ROGER MULLARKEY & ASSOCIATES
CONSULTING STRUCTURAL and CIVIL ENGINEERS

SITE SPECIFIC FLOOD RISK ASSESSMENT for a Residential project at Glenamuck North, Kilternan, Dublin 18.

PROJECT:	**GLENAMUCK NORTH SITE B LRD - 2411**
CLIENT:	**DURKAN CARRICKMINES DEVELOPMENTS LTD.**
DATE:	**MAY 2025**
ISSUE NO:	**LRD STAGE 3**
ISSUED BY:	**ROGER MULLARKEY**

DUNCREEVAN,
KILCOCK,
Co.KILDARE
Ph: 01 6103755
Mob: 087 2324917
Email: info@rmullarkey.ie
Web www.rmullarkey.ie

TABLE OF CONTENTS

1.0 Introduction

1.1 This document relates to the Flood Risk Assessment (FRA) for a proposed residential development located on lands at located at Glenamuck North, Glenamuck Road, Kilternan, Dublin 18.

1.2 We, Roger Mullarkey & Associates, were appointed by Durkan Carrickmines Developments Ltd.to carry out the Site Specific Flood Risk Assessment report to accompany the suite of other drawings and documentation relating to the proposed residential development at the above noted address.

1.3 The site application area is c.5.2Ha and the total drained S/W area in three separate catchments is 4.44Ha. The existing lands are currently greenfield. A watercourse crosses the subject lands and is known as the Glenamuck Stream/River and is also referred to as the Carrickmines Stream_010 (EPA Ref.IE_EA_10C040350). In this document the watercourse is referred to as "The Glenamuck Stream".

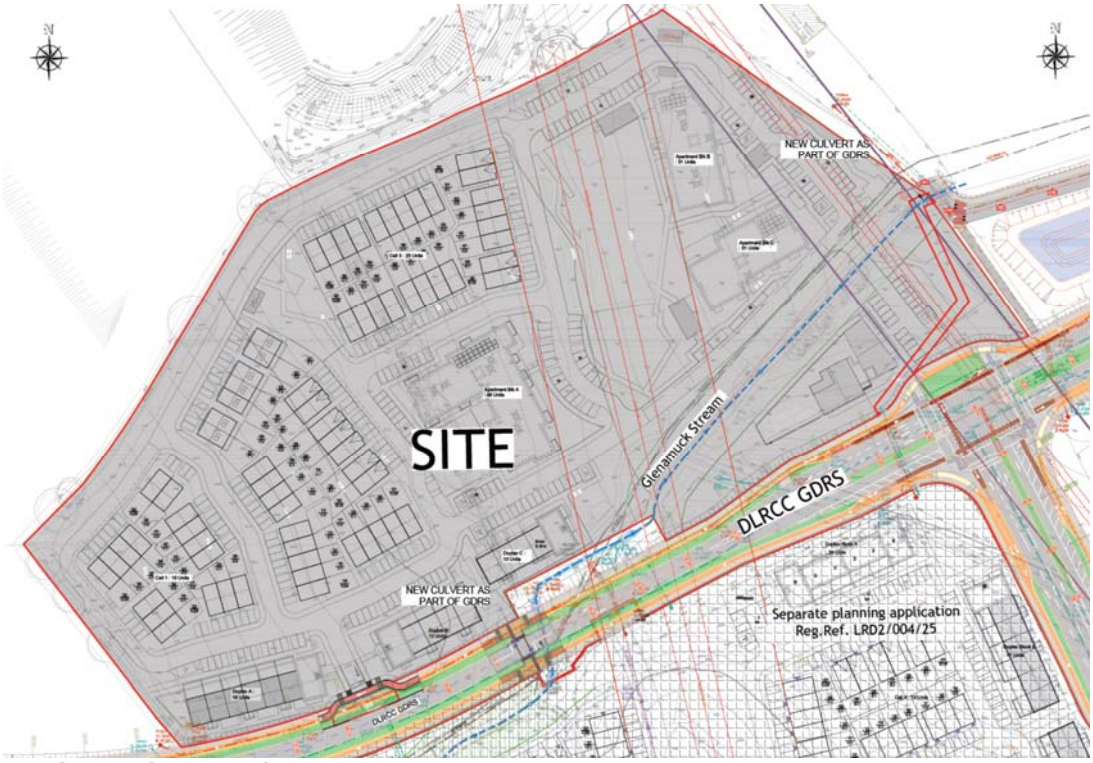


Fig.1 – Site Location

1.4 The site is bounded to the south by the recently constructed Glenamuck District Distributor Road (GDDR) in Kilternan, Dublin18. This road is part of the DLRCC Glenamuck District Roads Scheme (GDRS) project. This project will be referred to as the GDRS throughout this report.

1.5 The proposed development will consist of a residential development of 219No. Units and a Creche (571m^2). Please refer to Thornton O'Connor Planning Consultants for a full development description.

1.6 In accordance with the requirements set out in the DoEHLG and OPW published guidelines *The Planning System and Flood Risk Management 2009* (the Guidelines) and the Strategic Flood Risk Assessment Policy of Appendix 15 of the Dun Laoghaire Rathdown County Development Plan 2022 – 2028 a Site Specific Flood Risk Assessment (SSFRA) is carried out for this application.

1.7 The purpose of the SSFRA is to scope for possible sources of flooding, assess the types of flood risk for the proposed development and to consider if there are any possible impacts on flood risk elsewhere due to the development. Where appropriate, the SSFRA recommends flood mitigation and management measures and identifies residual risks, if any should remain after the implementation of the identified measures.

1.8 The report is intended for the sole use of the applicant, their elected agents and advisors and, further, solely for the purpose for which it was originally commissioned. It may not be assigned or copied to third parties or relied upon by third parties.

2.0 Flood Risk Guidelines and the Planning System

2.1 The Planning System and Flood Risk Management, Guidelines for Planning Authorities (the Guidelines) was published in November 2009. The main purpose of the Guidelines is to ensure that sustainable development can be delivered by integrating flood risk management into the planning process.

2.2 The core objectives of the guidelines are to;

- Avoid inappropriate development in areas at risk of flooding;
- Avoid new developments increasing flooding elsewhere, including that which may arise from surface water runoff;
- Ensure effective management of residual risks for development permitted in floodplains;
- Avoid unnecessary restriction of national, regional, or local economic and social growth;
- Improve the understanding of flood risk among relevant stakeholders;

- Ensure that the requirements of EU and national law in relation to the environment and nature conservation are complied with at all stages of flood risk management.

2.3 A staged approach is adopted to the Flood Risk Assessment (FRA) as follows;

2.4 *Stage 1 - Flood risk identification* – identify whether there may be any flooding or surface water management issues related to either the area or regional planning guidelines, development plans and LAP's or a proposed development site that may warrant further investigation at the appropriate lower level plan or planning application levels.

2.5 *Stage 2 - Initial flood risk assessment* – to confirm sources of flooding that may affect a plan area or 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.

2.6 *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 or land to be zoned, of its potential impact on flood risk elsewhere and of the effectiveness of any proposed mitigation measures.

2.7 From the Guidelines Section 3.1, the broad philosophy underpinning the sequential approach in flood risk management is laid out as follows;

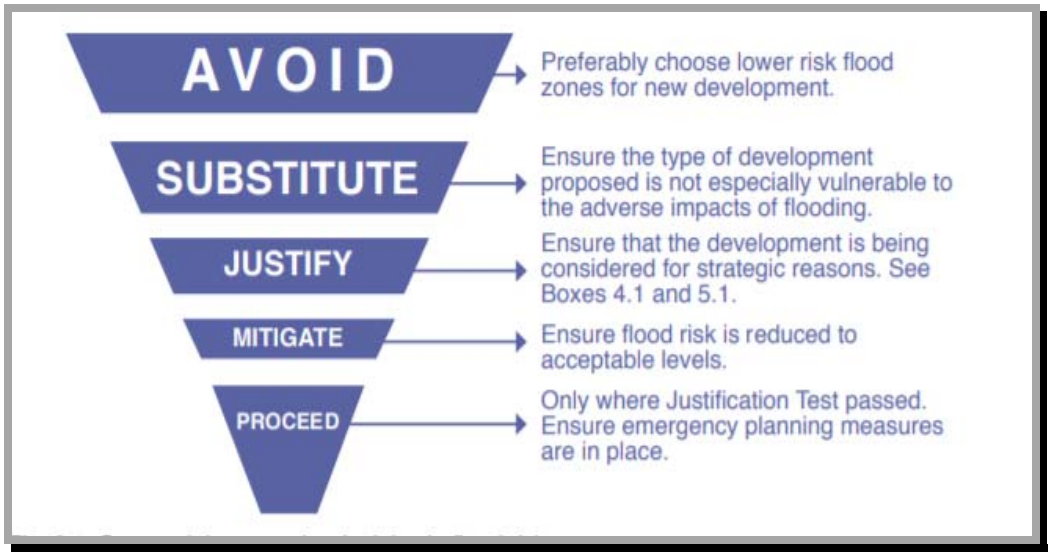


Fig.2 – Extract from *Section 3.1* **of the** *Guidelines*

2.8 The 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.

2.9 The sequential approach described in Fig.3 above should be applied to all stages of the planning and development management process and is applicable in the layout and design of development within a specific site at the development management stage.

2.10 The following flow chart from Section 3.2 of the Guidelines describes its mechanism for use in the planning process.

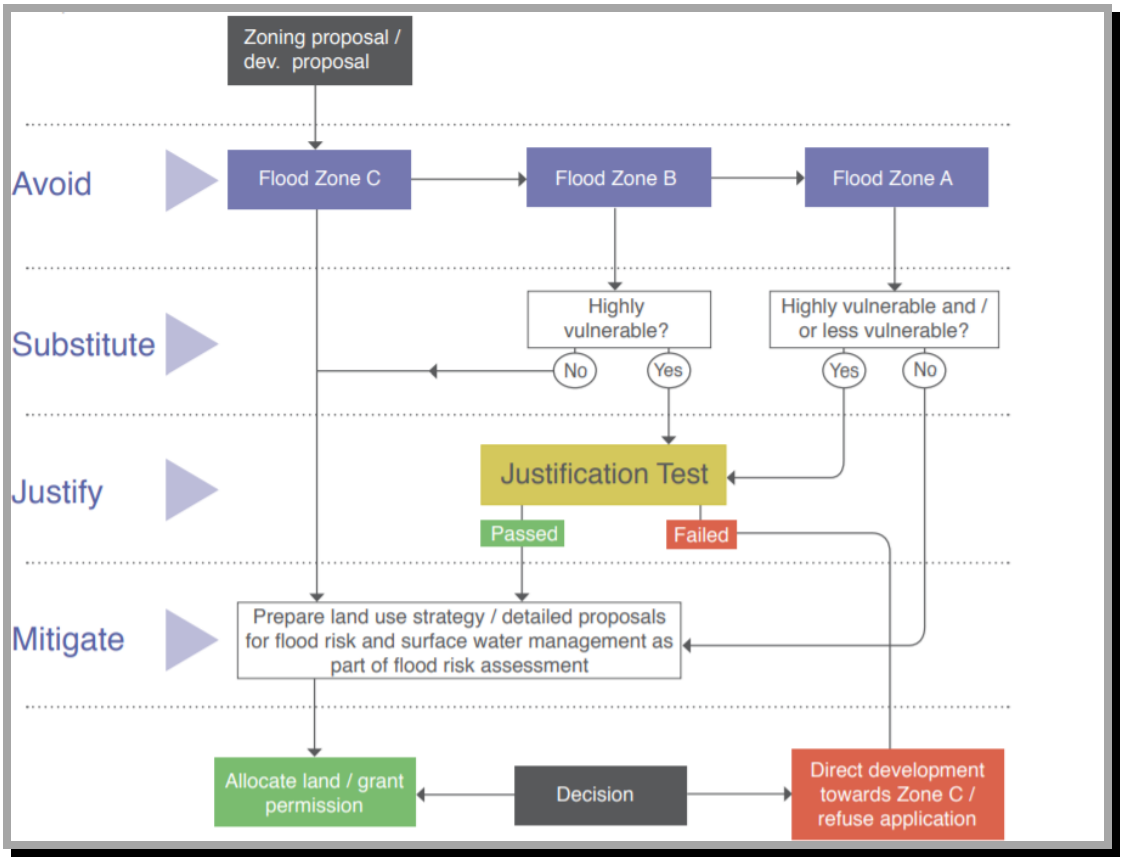


Fig.3 – Extract from *Section 3.2* **of the** *Guidelines*

2.11 There are 3 types or levels of flood zones defined in the Guidelines and are as described in Table 1 below;

Flood Zone	Description
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)
B	Where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 years and 1% or 1 in 100 years for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding)
C	Where the probability of flooding from rivers and sea is low (less than 0.1% or 1 in 1000 years for both river and coastal flooding). Flood Zone C covers all areas of the plan which are non in Zones A or B.

Table 1 – Flood Zones

2.12 The following table extracted from the Guidelines section 3.5 defines the Vulnerability Classes of various types of development.

Vulnerability class	Land uses and types of development which include*:
Highly vulnerable development (including essential infrastructure)	Garda, ambulance and fire stations and command centres required to be operational during flooding; Hospitals; Emergency access and egress points; Schools; Dwelling houses, student halls of residence and hostels; Residential institutions such as residential care homes, children's homes and social services homes; Caravans and mobile home parks; Dwelling houses designed, constructed or adapted for the elderly or, other people with impaired mobility; and Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and sewage treatment, and potential significant sources of pollution (SEVESO sites, IPPC sites, etc.) in the event of flooding.
Less vulnerable development	Buildings used for: retail, leisure, warehousing, commercial, industrial and non-residential institutions; Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans; Land and buildings used for agriculture and forestry; Waste treatment (except landfill and hazardous waste); Mineral working and processing; and Local transport infrastructure.
Water-compatible development	Flood control infrastructure; Docks, marinas and wharves; Navigation facilities; Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location; Water-based recreation and tourism (excluding sleeping accommodation); Lifeguard and coastguard stations; Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; and Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).

*Uses not listed here should be considered on their own merits

Fig.4 – Extract from *Section 3.5* **of the** *Guidelines*

2.13 The vulnerability of class of a development and the identified flood zone are used to determine the appropriateness of the development proposed and which types of development would need to undergo a Justification Test as per the extracted table from section 3.6 of the Guidelines below;

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

Fig.5 – Extract from *Section 3.6* **of the** *Guidelines*

2.14 Should the review of the sequential approach determine that a Justification test is necessary ,i.e., a development lies in a high/moderate risk of flooding and be inappropriate as per the Justification test able as above, the following table extracted from the Guidelines section 5.15 needs to be satisfied;

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.

Fig.6– Extract from *Section 5.15* **of the** *Guidelines*

3.0 Site Specific Flood Risk Assessment

3.1 General

3.1.1 The site is proposed on greenfield land located at Glenamuck North, Glenamuck Road, Kilternan, Dublin 18.

Fig.7 – Site Location from Google Maps

3.1.2 The site application area is c.5.2Ha but the drained S/W area is in three separate catchments equals c.4.44Ha. and the drainage design is discussed in detail in the separate Engineering Infrastructure & Stormwater Impact Assessment report accompanying this LRD Stage 3 submission.

3.1.3 The existing lands are currently greenfield. Crossing part of the site from the south to the northeast is a watercourse known as the Glenamuck

Stream/River and is also referred to as the Carrickmines Stream_010 (EPA Ref.IE_EA_10C040350). In this document the watercourse is referred to as "The Glenamuck Stream". The recently constructed GDRS roads project bounds the south of the site. To the north of the site lies the former DLRCC landfill site of Jamestown and the De La Salle Rugby playing fields. To the west lies a greenfield enclosed by the rugby grounds and the new GDRS road. To the east of the site lies the Bective Rangers Football Club & playing fields.

3.1.4 The topography generally has a west to east downwards gradient. The topography has a relatively consistent gradient varying between c.1/19 to 1/37. A site survey drawing is included in the application and can be viewed as background on the drawing RMA Dwg.No.2411/200 and is summarised in Fig 8 below.

