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CONSULTING STRUCTURAL and CIVIL ENGINEERS

ENGINEERING INFRASTRUCTURE REPORT & STORMWATER IMPACT ASSESSMENT for a Residential Development at Glenamuck North, Kilternan, Dublin 18.

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

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1.0 Introduction

1.1 This document relates to the Drainage & Water Infrastructure design, including the Storm Water Impact Assessment, for a proposed Large Residential Development (LRD) 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 drainage and water supply infrastructure report to accompany the suite of other drawings and documentation relating to a 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 c.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”.

1.4 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.

1.5 A summary response table of the DLRCC Stage 2 opinion relating to the drainage elements is included in Appendix 11.19

2.0 Key Objectives

2.1 This document relates to the Drainage and Water Infrastructure engineering that incorporates the design, background, and detail of the following aspects;

- Road & Block Levels
- Sustainable Drainage Systems (SuDS)
- Storm Water Impact Assessment
- Attenuation
- Foul Drainage
- Potable Drinking Water Infrastructure

2.2 Aspects relating to the Flood Risk Assessment are detailed in a separate document entitled the Site-Specific Flood Risk Assessment and the reader is referred to that report for further information in that regards.

2.3 Roads access and traffic/transportation assessments are contained in the separate submission documentation by Meinhardt Consulting Engineers included in the overall planning submission.

2.4 Reference should be made to all drainage drawings and designs included in the appendix of this report and all other consultant's reports and drawings as part of the overall application documentation.

3.0 Site Location & Topography

3.1 The site is bounded to the south by the recently constructed Glenamuck District Distributor Road (GDDR) in Kilternan, Dublin 18. 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.

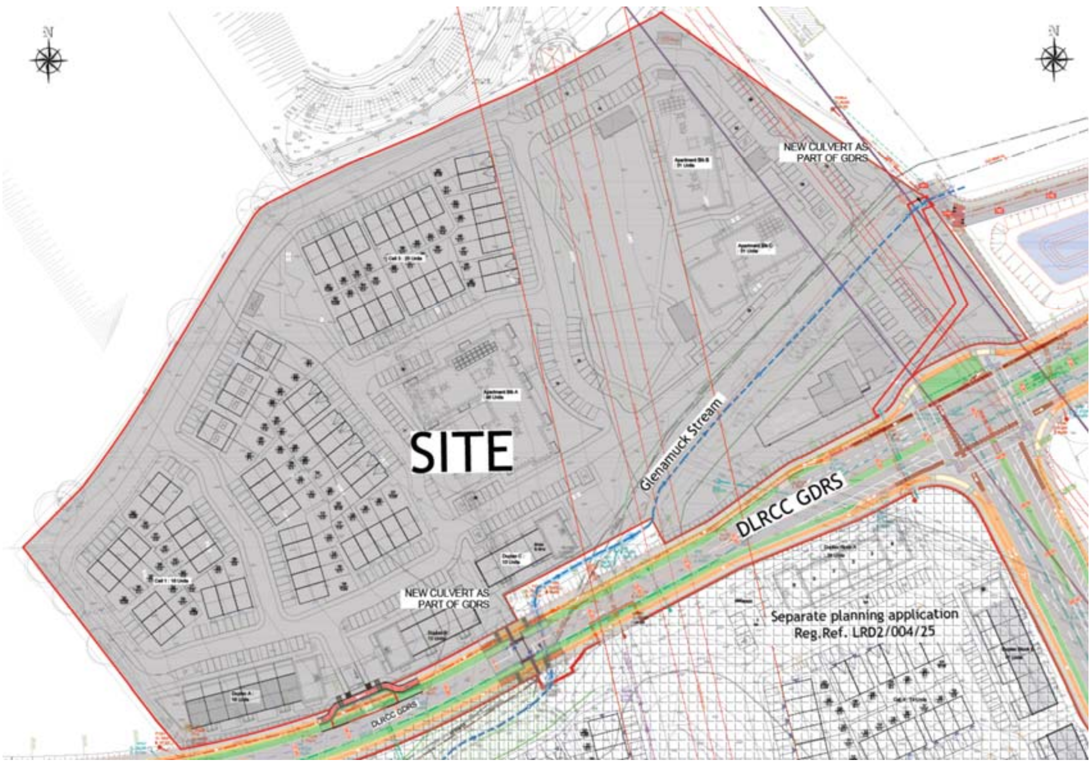


Fig. 1 - Site Location

3.2 The existing lands are currently greenfield. The site planning application area is c.5.2Ha but it is noted that the surface water drained area is c.4.44 Ha and is used for the Qbar and drainage calculations.

