning requirements stipulates that compensation be provided for any impact on the Q100 floodplain, as flooding in this instance is not predicted within the site, no compensation is required.

6.4.2.1.2 Where development is proposed within Flood Zone B, it is FRC's understanding that the Kildare County Council policy does not require consideration of the impact of infill within the Q1000 fluvial floodplain. However, consideration should be given to limiting any impact on Flood Zone B to a minimum. The acceptability of this will be a matter for the planning authority.

6.4.2.2 Risk to pluvial flooding elsewhere

6.4.2.2.1 If the proposed development will include any increase in the hardstanding area, the risk to pluvial flooding elsewhere has to be considered. Proposals for surface-water management should be applied to the development according to sustainable drainage principles to ensure that surface water runoff from the proposed development does not increase beyond that which presently discharged from the existing greenfield site. Measures such as the use of on-site storm water storage, with appropriate approved storm discharge, are recommended to ensure that the proposed development will not have a negative impact on pluvial flooding elsewhere. Alternatively, an appropriately designed soakaway may be used to address surface water runoff from the proposed development. All required appropriate storm water permissions should be acquired by the design team.

6.4.2.2.2 Subject to the implementation of the above recommendations and mitigation measures, the proposed development to not have a negative impact on local pluvial flooding.

6.4.3 *Measures to minimise flood risk to people, property, the economy, and the environment*

6.4.3.1 Coastal and fluvial flooding at the proposed development

6.4.3.1.1 As noted previously, the acceptability of residential development in Flood Zone B will be a matter for the planning authority. Consideration should be given to uses of ground floor levels for less vulnerable categories of development. Drawing C204 presents the proposed development layout relative to the CFRAM Q1000 fluvial flood depth mapping.

6.4.3.1.2 As development is proposed within Flood Zone B, the fluvial flood risk to the proposal will need to be considered. The Kildare County SFRA stipulates and FFLs for highly vulnerable development provide a minimum freeboard of 500mm above the Q1000 flood levels. Therefore, Drawing C204 shows that the recommended minimum freeboard levels vary from **27.15m OD** to **26.75m OD** from south to north across the site, as per the variation in estimated water levels.

6.4.3.1.3 Therefore, where feasible the recommended minimum development levels are **27.15m OD** to **26.75m OD** from south to north within the site, to ensure that the proposal will achieve the minimum 500mm freeboard above the Q1000 floodplain. These minimum levels apply to the entire development, including all access, parking, gardens and structures where achievable.

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KEY:

00.00 ESTIMATED Q1000 FLUVIAL FLOOD LEVELS

00.00 RECOMMENDED MINIMUM DEVELOPMENT LEVELS TO ALLOW FREEBOARD

00.00 SITE SURVEY SPOT LEVEL

FLOOD RISK CONSULTING

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Project
PROPOSED RESIDENTIAL DEVELOPMENT, CLUID HOUSING, AT LEIXLIP, CO KILDARE

Title
OPW CFRAM Q1000 FLOOD MAP RELATIVE TO PROPOSED LAYOUT

Drawing No.	Revision	Scale	Date
C204	*	1:500 @ A3	03.08.23

6.4.3.1.4 If portions of the development are tied to existing/surrounding levels and unable to be raised to the above minimum freeboard levels, it is recommended that suitable flood resistance and resilience measures are implemented at detailed design stage for all proposed development up to the above minimum levels. In this instance, the development's occupiers/management/owners should address the risk of flooding at the site up to the freeboard levels of **27.15m OD** to **26.75m OD** in their H&S considerations and emergency planning at detailed design stage. Flood risk mitigation at detailed design stage should include consideration of flood awareness, warning, emergency planning (including escape routes), location of critical switches and electrics and procedure for safe shutdown as appropriate. Where the site's main entrance will remain within Flood Zone B, consideration should be given to the provision of an emergency escape route from the site. Again, the acceptability of this will be a matter for the planning authority.

6.4.3.1.5 If the buildings are not able to achieve the full freeboard, design for flood resilient construction should also be considered, where resilient design of internal services and finishes can aid in limiting damage caused by floodwater and allow relatively quick recovery.

6.4.3.1.6 In addition to considering physical design issues, planning, and assessing new development must take account of the need for effective emergency response planning for flood events in areas of new development. This is normally the responsibility of the developer.

6.4.3.1.7 Key elements are:

- Provision of flood warnings, evacuation plans and ensuring public awareness of flood risks to people where they live and work
- Awareness of risks and evacuation procedures and the need for development flood plans.

6.4.3.1.8 In general, flood escape routes should be kept to publicly accessible land, as safeguarding escape routes located within private property may be problematic. Further and more detailed guidance and advice can be found at http://www.flooding.ie and in the Building Regulations. In addition, "Improving the Flood Performances of New Buildings" published by the Department of Communities and Local Government in the UK is a valuable resource.

6.4.3.2 Pluvial flooding at the proposed development

6.4.3.2.1 The Guidelines state that an SSFRA should not only consider fluvial risk at the proposed development but also consider other risks of flooding such as surface water exceedance.