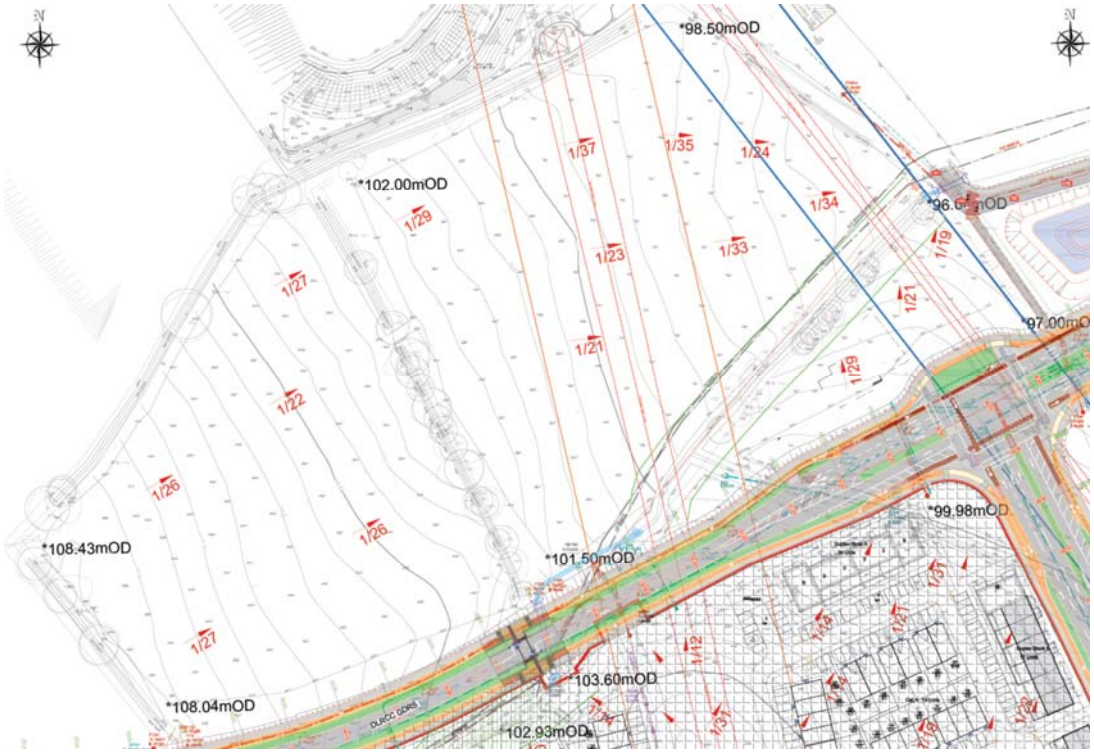


Fig.8– Topography

3.1.5 A Road & Block levels drawing has been prepared as part of this application and reference should be made to Dwg.No.2411/200 in this regards. Generally, the proposed road levels and house levels balance across the existing site levels.

3.1.6 The following assessment will identify the potential sources of flooding and categorise the risk as either very low, low, medium, high, and very high.

3.1.7 The risks categorised above are based on the judgement and experience of the Engineer carrying out the assessment and based on the documentation sourced from the Flood Risk Indicator sources as noted in Section 3.3 of this report.

3.1.8 The initial assessment process will involve examining the flood risk indicators. Where it is demonstrated that there is a risk of flooding the study will progress to a more detailed flood risk assessment, if required. Each of the below 5 potential sources of flood risk will be assessed in this regards.

3.2 Potential Sources of Flood Risk

3.2.1 **Tidal**
Coastal flooding is caused by higher sea levels than normal, largely because of storm surges, resulting in the sea overflowing onto the land.

3.2.2 **Fluvial**
Caused by the overtopping of rivers/streams when the capacity of a watercourse is exceeded or the channel is blocked or restricted, and excess water spills out from the channel onto adjacent low-lying area.

3.2.3 **Pluvial**
Caused when the intensity of rainfall events cannot be absorbed into the ground or urban drainage systems cannot effectively convey the flowrates.

3.2.4 **Groundwater**
Groundwater flooding occurs when the level of water stored in the ground, the water table, rises because of prolonged rainfall. Groundwater flooding tends to be very local and result from interactions of site specific factors such as tidal variations.

3.2.5 **Human/Mechanical Error**
Caused by blockages in piped systems or intervention of/failure of mechanical devices.

3.3 Flood Risk Indicators

3.3.1 The initial flood risk identification involves a scoping review of existing available information and datasets. The following source indicators were researched as part of the Stage 1 process;

- UÉ/DLRCC Drainage Records maps
- Available OPW flood maps and reports (from *floodmaps.ie*)
- DLRCC Carrickmines/Shanganagh River Catchment Study
- DLRCC Kilternan Glenamuck Local area Plan 2025
- DLRCC Development Plan– Appendix 15-Strategic Flood Risk assessment
- DLRCC GDRS published SSFRA
- OPW Eastern CFRAM study
- OPW PFRM mapping
- ECFRAM Maps
- National Indicative Fluvial Maps (NIFM)
- Geological Survey of Ireland (GSI) website
- Teagasc soils data sets
- Ordnance Survey mapping
- Topographical survey
- Site Investigation report
- Site walkover visits

3.4 Tidal Flood Risk

3.4.1 Tidal flooding is caused by higher sea levels than normal, largely because of storm surges, resulting in the sea overflowing onto the land. There are also tidal effects on groundwater levels.

3.5 Tidal Flood Risk Indicators

3.5.1 Reference to land mapping websites such as google maps/OSI mapviewer indicate that this site is more than 5km from the coast. The site topographical survey demonstrates that the land is elevated at c.103mOD Malin Head.

3.6 Initial Tidal Flood Risk Assessment

3.6.1 Based on the remote distance from the coastline and the elevated nature of the site, in our opinion there is no risk of Tidal flooding on this site.

3.7 Fluvial Flood Risk

3.7.1 Fluvial river/stream flooding occurs when the capacity of a watercourse is exceeded or the channel is blocked or restricted, and excess water spills out from the channel onto adjacent low-lying area.

3.8 Fluvial Flood Risk Indicators

3.8.1 Appendix 15 of the DLRCC CDP "Strategic Flood Risk Assessment" has created Flood Zone maps for the DLRCC area. Flood Zone Map No.9 published in the CDP indicates spot portions of the Glenamuck Stream as Flood Zone A where the watercourse floods locally but is immediately adjacent to the stream banks. These spot flood locations lie within the SE portion of the subject site, refer to Fig.9 below. As is stated in the Kilternan Glenamuck LAP, the National Indicative Fluvial Maps (NIFM) were used in the preparation of the CDP and Kilternan Glenamuck LAP and use of the NIFM is indicative and should not be used as the sole basis for defining flood zones.

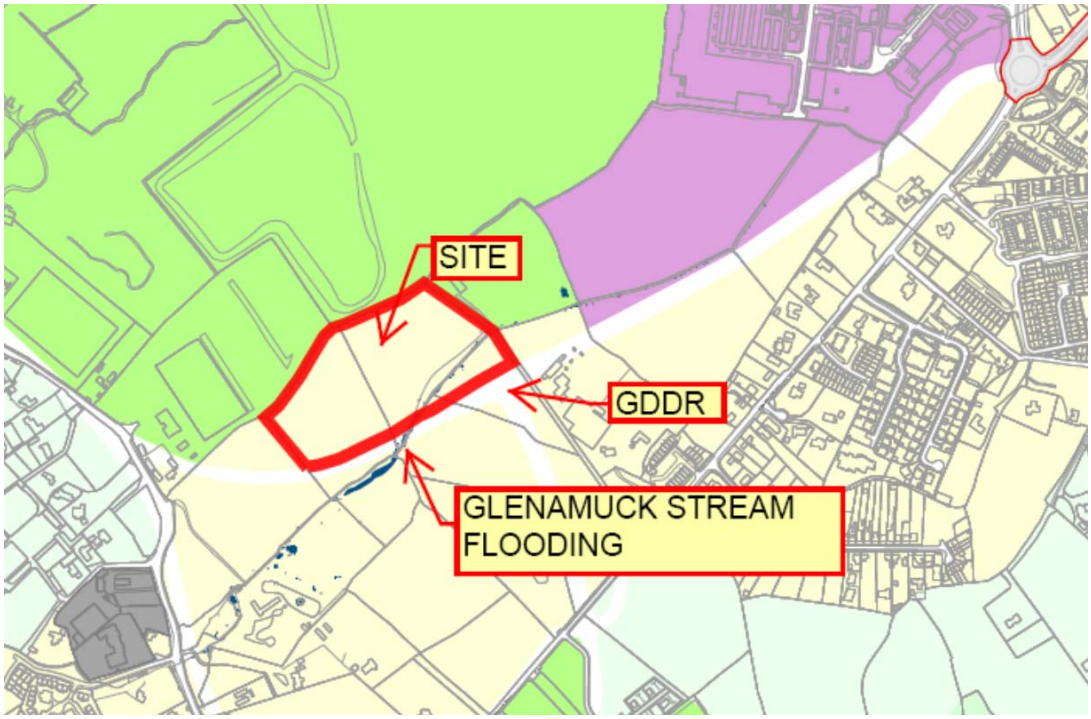


Fig.9- Ex DLRCC CDP Flood Zone map No.9

3.8.2 The EPA waterbodies mapping website identify The Glenamuck Stream as the "Carrickmines Stream_010" crossing the site (river waterbody code of "IE_EA_10C040350") and a smaller tributary of the same bounding the site along part of the northern boundary, refer Fig.10 below;

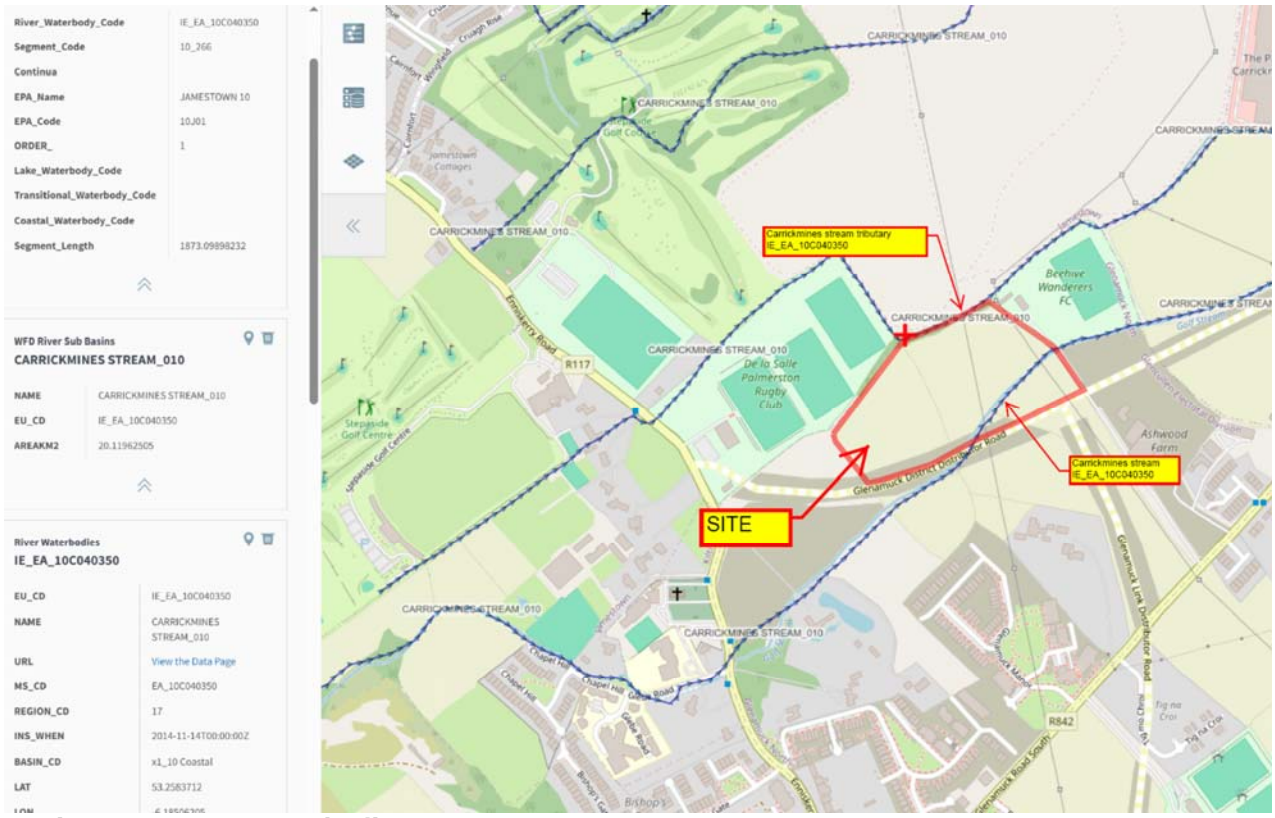


Fig.10- Ex. EPA Waterbodies Map

3.8.3 The OPW NIFM (extracted from the Kilternan Glenamuck LAP) mapping of the local area does not identify flooding associated with the Glenamuck Stream as referenced from Fig.11 below;

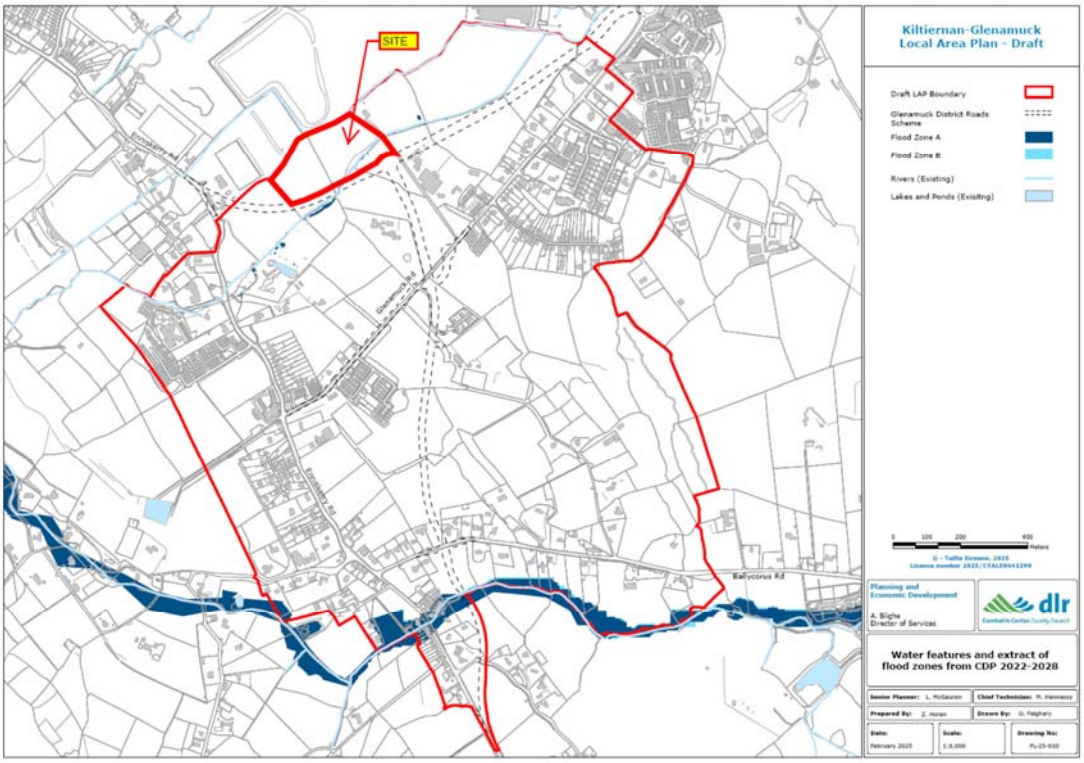


Fig.11– OPW NIFM ex.DLRCC Kilternan Glenamuck LAP

3.8.4 DLRCC commissioned RPS Consulting Engineers to carry out the Fluvial Flooding Report for Carrickmines/Shanganagh River Catchment Stage 1 Final Report 2008. Review of that report determined that there is no risk to flooding of property along the Golfcourse Stream between Enniskerry Road and Carrickmines River. The following Fig.12 is an extract taken from the DLRCC/RPS report.

3.2 GLENAMUCK AND GOLF COURSE STREAM AREA

This area consists of the catchments of the Stepaside Golf Course stream and the Glenamuck stream and the analysis covers the area between Enniskerry Road and the Carrickmines River. There is one predicted flooding location.

Location G1 – Beside Carrickmines Retail Park (DG2052)
Flooding in a field is predicted to occur south of Carrickmines Retail Park near the confluence of the Glenamuck Stream and a stream from the landfill area to the west. No properties are at risk. The flooding is caused by a 600mm diameter culvert restriction on the main Glenamuck Stream. The river is culverted at this location to facilitate a farm access track.

Fig.12 – Extract from DLRCC/RPS Carrickmines/Shanganagh River Catchment Study

3.8.5 A Site Specific Flood Risk Assessment was carried out by DBFL Consulting Engineers on behalf of DLRCC as part of the recently constructed GDRS project. That SSFRA was included in the appendix 14-1 of the Environmental Impact Assessment Report (EIAR) for that project. That SSFRA included a full hydrological assessment of the Glenamuck Stream, various existing undersized culverts within the stream, determined existing potential flood risk areas and proposed mitigation of the flood risk by inclusion of correctly sized culverts where the GDRS traverses the Glenamuck Stream.