3.3 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 2 below.

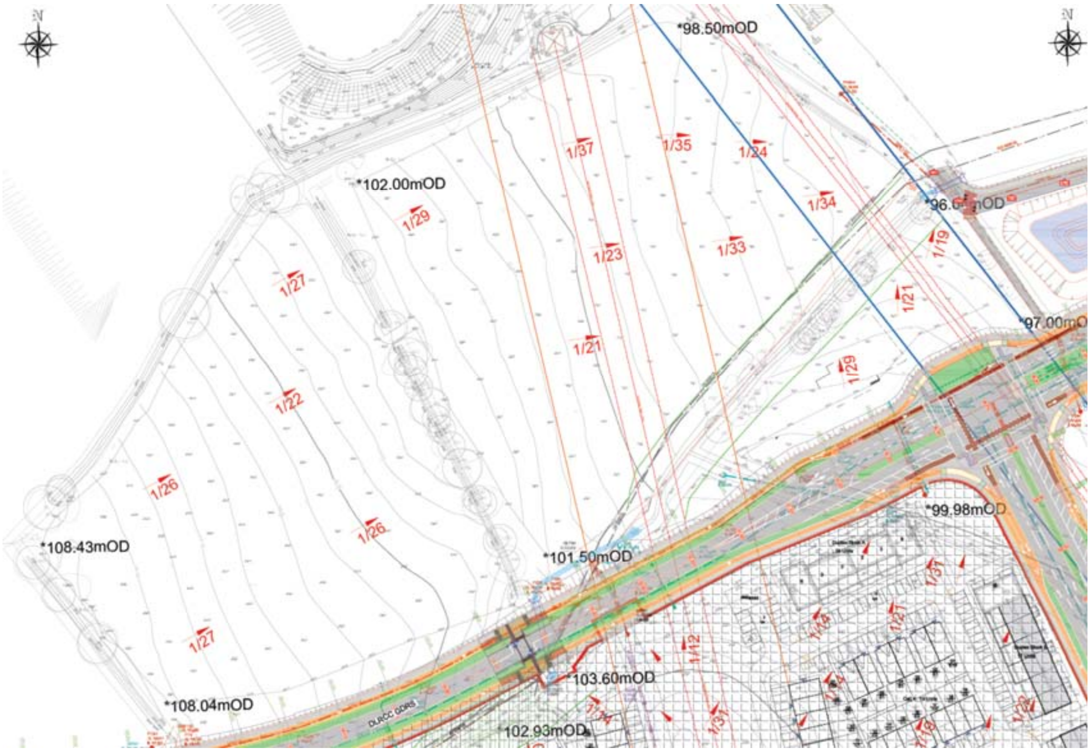


Fig.2 - Topography

3.4 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.

3.5 Consultations between the applicants and their agents with the Dun Laoghaire Rathdown County Councils (DLRCC) GDRS project team have taken place over the past 18 months.

3.6 Road access from this onto the GDRS has been discussed with the DLRCC Roads department and DLRCC GDRS Project Office team, and subject to a detailed review of this planning application, in principle they agree that a road junction can be provided onto the GDRS in the location as proposed.

3.7 Both foul drainage and watermain spurs connecting to the public infrastructure to serve the subject site has been provided by the GDRS project. Connection with these provided spurs is dependant on a successful outcome to this LRD planning application.

3.8 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.

3.9 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 regard. Generally, the proposed road levels and house levels follow the existing contours of the site topography as closely as reasonably possible.

3.10 Proposed road gradients vary between 1/150 (0.67%) and 1/20 (5.0%) which are in accordance with the DOELG Recommendations for Site Development Works for Housing Areas and the Dept. Of Transport's Design Manual for Urban Roads and Streets (DMURS) documentation.

3.11 Private house surface water drainage is limited to 8No.units per pipe run and is to be in accordance with the DOELG Recommendations for Site Development Works for Housing Areas.

3.12 Private foul water drainage is to be in accordance with the Uisce Éireann Code of Practice for wastewater Infrastructure 2020 which requires individual house connections to each dwelling.