6.4.3.2.2 The primary risk is that the local storm/land drain network is exceeded during an extreme rainfall event and so surcharge within the development. The flow routes of predicted exceedance should be confirmed by a topographical survey of the site and local vicinity at detailed design stage. The design team should ensure that the development's design would not restrict exceedance and would allow overland exceedance to follow the natural flow regime for the area. This could be achieved with features such as drop kerbs to direct overland flow and permeable boundary treatments. In addition, the internal FFLs of any proposed structures should be suitably located above external ground levels, typically a minimum of **150mm**, so that overland surface water exceedance flooding does not enter structures. Given the local predicted pluvial flood risk, the design team may wish to consider a precautionary approach and locate internal FFLs more than 150mm above external ground levels to provide additional mitigation.

6.4.3.2.3 In addition, if surface water from the development is proposed to discharge to local storm or watercourse features, it is recommended that the drainage design ensure that the storm system will not be at risk of flooding during a downstream flood event. This could be achieved through the use of features such as non-return valves.

6.4.3.2.4 The design team should consider Technical Appendix B of the Guidelines in order to consider appropriate measures that could be implemented at detailed design stage for the proposal.

7.0 CONCLUSIONS

7.1 The primary objective of the study was to carry out a Stage 2 Site Specific Flood Risk Assessment (SSFRA), in regulation with The Planning System and Flood Risk Management: Guidelines for Planning Authorities (OPW, 2009) for the proposed Cluid Housing at Leixlip, County Kildare.

7.2 CFRAM mapping identifies that the proposed development is located outside of the predicted Flood Zone A but partially within Flood Zone B.

7.3 The council's SFRA requires that high vulnerability development be located to Flood Zone C, where allowance is provided for the location of lower vulnerability development within Flood Zone B. Therefore, justification will be required for highly vulnerable residential development within Flood Zone B and the matter will be a decision for the planning authority. Consideration should be given to the use of ground floor levels for less vulnerable categories of development.

7.4 As Flood Zone A does not reach into the proposed site footprint the proposal will have no impact of the Q100 floodplain and no fluvial compensation is required under the Kildare County Council planning requirements.

7.5 Where development is proposed within Flood Zone B, it is FRC's understanding that the Kildare County Council policy does not require consideration of the impact of infill within the Q1000 fluvial floodplain. However, consideration should be given to limiting any impact on Flood Zone B to a minimum. The acceptability of this will be a matter for the planning authority.

7.6 Council requirements stipulate a minimum freeboard of 500mm for internal FFLs for highly vulnerable development relative to the Q1000 floodplain. Therefore, further assessment of the local topography and CFRAM flood depths was carried out to estimate the flood levels in the vicinity of the site, as the overland flood levels are not provided by CFRAM mapping data.

7.7 By comparing the CFRAM Q1000 floodplain outline and depths with OSI Lidar information, the local overland flood levels were estimated to range from **26.65m OD** to **26.25m OD** from south to north within this site's footprint. To provide the recommended minimum 500mm freeboard above the Q1000 floodplain, the recommended minimum development levels vary from **27.15m OD** to **26.75m OD** from south to north within the site. Therefore, where feasible, it is recommended that flood risk is mitigated by raising the development to these freeboard levels.

7.8 If portions of the development are tied to existing/surrounding levels and unable to be raised to the above minimum freeboard levels, it is recommended that suitable flood resistance and resilience measures are implemented at detailed design stage for all proposed development up to the above minimum levels. In this instance, the development's occupiers/management/owners should address the risk of flooding at the site up to the freeboard levels of **27.15m OD** to **26.75m OD** in their H&S considerations and emergency planning at detailed design stage.

7.9 Flood risk mitigation should include consideration of flood awareness, warning, emergency planning (including escape routes), location of critical switches and electrics and procedure for safe shutdown as appropriate. Where the site's main southern entrance will remain within Flood Zone B, consideration should be given to the provision of an alternative emergency escape route from the site which is not located within the floodplain if feasible.

7.10 To address predicted pluvial flood risk, the following measures are recommended:

- Proposals for surface-water management should be applied to the development according to sustainable drainage principles to ensure that surface water runoff from the proposed development does not increase beyond that which presently discharged from the existing site. All required appropriate storm water permissions should be acquired by the design team.
- The development's design should allow overland exceedance to follow the natural flow regime for the area. The internal FFLs of any proposed structures/cabinets should be suitably located above external ground levels, typically a minimum of **150mm**. In addition, if surface water from the development is proposed to discharge to local storm or watercourse features, it is recommended that the drainage design consider including non-return features so that the storm system will not be at risk of flooding during a downstream flood event.
- It is recommended that suitable flood resistance and resilience measures are considered at detailed design stage, proportionate to local pluvial flood risk.

7.11 The above recommendations are provided to ensure compliance with OPW planning guidelines on flood risk.

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APPENDIX D – SURFACE WATER CALCULATIONS