3.8.6 At the subject site the GDRS had included 2No. new drainage culverts referenced as "WX01" and "WX02" as identified in Fig.13 below extracted from the DLRCC GDRS SSFRA;

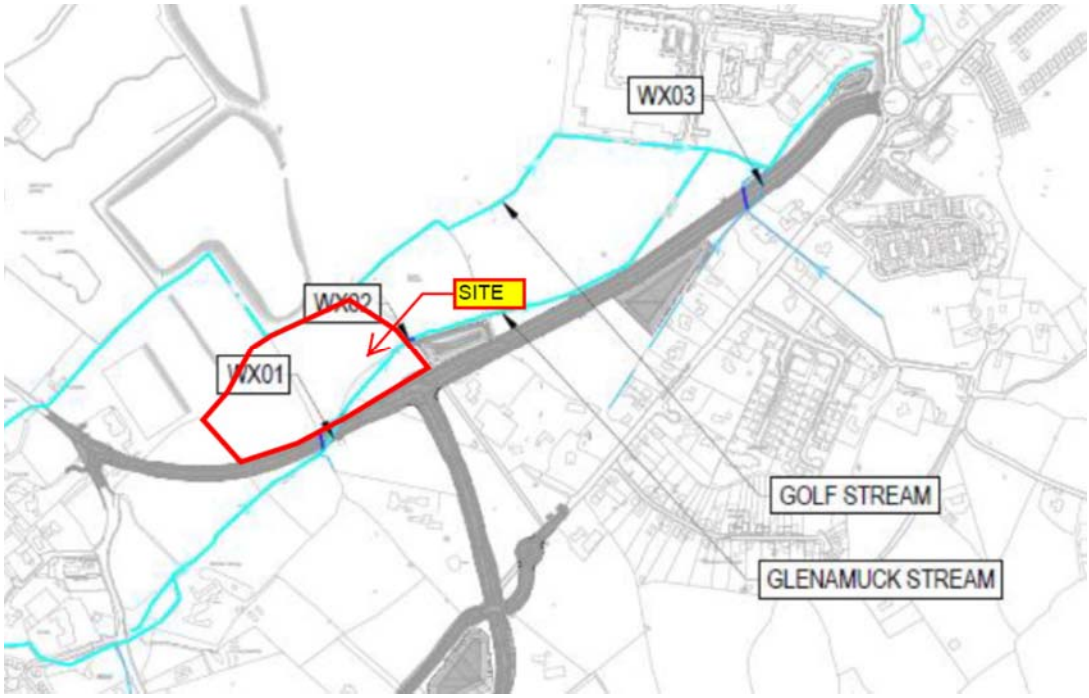


Fig.13- ex. DLRCC GDRS EIAR SSFRA **Appendix 14.1**

3.8.7 The hydrological model generated for the GDRS examined the Q100 and Q1000 flow characteristics of the Glenamuck Stream for both pre and post construction of the GDRS. The pre-construction (existing) Q100 and Q1000 events did not identify out of channel flooding of the Glenamuck Stream on the subject site. To the east of the subject site at a location identified as the "Bective Rangers Access" (ref.WX02), significant surcharging of the stream in the Q100 event was noted as was overtopping of the stream banks at this location during the Q1000 event. Surcharging and overtopping of the bank at this WX02 location was noted as "typically associated with deficiencies in the capacity in the existing culverts". Pre-construction of the GDRS this WX01 culvert was surveyed

as a 450mm pipe. Refer to Fig 14 below extracted from the DLRCC GDRS SSFRA (appendix 14 of the GDRS EIAR) entitled "Existing Flood Events".

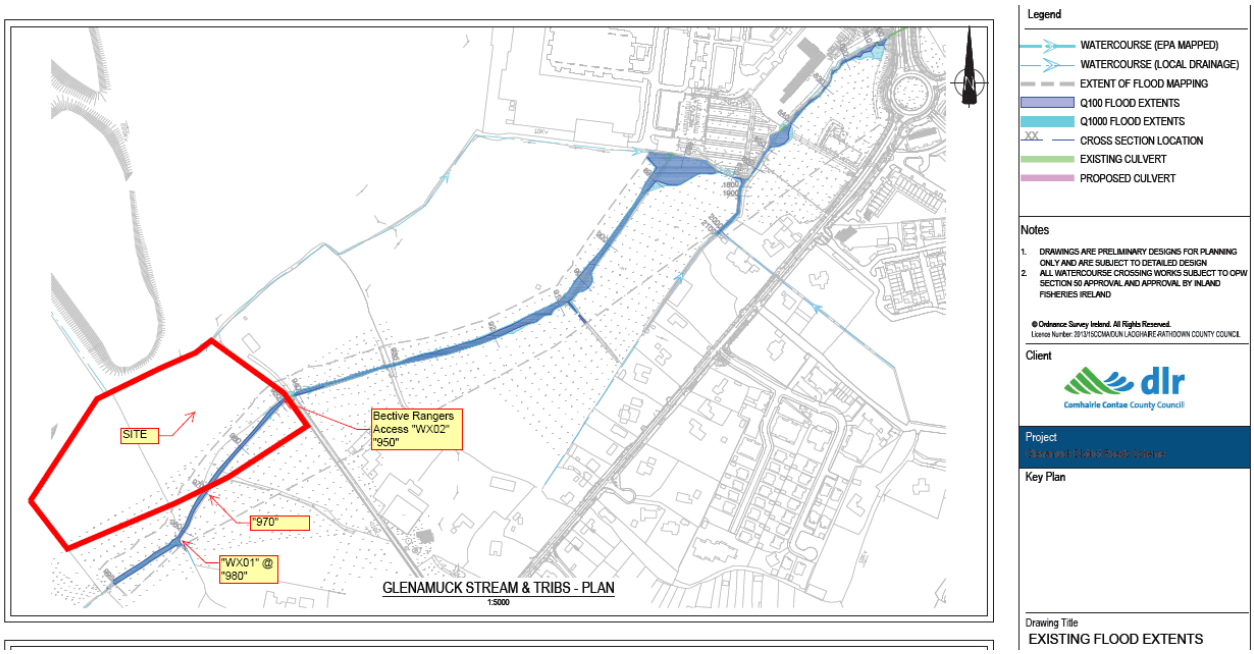


Fig.14- ex. DLRCC GDRS EIAR SSFRA **Appendix 14.1 Figure 1**

3.8.8 The GDRS project has constructed a new culvert diverting the Glenamuck Stream under the GDRS referenced as "WX01" (see Fig.14 above for location) and replacing the existing Bective Rangers 450mm culvert with a new designed culvert "WX02". The published hydrological study also modelled the post-construction scenario for the Q100 & Q1000 year events. The results of that drainage model noted that the "Proposed Culvert WX01 reduces modelled Q100 flood levels in the vicinity of the works (by approx.0.16m)". The DLRCC GDRS SSFRA also notes that "The proposed replacement of undersized culvert Ex Cul 1 with WX02 reduces the modelled Q100 flood levels by approx. 0.28m in the vicinity of the works". Refer to Fig 15 below extracted from the DLRCC GDRS SSFRA (appendix 14 of the GDRS EIAR) entitled "Proposed Flood Extents".

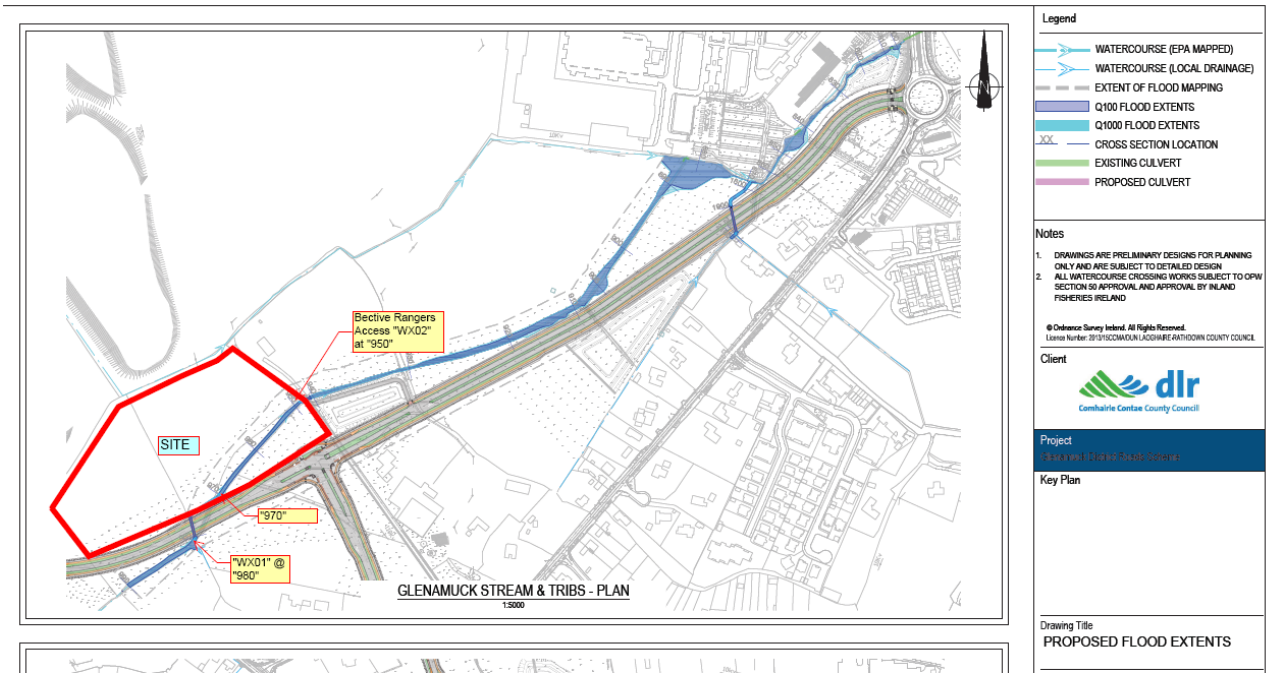


Fig.15- ex. DLRCC GDRS EIAR SSFRA **Appendix 14.1 Figure 2**

3.8.9 The GDRS SSFRA concluded that "the proposed roads are within Flood Zone C and are at low risk of fluvial flooding".

3.8.10 The Appendix C of the GDRS SSFRA includes results of the hydrological model for the Q1000 events at various locations along the Glenamuck stream. The identified locations relevant to this subject site are noted as "970" and "950" as per Fig.14 & 15 above.

3.8.11 The hydrological model results published in the DLRCC GDRS SSFRA Appendix C list the various paramaters and associated levels/flow rates/etc. The "W.S. Elev" result refers to the elevation of the surface of the water at that section and at location "970" is noted as 99.87mOD for the Q1000 year event for the post-construction, i.e. after the GDRS culvert WX01 is installed. Another value listed in the hydrological model results is called the "E.G Elev" which refers to the elevation of the Energy Grade Line, which is the sum of the actual water surface elevation and the additional head derived from the flow velocity. At the location "970" the "E.G. Elev" level is noted as 100.10mOD and is the highest modelled flood level at location "970".

3.8.12 Reference to the topographical survey carried out on the subject site indicates that the existing ground levels at/around the proposed housing c.10m from "970" (downstream of culvert "WX01") is at an elevation of c.102.0mOD. Furthermore, the proposed finished floor level of the lowest floor slab in this area is 102.00mOD. That is, the lowest FFL is c. 1.9m above the highest water level in the Glenamuck Stream during the Q1000 year event. Refer to Fig.16 below for an extract from the DLRCC GDRS SSFRA hydrological model results;

River	Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
					(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Glenamuck Stream	1	990	Q1000	proposed	1.93	104.69	105.28	105.28	105.47	0.082111	1.91	1.01	2.79	1.01
Glenamuck Stream	1	990	Q1000	existing	1.93	104.69	105.39	105.28	105.50	0.037589	1.44	1.34	3.07	0.70
Glenamuck Stream	1	980	Q1000	proposed	1.93	101.08	101.89	101.55	101.93	0.009810	0.90	2.15	3.65	0.37
Glenamuck Stream	1	980	Q1000	existing	1.93	101.14	101.77	101.63	101.85	0.028990	1.30	1.49	3.41	0.63
Glenamuck Stream	1	975			Culvert									
Glenamuck Stream	1	970	Q1000	proposed	1.93	99.23	99.87	99.87	100.10	0.088510	2.12	0.91	2.02	1.01
Glenamuck Stream	1	970	Q1000	existing	1.93	99.21	100.09	99.87	100.18	0.026486	1.36	1.44	3.23	0.57

Fig.16 – Extract from GDRS SSFRA appendix C

3.8.13 Similar to the above, the hydrological model results published in the DLRCC GDRS SSFRA Appendix C at location "950" (upstream of culvert WX02 indicates that the "W.S. Elev" is noted as 95.63mOD for the Q1000 year event for the post-construction, i.e. after the GDRS culvert WX02 is installed. The "E.G Elev" at location "95" is noted as 95.88mOD and is the highest modelled flood level at location "950".

3.8.14 Reference to the topographical survey carried out on the subject site indicates that the existing ground levels at/around the nearest proposed building (the creche) located c.45m from "950" (upstream of culvert "WX02") is at an elevation of c.98.50mOD. Furthermore, the proposed finished floor level of the creche floor slab is 99.25mOD. That is, the lowest FFL is c. 3.37m above the highest water level in the Glenamuck Stream during the Q1000 year event. Refer to Fig.17 below for an extract from the DLRCC GDRS SSFRA hydrological model results;

River	Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
					(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Glenamuck Stream	1	990	Q1000	proposed	1.93	104.69	105.28	105.28	105.47	0.082111	1.91	1.01	2.79	1.01
Glenamuck Stream	1	990	Q1000	existing	1.93	104.69	105.39	105.28	105.50	0.037589	1.44	1.34	3.07	0.70
Glenamuck Stream	1	980	Q1000	proposed	1.93	101.08	101.89	101.55	101.93	0.009810	0.90	2.15	3.65	0.37
Glenamuck Stream	1	980	Q1000	existing	1.93	101.14	101.77	101.63	101.85	0.028990	1.30	1.49	3.41	0.63
Glenamuck Stream	1	975			Culvert									
Glenamuck Stream	1	970	Q1000	proposed	1.93	99.23	99.87	99.87	100.10	0.088510	2.12	0.91	2.02	1.01
Glenamuck Stream	1	970	Q1000	existing	1.93	99.21	100.09	99.87	100.18	0.026486	1.36	1.44	3.23	0.57
Glenamuck Stream	1	960	Q1000	proposed	1.93	97.02	97.92	97.58	97.97	0.012590	1.00	1.93	3.23	0.41
Glenamuck Stream	1	960	Q1000	existing	1.93	97.02	97.69	97.58	97.81	0.039579	1.52	1.27	2.70	0.71
Glenamuck Stream	1	950	Q1000	proposed	1.93	94.92	95.63	95.63	95.88	0.096203	2.21	0.87	1.78	1.01
Glenamuck Stream	1	950	Q1000	existing	1.93	94.92	95.93	95.64	95.99	0.015832	1.12	1.81	5.33	0.42

Fig.17 – Extract from GDRS SSFRA appendix C

3.8.15 The proposed development on the subject lands requires a new road crossing over the Glenamuck Stream at a location c.30m upstream of the existing/recently constructed DLRCC WX02 culvert. It is intended that a similar size & configuration of culvert is installed to the 2No.existing recently installed (WX01 & WX02) both upstream and downstream of the proposed new road crossing. Details of the recently installed culvert

were obtained and were determined to be rectangular culvert 1.8m wide x 1.2m high as per Fig.18 below.

Fig.18 – Photo of existing culvert WX02

3.8.16 On review of the DLRCC GDRS SSFRA Appendix C it can be seen that the Q1000 year storm event has an estimated flowrate of 1.93m^3/s at the WX02 location c.30m downstream of the proposed culvert. The 1.8x1.2m culvert used in the GDRS project has a flow capacity multiple times greater than the predicted Q1000 1.93m^3/s event and therefore using a similar size culvert at a c.1/45 gradient for the new crossing is determined to be logical solution to maintaining a similar flow capacity for the Glenamuck Stream. A Section 50 application will be made to the OPW for the installation of this new crossing point in advance of the Stage 3 application submission.

3.8.17 There is tributary watercourse adjacent to the old DLRCC Jamestown landfill site for approximately half of the subject sites northern boundary (c.150m) and as identified in paragraph 3.8.2 and Fig 10 above. This watercourse was visually inspected during August and September 2024 and May 2025. Low flow water was observed in this location during the May 2025 visit only and the depth of water was measured to be a maximum of c.25-35mm maximum where determined to be at the greatest depth. That is, there was very little flow in this watercourse observed in the 3No.site visits. The only flow was observed to be only cascading downstream from small sections of standing water. This northern boundary watercourse passes via a 900mm diameter pipe culvert in the northeast corner of the site heading into the Bective lands, see Fig's.18 & 19 below;

Fig.18 – Photo looking towards the NE corner of site taken on 17/09/24

Fig.19 – Photo at the NE corner of site taken on 17/09/24

3.8.18 The cross section of this tributary varies between at c.0.75-1.2m width at the bottom and c.0.5-1m deep relative to the subject site topography. The proposed development raises the existing ground level by c.0.5m along the northern boundary therefore providing a greater level of freeboard to the existing watercourse than currently exists.