3.13 The site zoning is classified as Zoning Objective A as per the DLRCC CDP 2022-2028.

3.14 There are 4No. existing borehole standpipe monitors on the site used by DLRCC to monitor sub-surface water and gas levels. The proposed development requires that these boreholes be moved to facilitate the development. This proposal has been discussed with DLRCC and has been approved in principle as part of the pre-planning process. A drawing showing the existing and proposed re-location of the monitoring standpipes has been prepared and please refer to Dwg.2411/204 for further information.

4.0 Existing & Proposed Drainage/Water Services Summary

4.1 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.

4.2 The recently constructed GDRS project has locally diverted the route of the existing Glenamuck Stream via a new box culvert (WX01) passing beneath the distributor road and re-connecting with the existing stream path. Similarly, the GDRS has constructed a 2nd culvert at the downstream end of the subject site referred to as the Bective Rangers or WX02 culvert.

4.3 Water connection to the public infrastructure will be via a new 200mm diameter spur from the new pipeline laid as part of the GDRS project. This has been approved as feasible by Uisce Éireann, refer to CoF letter in appendix 11.14.

4.4 The proposed development will have 2No.surface water and 1No.foul water connection outfall points.

4.5 The total drained area of the site will be 4.1Ha and the surface water drainage is to be divided into 3No. catchment areas as shown in Table 1 below;

SURFACE WATER CATCHMENT SUMMARY		
Catchment No.	**Catchment Drained Area**	**Outfall Location**
B1	3.51Ha	Outfalls into to the Glenamuck Stream
B2	0.66Ha	Outfalls into to the Glenamuck Stream
B3	0.3Ha	Outfalls into to the Glenamuck Stream

Table 1 – S/W Catchment Summary

4.6 It is noted that the recently constructed GDRS project adjacent to the site has provided the foul and water service connections as part of that scheme. It has been stated by DLRCC that the GDRS project will be fully complete in c.Q1 of 2026 and therefore, the above noted connections are to be live and available by the time this development requires them, subject to a successful planning application.

4.7 The proposed foul drainage system will also have 1No.outfall connection located in the Southeast corner of the site

4.8 The Glenamuck Stream crosses the site through the southern part of the lands and a riparian corridor setback of 10m has been applied from the stream in accordance with the DLRCC CDP and can be identified on the application drawings.

4.9 Flood risk from this stream has been assessed in detail in the separate Site-Specific Flood Risk Assessment (SSFRA) report accompanying this planning application. A hydrological model of the Glenamuck Stream was completed by DLRCC as part of the EIAR for the GDRS project. This subject sites application SSFRA concluded that there was a low risk of fluvial flooding associated with the steam at or adjoining this site. Refer to the SSFRA accompanying this planning application for more information. Appendix 11.11 of this report includes the GDRS EIAR 1 in 1000 year hydrological model maps 14-1 & 14-2 indicating that there is no flooding of the Glenamuck Stream either at or adjacent to this site post construction of the GDRS. This applications SSFRA concluded that the site is in a Flood Zone C.

5.0 Key Design Reference Documents

5.1 As part of the design of the storm water network and SuDS components, the following documentation were the principal references;

- Dun Laoghaire Rathdown County Development Plan 2022 – 2028
- DLRCC Kilternan Glenamuck Local area Plan 2025
- CIRIA Report c753 "The SuDS Manual" 2015
- Greater Dublin Strategic Drainage Study (GDSDS) 2005
- DLRCC Stormwater Management Policy
- The Greater Dublin Regional Code of Practice for Drainage Works
- DOELG Recommendations for Site Development Works for Housing Areas.
- DLRCC Drainage Records maps
- Available OPW flood maps and reports (from *floodmaps.ie*)
- DLRCC Carrickmines/Shanganagh River Catchment Study
- OPW Eastern CFRAM study
- OPW PFRM mapping
- Geological Survey of Ireland (GSI) website
- Teagasc soils data sets
- Ordnance Survey mapping
- Topographical survey
- Site Investigation reports
- Site walkover visits
- Discussions with DLRCC Drainage Department
- Discussions with DLRCC GDRS Roads Project Office

6.0 STORMWATER IMPACT ASSESSMENT

6.1 The design of the storm water network has been carried out in accordance with and in conjunction with the requirements of Dun Laoghaire Rathdown County Councils Drainage Department.

6.2 The lands to the north of the Glenamuck Stream (approximately 93% of the site) slope in a southerly direction down towards to Stream and the lands to the south of the Glenamuck Stream (c.7% of the site) slope in a northerly direction downwards to the stream. The topography undulates between existing gradients of approximately 1/21 to 1/34, with some localised dips at 1/19. 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 2 above.