3.8.19 There was no available flow or flooding records available relating to this portion of the Glenamuck Stream tributary. The source of the watercourse is estimated to be c.900m upstream of the site in the Stepaside Golf Centre and it follows a route around the northern and eastern boundary of the De La Salle Palmerston rugby playing pitches before emerging onto the subject sites boundary.

3.8.20 An estimate of the catchment for this tributary watercourse was determined to be c.21.5Ha. Using the Institute of Hydrology IH124 equation for rural Qbar estimation, the Q100 flow was determined to be c.0.313m^3/s and the Q1000 flow was estimated to be 0.415m^3/s along the northern boundary of the subject site. Open channel flow calculations were carried out for two existing watercourse cross sections

along the northern boundary to determine the top water level for the Q100 & Q1000 events. The highest water level was determined to be c.208mm above the existing bed level for the Q1000 event at Section profile 2-2. As the finished road level along the northern boundary is proposed to be between c.0.9m to c.1.35m above the existing watercourse bed level, this would result in a freeboard of between 700mm to 850mm above the Q1000 year event. Calculations for the flow in the northern boundary watercourse are shown in Appendix 6.6. There are no proposed works to be carried out to this watercourse.

3.8.21 Research into the flooding history of the area on *floodmaps.ie* website determined that there was no flooding in the immediate area of the site. Refer to Fig.20 below. It is noted that the flood point markers on the OPW National Flood Hazard map extract are located c.780m downhill of the subject site and the published DLRCC/OPW summary reports relating to those locations did not record flooding occurring at the subject site.

Fig.20 – Extract from the OPW National Flood Hazard Map (*floodmaps.ie*)

3.8.22 The OPW has published the Catchment Flood Risk Assessment Management Studies and they have created a website portal for accessing the available results and mapping at *www.cfram.ie*. & *www.floodinfo.ie*

3.8.23 The mapping published indicates the flood extent boundaries for various return period events. These Annual Exceedance Probability (AEP) events of 10%, 1% and 0.1% (or 1 in 10 year, 1 in 100 year and 1 in 1000 year) were examined as part of the CFRAM mapping. Fig.21 below indicates the studied areas as shown in shaded blue.

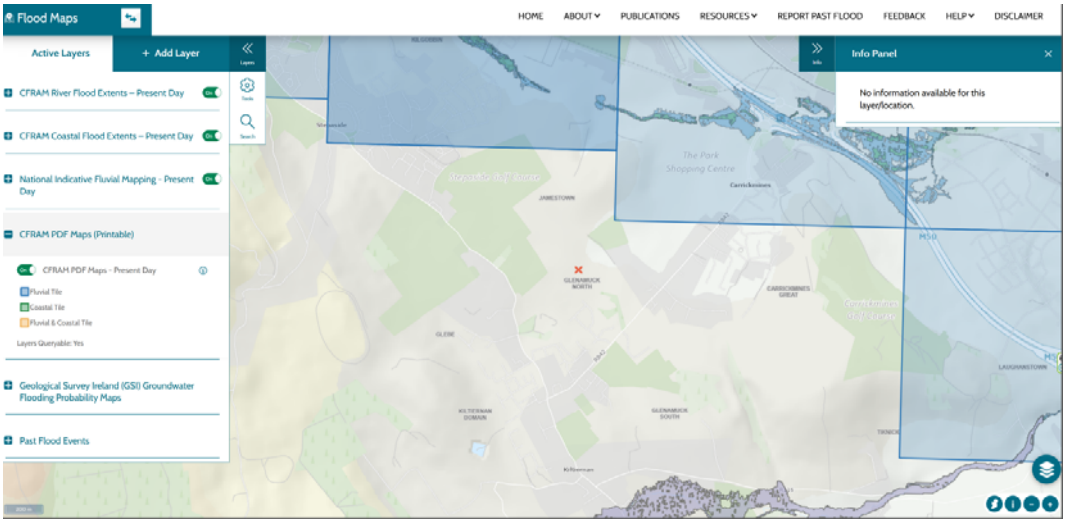


Fig.21 – Extract from CFRAM

3.8.24 It is apparent the CFRAM study (as shown in Fig.21 above in blue shading) has not been carried out in the immediate vicinity of Kilternan and is concentrated on the known Shanganagh-Carrickmines River Fluvial Extents area.

3.8.25 In preparation of this SSFRA, discussions were held with the previous landowner of the subject lands who has lived immediately adjacent to this site since 1971. The landowner was queried regarding any known flooding of the Glenamuck Stream at or onto the subject site and it was noted that there was no such flooding in his tenure on the lands.

3.8.26 3No.Site visits/walkovers were carried out (Aug & Sept 2024 & May 2025) in researching for this SSFRA and there was no visible evidence of localised flooding onto the subject site. It is noted that these visits took place in dry weather.

3.9 Initial Fluvial Flood Risk Assessment

3.9.1 Based on the research into the available published reports, studies and DLRCCs own GDRS hydrological model in our opinion there is a low risk of fluvial flooding onto the development area of the proposed site.

3.10 Pluvial Flood Risk

3.10.1 Pluvial flooding is caused when the intensity of rainfall events cannot be absorbed into the ground or urban drainage systems cannot effectively convey the flowrates.

3.11 Pluvial Flood Risk Indicators

3.11.1 Reference was made to the available drainage records drawings of Uisce Éireann/DLRCC. There are no known S/W drainage pipes on the subject lands. There is an existing 375/450mm diameter foul trunk main crossing the site parallel to the northern side of the Glenamuck Stream but this sewer has now (May 2025) been diverted into the GDDR as part of the GDRS roads project and is no longer a live sewer. There is also an existing 300mm trunk watermain laid in parallel to the above noted foul sewer but this main has also now been diverted into the GDDR and is no longer a live main.

3.11.2 As is recommended in the DLRCC Stormwater Management Policy, the HR Wallingford UKSuDS Greenfield runoff rate estimation tool was used to calculate the Qbar for the site. The overall total S/W outfall rate from the proposed development has been calculated using the drained site area of c.4.44 Ha (not the application "redline" area). **Qbar** was determined to be **= 32.3**. Refer to the main application submission Dwg.No.'s 2411/201 for the layout and detail of the proposed S/W infrastructure.

3.12 Initial Pluvial Flood Risk Assessment

3.12.1 As the risk of pluvial flooding from the new infrastructure planned is not deemed as a low risk occurrence and the vulnerability of residential development is deemed as high, it is seen as appropriate that a detailed pluvial flood risk assessment be reviewed.

3.13 Detailed Pluvial Flood Risk assessment

3.13.1 The proposed new drainage surface water infrastructure for the development has been designed to cater for flows generated by all storms up to the Q100+20%(climate change) without flooding occurring. The drainage design has also allowed for more than the min.10% Urban Creep allowance as required in the DLRCC Stormwater Management Policy document

3.13.2 This subject site planning application seeks to outfall the attenuated surface water flows into two outfall locations, both of which connect directly to the Glenamuck Stream. The sites pluvial system has been divided into 3No.catchments (B1/B2/B3). Catchment B1 & B2 outfall at the same location on the northern side of the Glenamuck Stream at the recently constructed GDRS culvert WX02. Catchment B3 outfalls at the same location but on the opposite southern side of the Glenamuck Stream at WX02. Refer to the main infrastructural report for details of same.

3.13.3 The pipe sizes and gradients are designed to convey the storm water flows to two separate attenuation locations where the storage capacity has been designed in each to exceed the Q100+20% event. Calculations for the critical rainfall events have been included in the appendix of the Engineering Infrastructure & Stormwater Impact Assessment report.

3.13.3 The calculated **Q30+20% Climate Change** storm water storage volume for total site is **c.539m³** as determined from the MicroDrainage simulation modelling software and is split between the three catchment storage locations.

3.13.4 The calculated **volume for the Q100 +20% Climate Change event** is **= c.740m³** as determined from the MicroDrainage simulation modelling software results. An additional 10% has been added to the storage capacity allowing for Urban Creep of 10% resulting in a site total of **c.814m³** storage required.

3.13.5 The freeboard achieved in the S/W design exceeds the minimum 500mm requirement as specified in the GDRS as noted in Section 6.18 of the main Engineering Infrastructure & Stormwater Impact Assessment report.

3.13.6 In reference to Section 6.25 of the main infrastructural report accompanying the application, it is noted that there is **additional interception storage volume** that has not been subtracted from the required attenuation volume nor has it been added to the available storage volume and is therefore considered to be a safer and more conservative approach to attenuation storage estimation.

3.13.7 SuDS elements included in the pluvial design include green roofs, filter drains, peremable paving, roadside filter swales, bio-retention areas, catchpits, tree pits and 3No.attenuation storage areas.

3.13.8 An overflow flood route map was prepared (Dwg.No.2411/206) and is included in the appendix of this assessment report. These extreme event overflow follow the natural grassland ground contours overland to a low point grasslands on the subject site.

3.14 Conclusion of the Detailed Pluvial Flood Risk Assessment

3.14.1 In accordance with the sequential assessment approach as per the Guidelines flowchart (section 2.10 above) it is concluded that the requirements have been met and no further assessment is required regarding pluvial flood risk.

3.15 Groundwater Flood Risk

3.15.1 Groundwater flooding occurs when the level of water stored in the ground, the water table, rises because of prolonged rainfall. Groundwater flooding tends to be very local and result from interactions of site specific factors such as tidal variations.

3.16 Groundwater Flood Risk Indicators

3.16.1 Site investigations have revealed that sub surface soil conditions on this site are known to be sandy gravelly CLAY. A soakaway testing report is included in the Appendix 11.6 of the main infrastructure report and the result of which determined that the site is not suitable for soakaway design.

3.16.2 Reference was also made to the online web portal provided by the Geological Survey of Ireland (GSI) as well as the alluvial maps provided by the Teagasc link on the GSI website.

3.16.3 Ground water was noted as encountered during the soakaway trial holes investigations at levels varying between 1-1.5m but it is noted that ground water levels can vary depending on the time of year.

3.16.4 There were no recorded groundwater issues for the subject site/area on the Geological Survey of Ireland online datasets and reference can be made to the summary groundwater map report included in the appendix of this report.

3.16.5 3No. site walkovers were carried out in dry weather conditions across the summer, autumn and spring seasons and the water table was not evident during the visits.

3.16.6 In reference to the Road and Block Levels drawings 2411/200 it is noted that all finished floor levels of buildings on the site are to be constructed above the ground level and above the adjacent roads.

3.17 Initial Groundwater Flood Risk Assessment

3.17.1 The indicators described above suggest that the site is not at risk of flooding from groundwater and accordingly a detailed assessment of the flooding mechanism is not required and, in our opinion, there is a low risk of groundwater flooding onto the site

3.18 Human/Mechanical Error Flood Risk

3.18.1 There are flood risks associated with misuse, neglect, damage, intervention of or lack of intervention attributable to mechanical failure or human error. Such a risk can be caused by blockages in piped systems or lack of maintenance of mechanical devices.

3.19 Human/Mechanical Error Flood Risk Indicators

3.19.1 Based on the experienced professional judgement of the engineering designer and in consultation with the Drainage Department of DLRCC, it has been considered that blockages can occur with systems for many reasons.

3.20 Initial Human/Mechanical Error Flood Risk Assessment

3.20.1 As there is some risk of pluvial flooding from human/mechanical error, the new infrastructure is not deemed as a low risk occurrence and the vulnerability of residential development is classified as high (refer to Section 2.12 of this report), it is seen as appropriate that a more detailed human/mechanical error flood risk assessment be reviewed.

3.21 Detailed Human/Mechanical Error Flood Risk Assessment

3.21.1 As part of the assessment for blockages in the system, the MicroDrainage design model was run on the basis that there was a near 100% blockage of the outfall vortex control devices for a 120 minute period. Therefore, the model was run with a reduction in the outfall rates from each Hydrobrake down to 0.1 l/s for a 120min duration in the Q100 + 20% event. These resulting volumes and top water level are contained within the detention basin and storage areas and no above ground flooding was evident in the drainage model.

3.21.2 Notwithstanding that the above noted blocked outfall model simulation contains the water below ground, in the event of an unprecedented scenario, an above ground flood path/exceedance flow route

assessment was carried out to determine and manage the flooding routes across the site and these flow routes are represented on Dwg.No.2411/206. Dropped kerbs and profiling of the local landscape will be constructed to direct the overland flows towards the lowest points of the sites landscaped areas. Refer to Dwg.No.2411/206 and to Appendix 6.1 for these calculation results.

3.22 Conclusion of the Detailed Human/Mechanical Error Risk Assessment

3.22.1 In accordance with the sequential assessment approach as per the Guidelines flowchart (section 2.10 above) it is concluded that the requirements have been met and no further assessment is required regarding human/mechanical error flood risk.

4.0 Source Pathway Receptor Model

4.1 A source-pathway-receptor model as per the Appendix A 1.3 of the Technical Appendices accompanying *the Guidelines* was created and is shown in the Table 2 below. This model indicates the possible sources of flood water and the pathway to the receptors (the buildings/people) and the risks associated based on the findings of the FRA research.

Source	Pathway	Receptor	Likelihood	Consequence	Risk
Tidal	c.5km from coast and elevated >100m above sea level	People/ property	Remote	N/A	None
Fluvial	Overtopping of the Glenamuck Stream	People/ property	Possible	Moderate	Low
Pluvial (Surface water)	Flooding from drainage systems	People/ property	Possible	Low	Low
Groundwater	Rising water table	People/ property	Possible	Low	Low
Human/ Mechanical Error	Blockage of drainage	People/ property	Possible	Moderate	Low

Table 2 – Source Pathway Receptor Model

5.0 SSFRA Conclusion

5.1 As is required under the Dun Laoghaire Rathdown County Development Plan 2022 – 2028 Appendix 15 – Strategic Flood Risk assessment and in accordance with the requirements set out in the DoEHLG and OPW published guidelines *The Planning System and Flood Risk Management 2009* (the Guidelines), a Site Specific Flood Risk Assessment (SSFRA) has been carried out for this application.

5.2 In accordance with the above noted Guidelines, as sequential staged approach was adopted in assessing the flood risk for the subject development.

5.3 It was determined in accordance with the Guidelines that the lands on which the subject development is located is within a **flood Zone C** as defined in the Guidelines.

5.4 It is concluded that a residential development is appropriate on the subject lands.

5.5 It is concluded that the above level of assessment is sufficient given the nature of the development and the level of flood risk identified for the site.

5.6 Based on the information available it is concluded that this site is suitable for development and has an overall low risk of being affected by flooding.

6.0 APPENDIX

Contents:

Appendix 6.1

Blocked Outfalls - Micro Drainage Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Catchment B1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	16.000	Add Flow / Climate Change (%)	0
Ratio R	0.276	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	1.000	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Free Flowing Outfall Details for Catchment B1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S200.018	S	96.500	95.637	95.640	225	0

Simulation Criteria for Catchment B1

Volumetric Runoff Coeff	1.000	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	100	Cv (Summer)	1.000
Region	Scotland and Ireland	Cv (Winter)	1.000
M5-60 (mm)	16.000	Storm Duration (mins)	30
Ratio R	0.276		

Online Controls for Catchment B1

Hydro-Brake® Optimum Manhole: S235, DS/PN: S200.015, Volume (m³): 5.9

Unit Reference	MD-SHE-0013-1000-1000-1000
Design Head (m)	1.000
Design Flow (l/s)	0.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	13
Invert Level (m)	96.650
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	0.1	Kick-Flo®	0.120	0.0
Flush-Flo™	0.052	0.0	Mean Flow over Head Range	-	0.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.0	0.800	0.1	2.000	0.1	4.000	0.2	7.000	0.2
0.200	0.1	1.000	0.1	2.200	0.1	4.500	0.2	7.500	0.2
0.300	0.1	1.200	0.1	2.400	0.1	5.000	0.2	8.000	0.2
0.400	0.1	1.400	0.1	2.600	0.1	5.500	0.2	8.500	0.2
0.500	0.1	1.600	0.1	3.000	0.2	6.000	0.2	9.000	0.3
0.600	0.1	1.800	0.1	3.500	0.2	6.500	0.2	9.500	0.3

Storage Structures for Catchment B1

Tank or Pond Manhole: S235, DS/PN: S200.015

Invert Level (m) 97.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1375.0	1.000	1375.0	1.001	0.0

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment B1

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	16.000
Region	Scotland and Ireland	Ratio R	0.276
Cv (Summer)	1.000		
Cv (Winter)	1.000		

Margin for Flood Risk Warning (mm) 150.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	120
Return Period(s) (years)	2, 30, 100
Climate Change (%)	20, 20, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)
S200.000	S201	120 minute 2 year Summer I+20%	108.310	106.846	-0.189	0.000	0.06		0.036
S200.001	S202	120 minute 2 year Summer I+20%	107.700	106.242	-0.183	0.000	0.08		0.055
S200.002	S203	120 minute 2 year Summer I+20%	106.970	105.528	-0.177	0.000	0.10		0.058
S200.003	S204	120 minute 2 year Summer I+20%	106.480	104.997	-0.168	0.000	0.15		0.068
S200.004	S205	120 minute 2 year Summer I+20%	105.290	103.866	-0.149	0.000	0.25		0.092
S200.005	S206	120 minute 2 year Summer I+20%	104.370	102.901	-0.144	0.000	0.27		0.101
S200.006	S207	120 minute 2 year Summer I+20%	103.920	102.275	-0.140	0.000	0.30		0.109
S200.007	S208	120 minute 2 year Summer I+20%	102.120	100.385	-0.215	0.000	0.18		0.091
S200.008	S209	120 minute 2 year Summer I+20%	100.730	98.872	-0.188	0.000	0.29		0.146
S200.009	S217	120 minute 2 year Summer I+20%	100.250	98.512	-0.168	0.000	0.38		0.150
S200.010	S218	120 minute 2 year Summer I+20%	100.870	98.142	-0.178	0.000	0.34		0.258
S200.011	S17	120 minute 2 year Summer I+20%	99.750	97.636	-0.167	0.000	0.22		0.790
S201.000	S210	120 minute 2 year Summer I+20%	104.240	102.793	-0.162	0.000	0.17		0.065
S201.001	S211	120 minute 2 year Summer I+20%	104.040	102.495	-0.160	0.000	0.19		0.115
S201.002	S212	120 minute 2 year Summer I+20%	103.600	102.178	-0.147	0.000	0.26		0.113
S201.003	S213	120 minute 2 year Summer I+20%	101.270	99.925	-0.215	0.000	0.18		0.102
S200.012	S13	120 minute 2 year Summer I+20%	100.100	97.623	-0.107	0.000	0.38		6.930
S202.000	S219	120 minute 2 year Summer I+20%	108.360	106.603	-0.182	0.000	0.08		0.043
S202.001	S220	120 minute 2 year Summer I+20%	108.050	106.337	-0.168	0.000	0.14		0.089
S202.002	S221	120 minute 2 year Summer I+20%	107.970	106.222	-0.153	0.000	0.22		0.123
S203.000	S222	120 minute 2 year Summer I+20%	106.680	105.240	-0.185	0.000	0.07		0.040
S203.001	S223	120 minute 2 year Summer I+20%	106.560	105.117	-0.168	0.000	0.14		0.078
S203.002	S224	120 minute 2 year Summer I+20%	106.230	104.744	-0.206	0.000	0.21		0.102
S202.003	S225	120 minute 2 year Summer I+20%	106.560	104.371	-0.254	0.000	0.23		0.197
S202.004	S226	120 minute 2 year Summer I+20%	105.940	104.114	-0.261	0.000	0.20		0.313
S202.005	S227	120 minute 2 year Summer I+20%	104.200	102.780	-0.245	0.000	0.26		0.280
S202.006	S228	120 minute 2 year Summer I+20%	103.920	102.309	-0.256	0.000	0.22		0.193
S202.007	S229	120 minute 2 year Summer I+20%	102.050	100.607	-0.248	0.000	0.25		0.175
S202.008	S230	120 minute 2 year Summer I+20%	100.300	98.979	-0.271	0.000	0.32		0.256
S204.000	S231	120 minute 2 year Summer I+20%	100.320	98.855	-0.180	0.000	0.09		0.045
S204.001	S232	120 minute 2 year Summer I+20%	100.160	98.622	-0.173	0.000	0.12		0.087

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment B1

PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S200.000	S201	1.2	4.9	OK
S200.001	S202	1.3	6.4	OK
S200.002	S203	1.5	9.2	OK
S200.003	S204	1.7	13.8	OK
S200.004	S205	1.8	21.5	OK
S200.005	S206	1.8	23.1	OK
S200.006	S207	2.3	30.3	OK
S200.007	S208	2.3	36.9	OK
S200.008	S209	1.6	38.6	OK
S200.009	S217	1.4	39.3	OK
S200.010	S218	2.3	60.9	OK
S200.011	S17	0.4	59.2	OK
S201.000	S210	1.0	9.3	OK
S201.001	S211	1.5	14.3	OK
S201.002	S212	2.3	27.8	OK
S201.003	S213	2.3	37.8	OK
S200.012	S13	0.5	94.3	OK
S202.000	S219	0.8	4.3	OK
S202.001	S220	0.9	7.1	OK
S202.002	S221	1.7	17.9	OK
S203.000	S222	0.8	3.8	OK
S203.001	S223	1.1	8.3	OK
S203.002	S224	1.2	21.6	OK
S202.003	S225	1.4	42.7	OK
S202.004	S226	2.2	61.6	OK
S202.005	S227	2.0	67.9	OK
S202.006	S228	2.7	79.9	OK
S202.007	S229	2.9	94.2	OK
S202.008	S230	1.7	95.8	OK
S204.000	S231	0.8	4.6	OK
S204.001	S232	0.8	5.7	OK

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment B1

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m^3)
S202.009	S233	120 minute 2 year Summer I+20%	100.070	98.346	-0.284	0.000	0.28		0.231
S200.013	S234	120 minute 2 year Summer I+20%	99.550	97.600	0.000	0.000	1.22		8.046
S200.014	S35	120 minute 2 year Summer I+20%	99.550	97.330	-0.220	0.000	0.68		2.380
S200.015	S235	120 minute 2 year Winter I+20%	99.250	97.317	0.442	0.000	0.00		437.429
S200.016	S236	120 minute 2 year Summer I+20%	98.680	96.531	-0.214	0.000	0.01		0.060
S200.017	S237	120 minute 2 year Summer I+20%	97.830	96.193	-0.212	0.000	0.01		0.019
S200.018	S238	120 minute 2 year Summer I+20%	97.250	95.773	-0.212	0.000	0.01		0.009

PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S202.009	S233	2.0	103.5	OK
S200.013	S234	0.7	200.6	OK
S200.014	S35	1.1	201.4	OK
S200.015	S235	0.1	0.1	SURCHARGED
S200.016	S236	0.5	0.5	OK
S200.017	S237	0.4	0.4	OK
S200.018	S238	0.4	0.5	OK

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment B1

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	16.000
Region	Scotland and Ireland	Ratio R	0.276
Cv (Summer)	1.000		
Cv (Winter)	1.000		

Margin for Flood Risk Warning (mm) 150.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	120
Return Period(s) (years)	2, 30, 100
Climate Change (%)	20, 20, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)
S200.000	S201	120 minute 30 year Summer I+20%	108.310	106.860	-0.175	0.000	0.11		0.051
S200.001	S202	120 minute 30 year Summer I+20%	107.700	106.256	-0.169	0.000	0.14		0.075
S200.002	S203	120 minute 30 year Summer I+20%	106.970	105.545	-0.160	0.000	0.18		0.081
S200.003	S204	120 minute 30 year Summer I+20%	106.480	105.018	-0.147	0.000	0.26		0.096
S200.004	S205	120 minute 30 year Summer I+20%	105.290	103.896	-0.119	0.000	0.45		0.131
S200.005	S206	120 minute 30 year Summer I+20%	104.370	102.932	-0.113	0.000	0.49		0.148
S200.006	S207	120 minute 30 year Summer I+20%	103.920	102.308	-0.107	0.000	0.54		0.162
S200.007	S208	120 minute 30 year Summer I+20%	102.120	100.416	-0.184	0.000	0.32		0.129
S200.008	S209	120 minute 30 year Summer I+20%	100.730	98.917	-0.143	0.000	0.53		0.231
S200.009	S217	120 minute 30 year Summer I+20%	100.250	98.568	-0.112	0.000	0.71		0.229
S200.010	S218	120 minute 30 year Summer I+20%	100.870	98.191	-0.129	0.000	0.62		0.474
S200.011	S17	120 minute 30 year Summer I+20%	99.750	97.842	0.039	0.000	0.42		1.346
S201.000	S210	120 minute 30 year Summer I+20%	104.240	102.816	-0.139	0.000	0.31		0.091
S201.001	S211	120 minute 30 year Summer I+20%	104.040	102.519	-0.136	0.000	0.33		0.155
S201.002	S212	120 minute 30 year Summer I+20%	103.600	102.208	-0.117	0.000	0.47		0.162
S201.003	S213	120 minute 30 year Summer I+20%	101.270	99.955	-0.185	0.000	0.31		0.146
S200.012	S13	120 minute 30 year Summer I+20%	100.100	97.817	0.087	0.000	0.70		9.219
S202.000	S219	120 minute 30 year Summer I+20%	108.360	106.617	-0.168	0.000	0.14		0.059
S202.001	S220	120 minute 30 year Summer I+20%	108.050	106.358	-0.147	0.000	0.26		0.123
S202.002	S221	120 minute 30 year Summer I+20%	107.970	106.248	-0.127	0.000	0.39		0.168
S203.000	S222	120 minute 30 year Summer I+20%	106.680	105.254	-0.171	0.000	0.13		0.056
S203.001	S223	120 minute 30 year Summer I+20%	106.560	105.137	-0.148	0.000	0.26		0.110
S203.002	S224	120 minute 30 year Summer I+20%	106.230	104.779	-0.171	0.000	0.38		0.158
S202.003	S225	120 minute 30 year Summer I+20%	106.560	104.417	-0.208	0.000	0.41		0.333
S202.004	S226	120 minute 30 year Summer I+20%	105.940	104.155	-0.220	0.000	0.36		0.499
S202.005	S227	120 minute 30 year Summer I+20%	104.200	102.831	-0.194	0.000	0.47		0.423
S202.006	S228	120 minute 30 year Summer I+20%	103.920	102.354	-0.211	0.000	0.40		0.294
S202.007	S229	120 minute 30 year Summer I+20%	102.050	100.656	-0.199	0.000	0.45		0.245
S202.008	S230	120 minute 30 year Summer I+20%	100.300	99.050	-0.200	0.000	0.59		0.392
S204.000	S231	120 minute 30 year Summer I+20%	100.320	98.869	-0.166	0.000	0.15		0.061
S204.001	S232	120 minute 30 year Summer I+20%	100.160	98.641	-0.154	0.000	0.22		0.119

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment B1

PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S200.000	S201	1.3	8.8	OK
S200.001	S202	1.5	11.5	OK
S200.002	S203	1.7	16.5	OK
S200.003	S204	2.0	24.7	OK
S200.004	S205	2.1	38.6	OK
S200.005	S206	2.1	41.7	OK
S200.006	S207	2.6	54.8	OK
S200.007	S208	2.7	67.0	OK
S200.008	S209	1.9	70.1	OK
S200.009	S217	1.6	72.4	OK
S200.010	S218	2.7	110.9	OK
S200.011	S17	0.4	109.7	SURCHARGED
S201.000	S210	1.2	16.5	OK
S201.001	S211	1.7	25.5	OK
S201.002	S212	2.6	49.9	OK
S201.003	S213	2.7	67.9	OK
S200.012	S13	0.6	176.1	SURCHARGED
S202.000	S219	1.0	7.6	OK
S202.001	S220	1.1	12.7	OK
S202.002	S221	1.9	32.1	OK
S203.000	S222	0.9	6.8	OK
S203.001	S223	1.2	14.9	OK
S203.002	S224	1.4	39.0	OK
S202.003	S225	1.6	77.0	OK
S202.004	S226	2.6	111.3	OK
S202.005	S227	2.3	123.2	OK
S202.006	S228	3.1	145.2	OK
S202.007	S229	3.4	171.7	OK
S202.008	S230	1.9	174.9	OK
S204.000	S231	1.0	8.1	OK
S204.001	S232	1.0	10.3	OK

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment B1

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)
S202.009	S233	120 minute 30 year Summer I+20%	100.070	98.412	-0.218	0.000	0.52		0.325
S200.013	S234	120 minute 30 year Summer I+20%	99.550	97.777	0.177	0.000	2.30		9.718
S200.014	S35	120 minute 30 year Summer I+20%	99.550	97.628	0.078	0.000	1.26		4.626
S200.015	S235	120 minute 30 year Winter I+20%	99.250	97.560	0.685	0.000	0.00		773.073
S200.016	S236	120 minute 30 year Summer I+20%	98.680	96.538	-0.207	0.000	0.02		0.076
S200.017	S237	120 minute 30 year Summer I+20%	97.830	96.201	-0.204	0.000	0.02		0.035
S200.018	S238	120 minute 30 year Summer I+20%	97.250	95.782	-0.203	0.000	0.02		0.019

PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S202.009	S233	2.3	190.1	OK
S200.013	S234	1.3	376.6	SURCHARGED
S200.014	S35	1.3	376.3	SURCHARGED
S200.015	S235	0.1	0.1	SURCHARGED
S200.016	S236	0.6	0.8	OK
S200.017	S237	0.5	0.8	OK
S200.018	S238	0.5	0.8	OK

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment B1

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	16.000
Region	Scotland and Ireland	Ratio R	0.276
Cv (Summer)	1.000		
Cv (Winter)	1.000		

Margin for Flood Risk Warning (mm) 150.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	120
Return Period(s) (years)	2, 30, 100
Climate Change (%)	20, 20, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)
S200.000	S201	120 minute 100 year Summer I+20%	108.310	106.867	-0.168	0.000	0.14		0.058
S200.001	S202	120 minute 100 year Summer I+20%	107.700	106.265	-0.160	0.000	0.18		0.087
S200.002	S203	120 minute 100 year Summer I+20%	106.970	105.554	-0.151	0.000	0.24		0.093
S200.003	S204	120 minute 100 year Summer I+20%	106.480	105.031	-0.134	0.000	0.34		0.111
S200.004	S205	120 minute 100 year Summer I+20%	105.290	103.913	-0.102	0.000	0.58		0.163
S200.005	S206	120 minute 100 year Summer I+20%	104.370	102.951	-0.094	0.000	0.64		0.185
S200.006	S207	120 minute 100 year Summer I+20%	103.920	102.329	-0.086	0.000	0.70		0.203
S200.007	S208	120 minute 100 year Summer I+20%	102.120	100.434	-0.166	0.000	0.41		0.153
S200.008	S209	120 minute 100 year Summer I+20%	100.730	98.944	-0.116	0.000	0.69		0.285
S200.009	S217	120 minute 100 year Summer I+20%	100.250	98.673	-0.007	0.000	0.91		0.458
S200.010	S218	120 minute 100 year Summer I+20%	100.870	98.375	0.055	0.000	0.78		1.718
S200.011	S17	120 minute 100 year Summer I+20%	99.750	98.054	0.251	0.000	0.52		1.978
S201.000	S210	120 minute 100 year Summer I+20%	104.240	102.829	-0.126	0.000	0.40		0.106
S201.001	S211	120 minute 100 year Summer I+20%	104.040	102.533	-0.122	0.000	0.43		0.187
S201.002	S212	120 minute 100 year Summer I+20%	103.600	102.227	-0.098	0.000	0.60		0.198
S201.003	S213	120 minute 100 year Summer I+20%	101.270	99.973	-0.167	0.000	0.41		0.176
S200.012	S13	120 minute 100 year Summer I+20%	100.100	98.023	0.293	0.000	0.91		9.685
S202.000	S219	120 minute 100 year Summer I+20%	108.360	106.625	-0.160	0.000	0.19		0.068
S202.001	S220	120 minute 100 year Summer I+20%	108.050	106.370	-0.135	0.000	0.33		0.144
S202.002	S221	120 minute 100 year Summer I+20%	107.970	106.264	-0.111	0.000	0.51		0.215
S203.000	S222	120 minute 100 year Summer I+20%	106.680	105.262	-0.163	0.000	0.17		0.065
S203.001	S223	120 minute 100 year Summer I+20%	106.560	105.149	-0.136	0.000	0.33		0.128
S203.002	S224	120 minute 100 year Summer I+20%	106.230	104.799	-0.151	0.000	0.49		0.196
S202.003	S225	120 minute 100 year Summer I+20%	106.560	104.444	-0.181	0.000	0.53		0.415
S202.004	S226	120 minute 100 year Summer I+20%	105.940	104.179	-0.196	0.000	0.46		0.608
S202.005	S227	120 minute 100 year Summer I+20%	104.200	102.861	-0.164	0.000	0.60		0.531
S202.006	S228	120 minute 100 year Summer I+20%	103.920	102.380	-0.185	0.000	0.51		0.354
S202.007	S229	120 minute 100 year Summer I+20%	102.050	100.685	-0.170	0.000	0.58		0.287
S202.008	S230	120 minute 100 year Summer I+20%	100.300	99.097	-0.153	0.000	0.76		0.490
S204.000	S231	120 minute 100 year Summer I+20%	100.320	98.878	-0.157	0.000	0.20		0.071
S204.001	S232	120 minute 100 year Summer I+20%	100.160	98.651	-0.144	0.000	0.28		0.136

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment B1

PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S200.000	S201	1.4	11.3	OK
S200.001	S202	1.6	14.8	OK
S200.002	S203	1.9	21.3	OK
S200.003	S204	2.1	31.9	OK
S200.004	S205	2.2	49.8	OK
S200.005	S206	2.3	53.8	OK
S200.006	S207	2.8	70.7	OK
S200.007	S208	2.8	86.4	OK
S200.008	S209	2.0	90.4	OK
S200.009	S217	1.6	92.8	OK
S200.010	S218	2.6	140.1	SURCHARGED
S200.011	S17	0.5	138.1	SURCHARGED
S201.000	S210	1.3	21.3	OK
S201.001	S211	1.9	32.9	OK
S201.002	S212	2.8	64.3	OK
S201.003	S213	2.9	87.6	OK
S200.012	S13	0.8	226.8	SURCHARGED
S202.000	S219	1.0	9.9	OK
S202.001	S220	1.1	16.4	OK
S202.002	S221	2.1	41.4	OK
S203.000	S222	1.0	8.8	OK
S203.001	S223	1.3	19.2	OK
S203.002	S224	1.4	50.3	OK
S202.003	S225	1.7	99.4	OK
S202.004	S226	2.8	143.6	OK
S202.005	S227	2.5	158.9	OK
S202.006	S228	3.3	187.4	OK
S202.007	S229	3.6	221.6	OK
S202.008	S230	2.0	225.6	OK
S204.000	S231	1.0	10.5	OK
S204.001	S232	1.0	13.2	OK

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment B1

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)
S202.009	S233	120 minute 100 year Summer I+20%	100.070	98.452	-0.178	0.000	0.67		0.383
S200.013	S234	120 minute 100 year Summer I+20%	99.550	97.970	0.370	0.000	2.97		10.357
S200.014	S35	120 minute 100 year Summer I+20%	99.550	97.724	0.174	0.000	1.64		4.885
S200.015	S235	120 minute 100 year Winter I+20%	99.250	97.723	0.848	0.000	0.00		997.570
S200.016	S236	120 minute 100 year Summer I+20%	98.680	96.542	-0.203	0.000	0.02		0.086
S200.017	S237	120 minute 100 year Summer I+20%	97.830	96.204	-0.201	0.000	0.02		0.040
S200.018	S238	120 minute 100 year Summer I+20%	97.250	95.784	-0.201	0.000	0.03		0.022

PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S202.009	S233	2.5	245.3	OK
S200.013	S234	1.7	487.8	SURCHARGED
S200.014	S35	1.7	488.0	SURCHARGED
S200.015	S235	0.1	0.1	SURCHARGED
S200.016	S236	0.6	1.0	OK
S200.017	S237	0.5	1.0	OK
S200.018	S238	0.5	1.0	OK

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Catchment B2

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	16.000	Add Flow / Climate Change (%)	0
Ratio R	0.276	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	1.000	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Free Flowing Outfall Details for Catchment B2

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S300.006	S	96.500	95.720	95.640	0	0

Simulation Criteria for Catchment B2

Volumetric Runoff Coeff	1.000	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	100	Cv (Summer)	1.000
Region	Scotland and Ireland	Cv (Winter)	1.000
M5-60 (mm)	16.000	Storm Duration (mins)	30
Ratio R	0.276		

Online Controls for Catchment B2

Hydro-Brake® Optimum Manhole: S310, DS/PN: S300.006, Volume (m³): 3.7

Unit Reference	MD-SHE-0013-1000-1000-1000
Design Head (m)	1.000
Design Flow (l/s)	0.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	13
Invert Level (m)	95.850
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	0.1	Kick-Flo®	0.120	0.0
Flush-Flo™	0.052	0.0	Mean Flow over Head Range	-	0.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.0	0.800	0.1	2.000	0.1	4.000	0.2	7.000	0.2
0.200	0.1	1.000	0.1	2.200	0.1	4.500	0.2	7.500	0.2
0.300	0.1	1.200	0.1	2.400	0.1	5.000	0.2	8.000	0.2
0.400	0.1	1.400	0.1	2.600	0.1	5.500	0.2	8.500	0.2
0.500	0.1	1.600	0.1	3.000	0.2	6.000	0.2	9.000	0.3
0.600	0.1	1.800	0.1	3.500	0.2	6.500	0.2	9.500	0.3

Storage Structures for Catchment B2

Tank or Pond Manhole: S310, DS/PN: S300.006

Invert Level (m) 95.850

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	200.0	1.000	200.0	1.001	0.0

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Catchment B3

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	16.000	Add Flow / Climate Change (%)	0
Ratio R	0.276	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	1.000	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Simulation Criteria for Catchment B3

Volumetric Runoff Coeff	1.000	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	100	Cv (Summer)	1.000
Region	Scotland and Ireland	Cv (Winter)	1.000
M5-60 (mm)	16.000	Storm Duration (mins)	30
Ratio R	0.276		

Online Controls for Catchment B3

Hydro-Brake® Optimum Manhole: S402, DS/PN: S400.002, Volume (m³): 2.6

Unit Reference	MD-SHE-0014-1000-0750-1000
Design Head (m)	0.750
Design Flow (l/s)	0.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	14
Invert Level (m)	95.900
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.750	0.1	Kick-Flo®	0.128	0.0
Flush-Flo™	0.059	0.1	Mean Flow over Head Range	-	0.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.1	0.800	0.1	2.000	0.1	4.000	0.2	7.000	0.3
0.200	0.1	1.000	0.1	2.200	0.2	4.500	0.2	7.500	0.3
0.300	0.1	1.200	0.1	2.400	0.2	5.000	0.2	8.000	0.3
0.400	0.1	1.400	0.1	2.600	0.2	5.500	0.2	8.500	0.3
0.500	0.1	1.600	0.1	3.000	0.2	6.000	0.2	9.000	0.3
0.600	0.1	1.800	0.1	3.500	0.2	6.500	0.2	9.500	0.3

Storage Structures for Catchment B3

Tank or Pond Manhole: S402, DS/PN: S400.002

Invert Level (m) 95.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	120.0	1.000	120.0	1.001	0.0

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment B3

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	16.000
Region	Scotland and Ireland	Ratio R	0.276
Cv (Summer)	1.000		
Cv (Winter)	1.000		

Margin for Flood Risk Warning (mm) 150.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	120
Return Period(s) (years)	2, 30, 100
Climate Change (%)	20, 20, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)
S400.000	S400	120 minute 2 year Summer I+20%	99.150	97.390	-0.165	0.000	0.16		0.062
S400.001	S401	120 minute 2 year Summer I+20%	97.750	96.227	-0.173	0.000	0.32		0.137
S400.002	S402	120 minute 2 year Winter I+20%	97.750	96.227	0.102	0.000	0.00		39.784
S400.003	S403	120 minute 2 year Summer I+20%	96.750	95.762	-0.223	0.000	0.00		0.000

PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S400.000	S400	1.6	14.0	OK
S400.001	S401	0.8	19.6	OK
S400.002	S402	0.1	0.1	SURCHARGED
S400.003	S403	0.1	0.1	OK

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment B3

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	16.000
Region	Scotland and Ireland	Ratio R	0.276
Cv (Summer)	1.000		
Cv (Winter)	1.000		

Margin for Flood Risk Warning (mm) 150.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	120
Return Period(s) (years)	2, 30, 100
Climate Change (%)	20, 20, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)
S400.000	S400	120 minute 30 year Summer I+20%	99.150	97.412	-0.143	0.000	0.29		0.087
S400.001	S401	120 minute 30 year Winter I+20%	97.750	96.479	0.079	0.000	0.40		0.424
S400.002	S402	120 minute 30 year Summer I+20%	97.750	96.479	0.354	0.000	0.00		70.659
S400.003	S403	120 minute 30 year Summer I+20%	96.750	95.763	-0.222	0.000	0.00		0.000

PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S400.000	S400	1.9	24.9	OK
S400.001	S401	0.8	24.6	SURCHARGED
S400.002	S402	0.1	0.1	SURCHARGED
S400.003	S403	0.1	0.1	OK

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment B3

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	16.000
Region	Scotland and Ireland	Ratio R	0.276
Cv (Summer)	1.000		
Cv (Winter)	1.000		

Margin for Flood Risk Warning (mm) 150.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

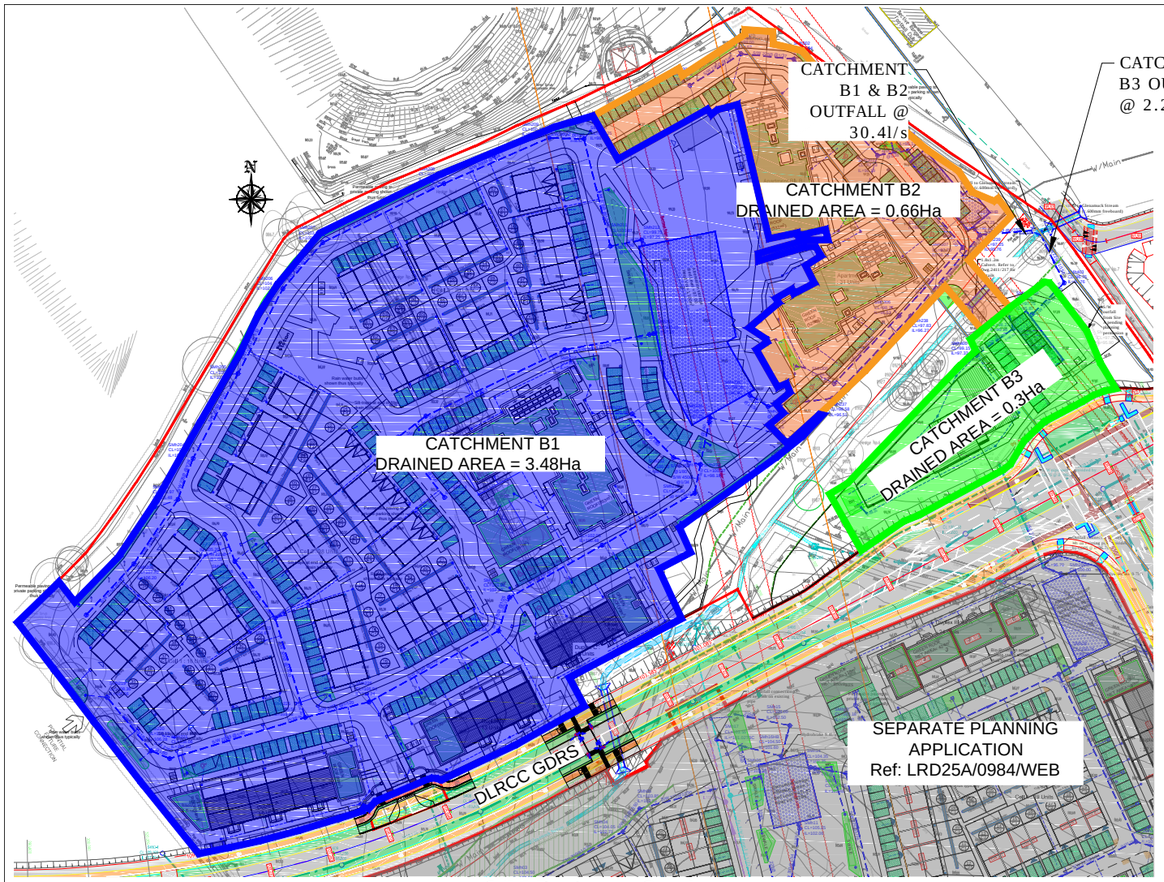
Profile(s)	Summer and Winter
Duration(s) (mins)	120
Return Period(s) (years)	2, 30, 100
Climate Change (%)	20, 20, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)
S400.000	S400	120 minute 100 year Summer I+20%	99.150	97.425	-0.130	0.000	0.37		0.101
S400.001	S401	120 minute 100 year Winter I+20%	97.750	96.648	0.248	0.000	0.51		0.622
S400.002	S402	120 minute 100 year Winter I+20%	97.750	96.648	0.523	0.000	0.00		91.106
S400.003	S403	120 minute 100 year Winter I+20%	96.750	95.763	-0.222	0.000	0.00		0.000

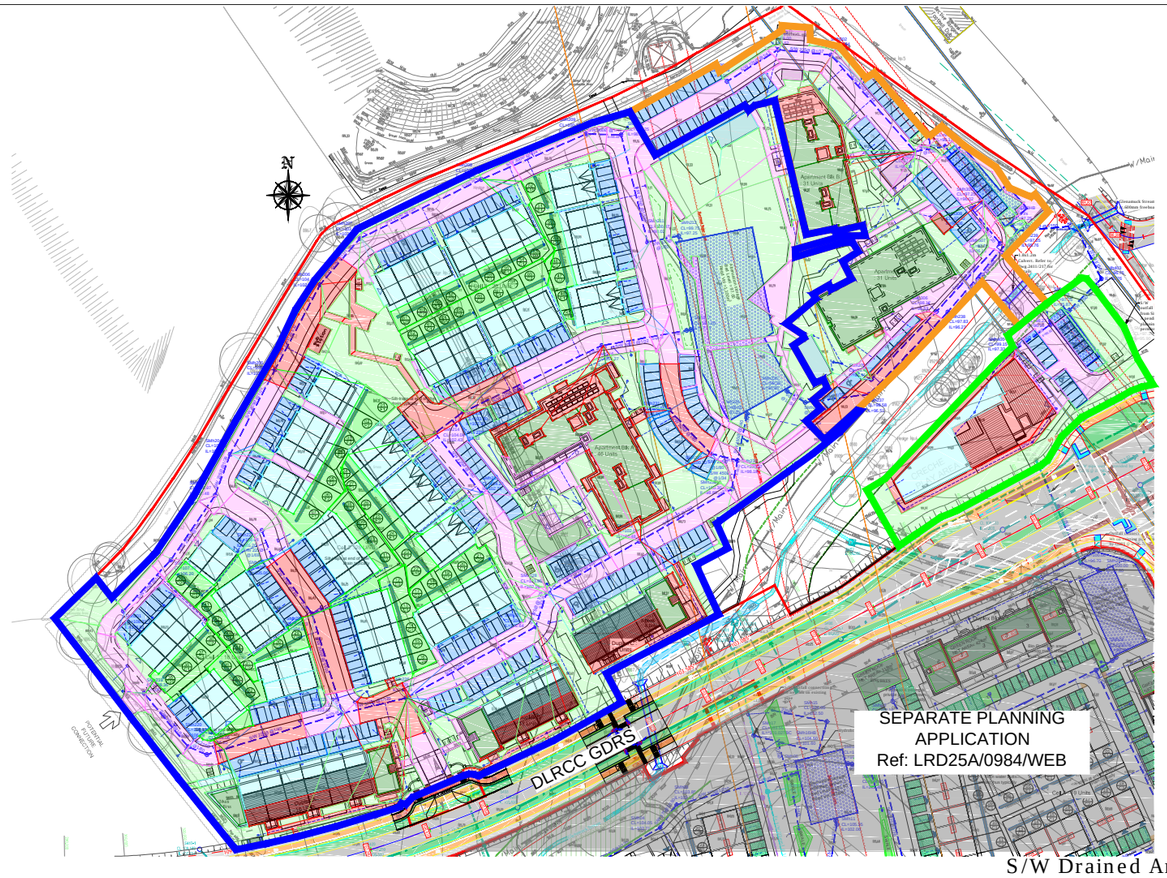
PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S400.000	S400	2.0	32.1	OK
S400.001	S401	0.9	31.4	SURCHARGED
S400.002	S402	0.1	0.1	SURCHARGED
S400.003	S403	0.1	0.1	OK

Appendix 6.2

Dwg.2411/204 – Flood Exceedence Routing



S/W Drainage Catchments Scale 1:1000



S/W Drained Areas

Scale 1:1000

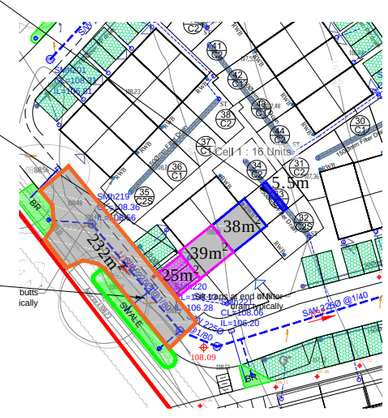
Surface Type	PAF	GROSS AREA (Ha)	NET AREA (Ha)	Colour
Impermeable to Drain	0.95	0.503	0.48	
Green Roof	0.83	0.269	0.22	
Roof to Suds	0.71	0.744	0.53	
Road/Paths to SuDS	0.70	0.925	0.65	
Permeable Paving	0.60	0.557	0.33	
Grassland drained	0.37	1.438	0.58	
	TOTAL	4.44	2.79	

Exceedance Flow Path Scale 1:1000

REAR ROOF AND PATH DRAINING TO FILTER DRAIN ;
Area Roof/Path =38m^2. Interception volume required as per GDSDS = 80% of impermeable area for 5mm rainfall, therefore; 38m^2 x 0.8 x 0.005= 0.152m^3 interception required.
Interception provided in the 150mm depth of 40% voids stone below the 5.5m long x 0.75m wide filter drain as follows;
5.5x0.75x0.15x0.4 = 0.248m^2
interception volume provided.
As the 0.248m^3 provided is greater than 0.152m^3 required, the localised interception is deemed as sufficient.

FRONT ROOF AND PATH DRAINING TO PERMEABLE PAVING ;
Area Roof/Path =39m^2
Area Permeable Paving =25m^2
CIRIA Table 4.6 notes 2 times permeable paved area is compliant for interception. Therefore 25m^2 x 2 = 50m^2 < 64m^2 and additional downstream interception is required.
Noting that interception volume required as per GDSDS = 80% of impermeable area for 5mm rainfall, therefore; 64m^2 x 0.8 x 0.005= 0.256m^3 interception required.
Interception provided in 30% voids of 300mm stone below perforated drain =
0.3 x 25 x 0.3 = 2.25m^3 interception volume provided.
As the 2.25m^3 provided is greater than 0.256m^3 required, the localised interception is deemed as sufficient.

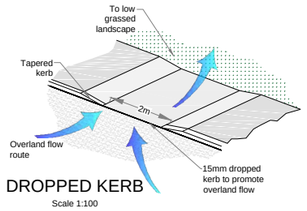
ROAD DRAINING TO SWALE;
Area Road =232m^2
Area Swale =48m^2
CIRIA Table 4.6 notes 5 times drained area is allowable. Therefore 5 x 48 = 240m^2 > 232m^2 is deemed compliant



Sample Localised Interception

Scale 1:500

Exceedance Flow Routing



DROPPED KERB

Scale 1:100

REV	DATE	DESCRIPTION

ROGER MULLARKEY & ASSOCIATES
Consulting Structural and Civil Engineers
Duncreevan, Kilcock, Co.Kildare
Tel: +353 1 610 3755 Mob: +353 87 232 4917
E-mail. info@rmullarkey.ie www.rmullarkey.ie

Project

GLENAMUCK NORTH LRD - Site B

Drawing Title

Drainage Catchments & Exceedance Flow

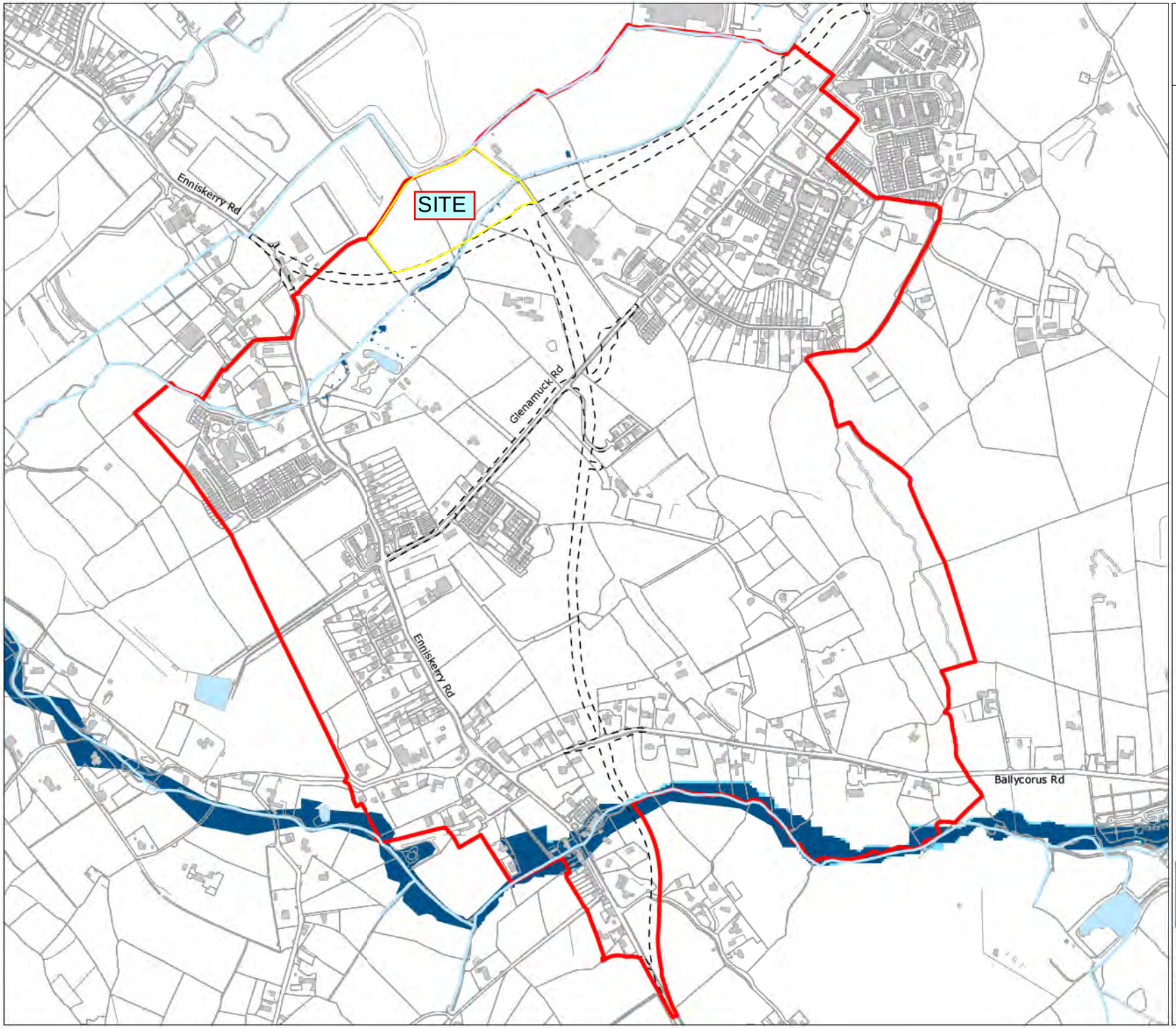
Architect

MCORM

Date	Drawn By	Scales	Dwg.No.	Stage	Rev
Mar'25	RM	As Shown @ A1	2411/206	LRD Stage 3	

Appendix 6.3

LAP Water Features Map PL-25-010



Kiltiernan-Glenamuck Local Area Plan - Draft

Draft LAP Boundary

Glenamuck District Roads Scheme

Flood Zone A

Flood Zone B

Rivers (Existing)

Lakes and Ponds (Exisitng)

0 100 200 400 Meters

Planning and Economic Development

A. Blighe
Director of Services

dlr Comhairle Contae Chill Dara County Council

Water features and extract of flood zones from CDP 2022-2028

Senior Planner: L. McGauran	**Chief Technician:** M. Hennessy
Prepared By: Z. Horan	**Drawn By:** O. Feighery

Date:	Scale:	Drawing No:
February 2025	1:8,000	PL-25-010

Appendix 6.4

CDP Flood Zone Map No.9

Mapping Notes

1. The lines of the Road Proposals shown are diagrammatic only and may be subject to change.
2. Wave Overtopping layer is relevant to the following maps only: Map No's. 2, 3, 4, 7, 10 & 14 unless noted otherwise.
3. These flood maps contain Land Use Zonings & Flooding information only. Please refer to the Land Use Zoning maps for more detailed land use objectives.

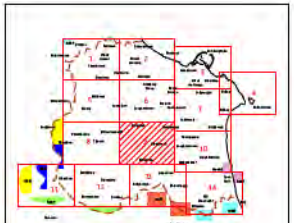
Flood Zone Map

COMHAIRLE CHONTAE DHÚN LAOGHAIRE-RÁTH AN DÚIN

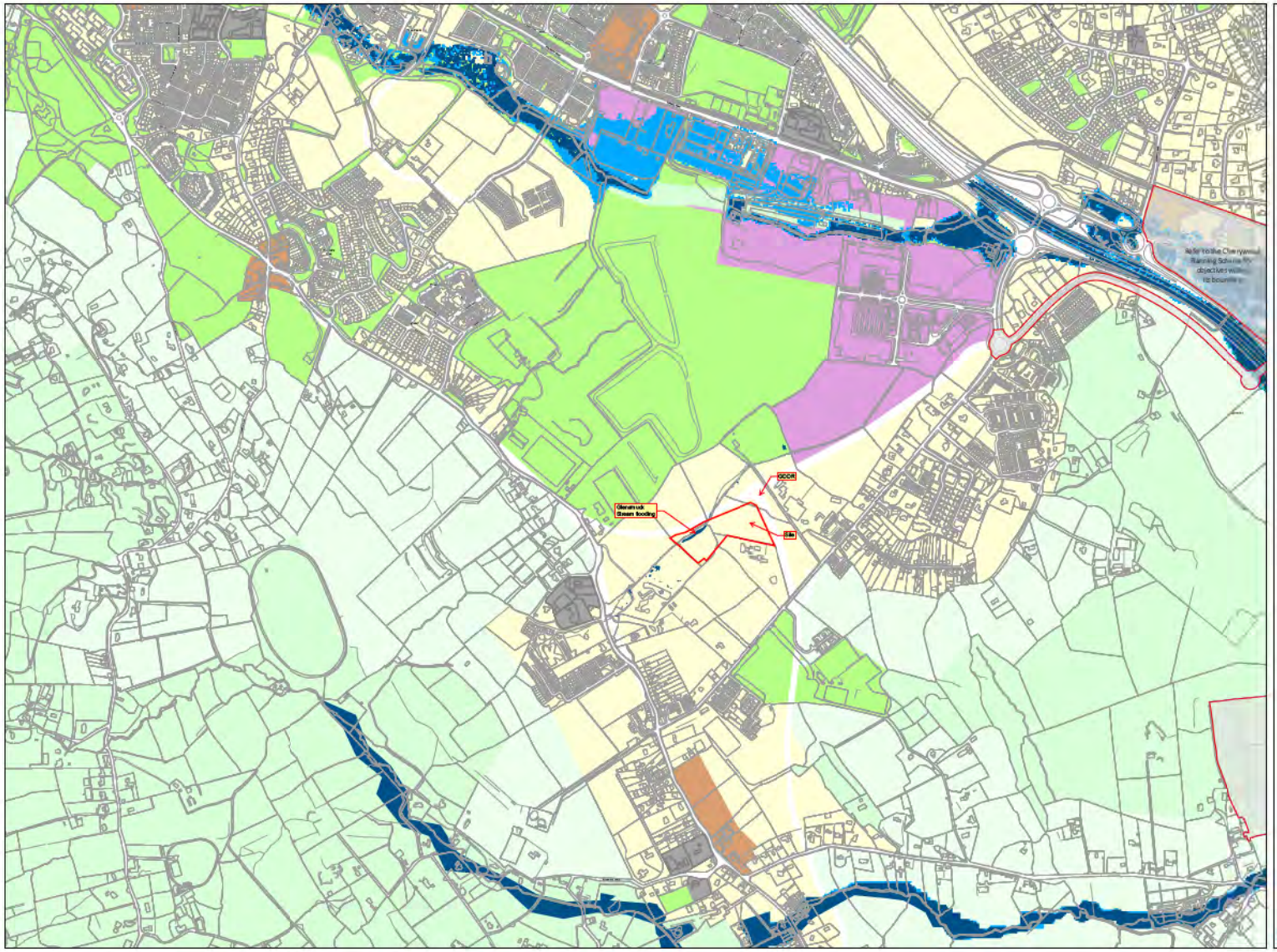
DÚN LAOGHAIRE-RATHDOWN COUNTY COUNCIL

COUNTY DEVELOPMENT PLAN 2022-2028

Adopted March 2022



INDEX



Land Use Zonings

Objective A — To provide residential development and improve residential amenity while protecting the existing residential amenities.

Objective A1 — To provide for new residential communities and Sustainable Neighbourhood Infrastructure in accordance with approved local area plans.

Objective A2 — To provide for the creation of sustainable residential neighbourhoods and preserve and protect residential amenity.

Objective B — To protect and improve rural amenity and to provide for the development of agriculture.

Objective DC — To protect, provide for and/or improve mix of use district centre facilities.

Objective E — To provide for economic development and employment.

Objective F — To preserve and provide for open space with ancillary active recreational amenities.

Objective G — To protect and improve high amenity areas.

Objective GB — To protect and enhance the open nature of lands between urban areas.

Objective LW — To improve and provide for low density warehousing/light industrial warehousing uses.

Objective MIC — To consolidate and complete the development of the mixed use inner core to enhance and reinforce its primacy.

Objective MIC — To provide for a mix of uses which complements the inner core, but will keep retail and retail services subsidiary to employment and services.

Objective MTC — To protect, provide for and/or improve major town centre facilities.

Objective NC — To protect, provide for and/or improve mix of use neighbourhood centre facilities.

Objective OE — To provide for office and enterprise development.

Objective TI — To facilitate, support and enhance the development of third level education institutions.

Objective W — To provide for warehouse development and ancillary/related uses.

Objective SN — To protect, improve and encourage the provision of sustainable neighbourhood infrastructure.

Areas of Flood Risk Concern

Fluvial - Surface Water ..... A

Fluvial -Surface Water ..... B

Fluvial -Foul C

Flood Zone A ..... Flood Zone A

Flood Zone B ..... Flood Zone B

Wave Overtopping ..... WOD

County Boundary .....

Boundary of Adopted Cherrywood Planning Scheme .....

Metres

Director of Planning: Ali Grehy

Senior Planner: L McGuinn

Appendix 6.5

OPW Flood Hazard Map & Summary Report

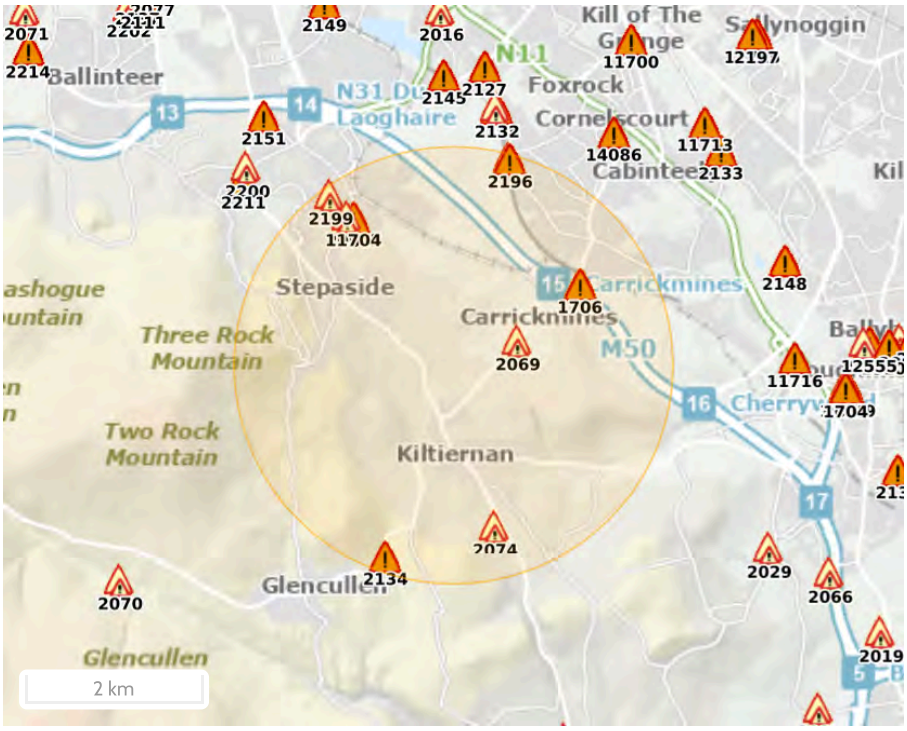

The Park
Shopping Centre
Stepaside Golf Course
Carrickmines
JAMESTOWN
Aprox. Site location
R842
GLENAMUCK
NORTH
GLEBE
R842

Past Flood Event Local Area Summary Report

OPW Oifig na nOibreacha Poiblí Office of Public Works

Report Produced: **8/3/2025 16:28**

This Past Flood Event Summary Report summarises all past flood events within 2.5 kilometres of the map centre.



Map Legend

- Single Flood Event
- Recurring Flood Event
- Past Flood Event Extents
- Drainage Districts Benefited Lands*
- Land Commission Benefited Lands*
- Arterial Drainage Schemes Benefited Lands*

* Important: These maps do not indicate flood hazard or flood extent. Their purpose and scope is explained on Floodinfo.ie

14 Results

	Name (Flood_ID)	Start Date	Event Location
1.	Flooding at Clonskeagh Road, Dublin 6 on 24th Oct 2011 (ID-11704)	23/10/2011	Exact Point
	Additional Information: Reports (1) Press Archive (0)		
2.	Flooding at Kilgobbin Road, Stepaside, Co. Dublin on 24th Oct 2011 (ID-11712)	23/10/2011	Exact Point
	Additional Information: Reports (1) Press Archive (0)		
3.	Brighton Cottages Foxrock Recurring (ID-2196)	n/a	Exact Point
	Additional Information: Reports (7) Press Archive (0)		
4.	Shanganagh Carrickmines Nov 1982 (ID-1706)	06/11/1982	Approximate Point
	Additional Information: Reports (3) Press Archive (0)		
5.	Shanganagh Carrickmines May 1993 (ID-1707)	25/05/1993	Approximate Point
	Additional Information: Reports (7) Press Archive (0)		
6.	Shanganagh Carrickmines Dec 1997 (ID-1708)	18/12/1997	Approximate Point
	Additional Information: Reports (1) Press Archive (0)		

	Name (Flood_ID)	Start Date	Event Location
7.	Brighton Terrace Jan 1980 (ID-2152)	01/01/1980	Approximate Point
	Additional Information: Reports (1) Press Archive (0)		
8.	Brighton Cottages Dec 1978 (ID-2154)	26/12/1978	Exact Point
	Additional Information: Reports (2) Press Archive (0)		
9.	Kilternan Glencullen Road Nov 1982 (ID-2134)	05/11/1982	Approximate Point
	Additional Information: Reports (1) Press Archive (0)		
10.	Enniskerry Road Recurring (ID-2074)	n/a	Exact Point
	Additional Information: Reports (2) Press Archive (0)		
11.	Kilgobbin Road Recurring (ID-2068)	n/a	Exact Point
	Additional Information: Reports (2) Press Archive (0)		
12.	Glenamuck Stream Glenamuck Road Recurring (ID-2069)	n/a	Exact Point
	Additional Information: Reports (2) Press Archive (0)		
13.	Carrickmines River Sandyford Hall Recurring (ID-2199)	n/a	Exact Point
	Additional Information: Reports (1) Press Archive (0)		
14.	Shanganagh Carrickmines Nov 2002 (ID-1703)	26/11/2002	Approximate Point
	Additional Information: Reports (1) Press Archive (0)		

Results

Keep Previous Results

River Waterbodies
IE_EA_10C040350

EU_CD	IE_EA_10C040350
NAME	CARRICKMINES STREAM_010
URL	View the Data Page
MS_CD	EA_10C040350
REGION_CD	17
INS_WHEN	2014-11-14T00:00:00Z
BASIN_CD	x1_10 Coastal
LAT	53.2583712
LON	-6.18506205
LENGTHKM	27.11683814
SUB_CD	10_5
DateChanged	2019-11-20T00:00:00Z
Change	Rivers updated
GEOLOGY	1
CatchmentAreaKm2	20.11962505
CatchmentAreaHectares	2011.962505
Slope	-0.00791713
Altitude	18.38450813
WaterManagementUnit	IE_EA_Shanganagh
EdenEntityCode	10C04
Easting	321168.94
Northing	224621.96
LocalAuthority	DUN LAOGHAIRE/RATHDOWN CC
MODIFIED	Unknown
ARTIFICIAL	Unknown
SYSTEM	B
CATEGORY	River Waterbody

Active Layers | + Add Layer

Layers | Tools | Search

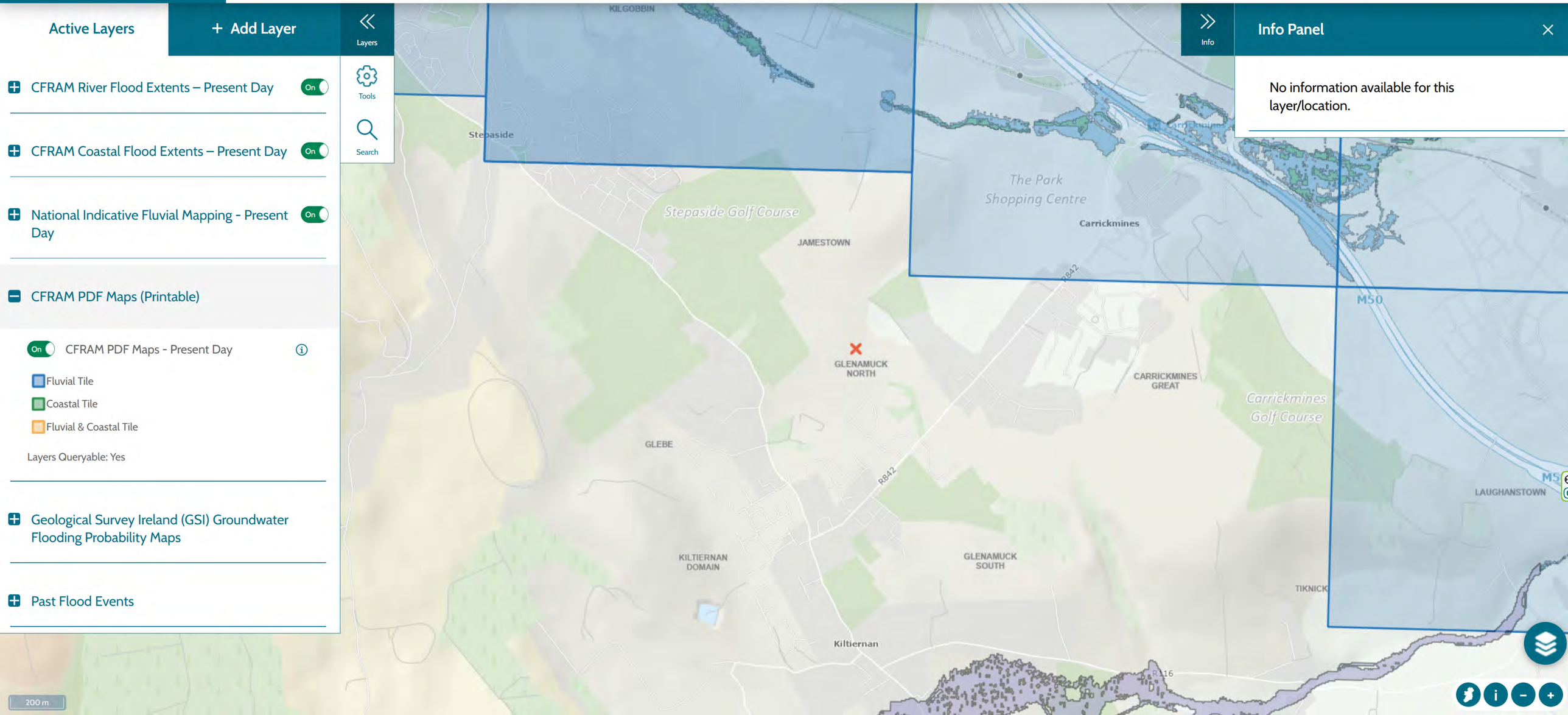
- CFRAM River Flood Extents – Present Day — On
- CFRAM Coastal Flood Extents – Present Day — On
- National Indicative Fluvial Mapping - Present Day — On
- CFRAM PDF Maps (Printable)
  - On — CFRAM PDF Maps - Present Day
    - Fluvial Tile
    - Coastal Tile
    - Fluvial & Coastal Tile

    Layers Queryable: Yes
- Geological Survey Ireland (GSI) Groundwater Flooding Probability Maps
- Past Flood Events

Info

Info Panel

No information available for this layer/location.



Appendix 6.6

Glenamuck Stream Tributary Hydrological Calculations

Hydrological Flow Estimation for Tributary to Glenamuck Stream

IH124 Qbar Rural Formula

$$QBAR_{Rural} = 0.00108\ AREA^{0.89}\ SAAR^{1.17}\ SOIL^{2.17}$$

Area (Km^2) =	0.2276
SAAR (mm) =	969
SOIL =	0.37
Qbar Rural	**0.1043** m^3/s
Factorial Standard error =	1.65
Growth Factor to Q100 (from FSR) =	1.96
Growth Factor to Q1000 (from FSR) =	2.6

Q100	0.337 m^3/s
Q1000	0.447 m^3/s

Roger Mullarkey & Associates Duncreevan Kilcock Co.Kildare	Project Glenamuck North - Site B				Job no. 2411	
	Calcs for North Boundary Watercourse - Section 1-1 Q100				Start page no./Revision 1	
	Calcs by RM	Calcs date 18/05/2025	Checked by	Checked date	Approved by	Approved date

STEADY FLOW IN OPEN CHANNELS

TEDDS calculation version 1.0.01

Channel details

Bed slope $S_0 =$ **0.028000** (1 in 36)

Channel section 1

Wetted perimeter $P_1 =$ **1.930** m

Area of flow $A_1 =$ **0.200** m^2

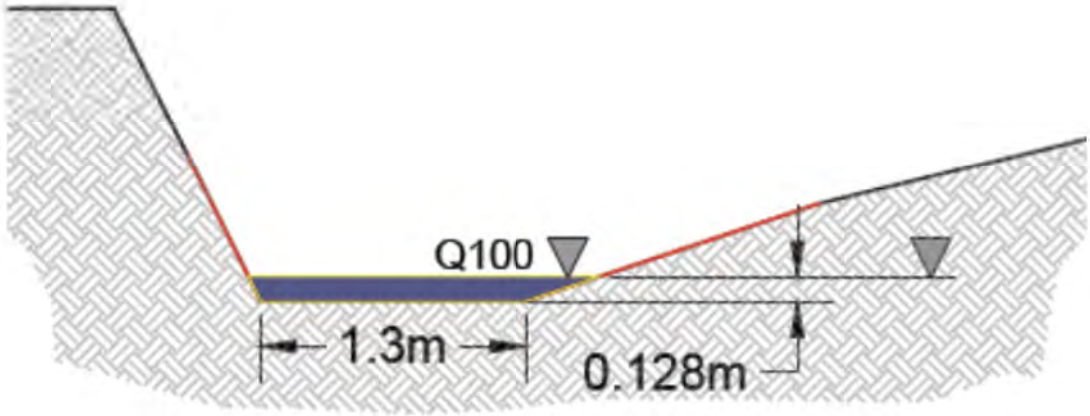
Manning roughness factor $n_1 =$ **0.022**

Hydraulic radius $R_1 = A_1 / P_1 =$ **0.104** m

Discharge $Q_1 = A_1 \times (R_1 / 1\ m)^{2/3} \times S_0^{1/2} \times 1\ m/s / n_1 =$ **0.336** m^3/s

Compound channel flow

Total discharge $\mathbf{Q_{total} = Q_1 = 0.336\ m^3/s}$



STREAM SECTION 1-1
Q100

Roger Mullarkey & Associates Duncreevan Kilcock Co.Kildare	Project Glenamuck North - Site B				Job no. 2411	
	Calcs for North Boundary Watercourse - Section 1-1 Q1000				Start page no./Revision 1	
	Calcs by RM	Calcs date 18/05/2025	Checked by	Checked date	Approved by	Approved date

STEADY FLOW IN OPEN CHANNELS

TEDDS calculation version 1.0.01

Channel details

Bed slope $S_0 =$ **0.028000** (1 in 36)

Channel section 1

Wetted perimeter $P_1 =$ **1.970** m

Area of flow $A_1 =$ **0.240** m^2

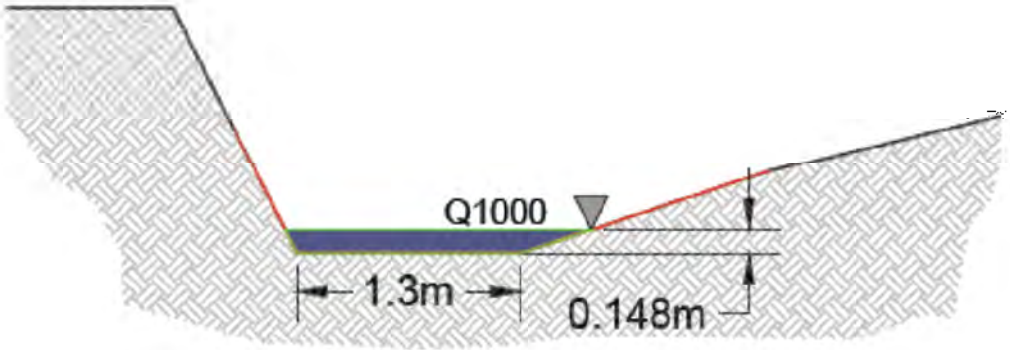
Manning roughness factor $n_1 =$ **0.022**

Hydraulic radius $R_1 = A_1 / P_1 =$ **0.122** m

Discharge $Q_1 = A_1 \times (R_1 / 1\ m)^{2/3} \times S_0^{1/2} \times 1\ m/s / n_1 =$ **0.449** m^3/s

Compound channel flow

Total discharge **$Q_{total} = Q_1 = 0.449\ m^3/s$**



STREAM SECTION 1-1
Q1000

Roger Mullarkey & Associates Duncreevan Kilcock Co.Kildare	Project Glenamuck North - Site B			Job no. 2411	
	Calcs for North Boundary Watercourse - Section 2-2 Q100			Start page no./Revision 1	
	Calcs by RM	Calcs date 18/05/2025	Checked by	Checked date	Approved by	Approved date

STEADY FLOW IN OPEN CHANNELS

TEDDS calculation version 1.0.01

Channel details

Bed slope $S_0 = \mathbf{0.028000}$ (1 in 36)

Channel section 1

Wetted perimeter $P_1 = \mathbf{1.255}$ m

Area of flow $A_1 = \mathbf{0.164}$ m²

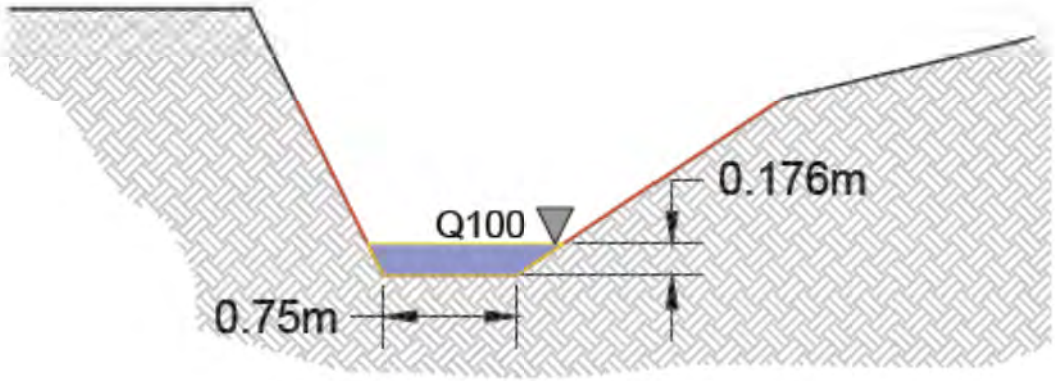
Manning roughness factor $n_1 = \mathbf{0.022}$

Hydraulic radius $R_1 = A_1 / P_1 = \mathbf{0.131}$ m

Discharge $Q_1 = A_1 \times (R_1 / 1\ \text{m})^{2/3} \times S_0^{1/2} \times 1\ \text{m/s} / n_1 = \mathbf{0.321}$ m³/s

Compound channel flow

Total discharge $\mathbf{Q_{total} = Q_1 = 0.321\ m^3/s}$



STREAM SECTION 2-2
Q100

Roger Mullarkey & Associates Duncreevan Kilcock Co.Kildare	Project Glenamuck North - Site B				Job no. 2411	
	Calcs for North Boundary Watercourse - Section 2-2 Q1000				Start page no./Revision 1	
	Calcs by RM	Calcs date 18/05/2025	Checked by	Checked date	Approved by	Approved date

STEADY FLOW IN OPEN CHANNELS

TEDDS calculation version 1.0.01

Channel details

Bed slope $S_0 = \mathbf{0.028000}$ (1 in 36)

Channel section 1

Wetted perimeter $P_1 = \mathbf{1.358}$ m

Area of flow $A_1 = \mathbf{0.207}$ m^2

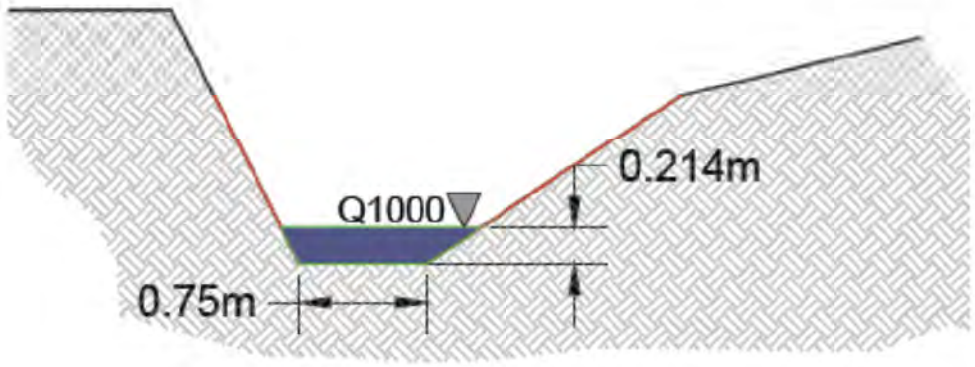
Manning roughness factor $n_1 = \mathbf{0.022}$

Hydraulic radius $R_1 = A_1 / P_1 = \mathbf{0.152}$ m

Discharge $Q_1 = A_1 \times (R_1 / 1\ \text{m})^{2/3} \times S_0^{1/2} \times 1\ \text{m/s} / n_1 = \mathbf{0.447}$ m^3/s

Compound channel flow

Total discharge $\mathbf{Q_{total} = Q_1 = 0.447\ m^3/s}$



STREAM SECTION 2-2
Q1000