6.3 Replicating the natural characteristics and providing amenity/biodiversity has been achieved in the SuDS elements included in this application. A full SuDS treatment train approach has been implemented in accordance with the CIRIA SuDS Manual as described in detail in Chapter 7 of this report, summarised as follows;

- Bio-Retention areas
- Filter Drains to rear of housing
- Swales adjacent to roads where practically feasible
- Tree pits where practically feasible
- Green Roofs (intensive)
- Permeable paving to all parking spaces
- Silt-trap/catchpit manholes
- Hydrobrake limiting flow to the drained area Qbar greenfield rate
- Stone lined voided arch retention storage devices

6.4 As was noted in paragraph 4.5 above, there are 3No.S/W drainage catchments with 2No.outfall points. Catchment B1 (c.3.51Ha drained area), downstream of the full SuDS treatment train will outfall the attenuated flow into the Glenamuck Stream at the headwall/Culvert WX02 constructed by the GDRS project. Catchment B2 (c.0.66Ha drained area) will share the outfall location with that of catchment B1. Catchment B3 (c.0.3Ha drained area), will outfall on the opposite side of the Glenamuck Stream at WX02. Refer to Dwg.No.2411/201 for detailed information of same.

6.5 A new road crossing over the Glenamuck Stream is proposed in this application connecting the creche on the southern side of the Glenamuck Stream with the main northern part of the site. A new culvert is proposed in this location replicating the same size/type as the recently installed WX01 & WX02 as part of the DLRCC GDRS project. Details of this culvert are shown on Dwg.2411/217, an extract of which is shown in Fig.3 below;

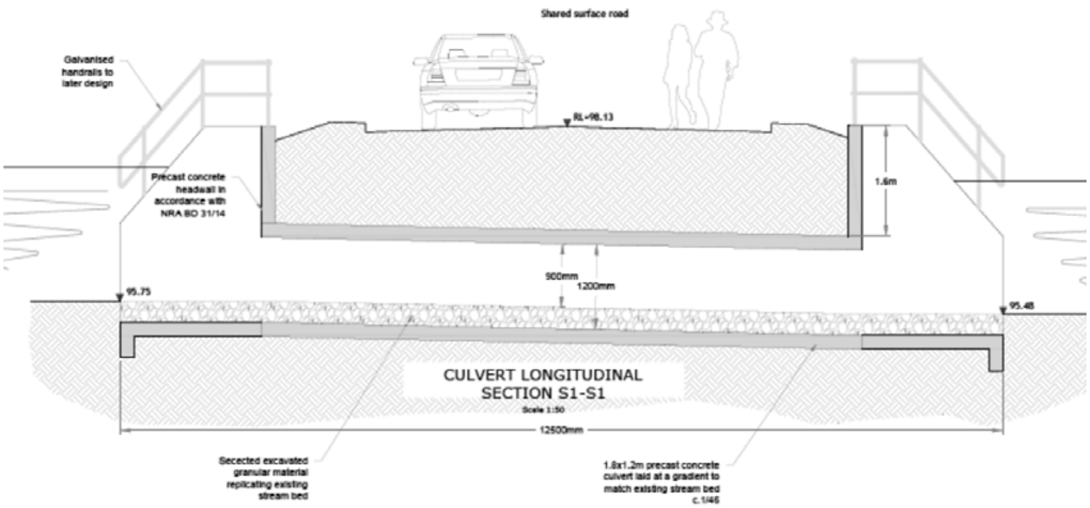


Fig.3 – Culvert detail ex. Dwg.2411/217

6.6 The surface water drainage design has been carried out in accordance with the Greater Dublin Regional Code of Practice, the GDSDS and the CIRIA Report c753 "The SuDS Manual" 2015. A SuDS treatment train and attenuation are included in the design. A Stage 1 Stormwater Audit has been completed and submitted to DLRCC Drainage Department in accordance with the Stormwater Management Policy at the Stage 3 LRD application stage.

6.7 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 and was determined to be 30.1 l/s for catchments B1 & B2 combined, and 2.2 l/s for catchment B3. Catchments B1 & B2 have the outfall rate divided as 20.1 l/s and 10 l/s to suit the S/W design and available attenuation space. It is relevant to note that S/W outfall rates for proposed development have been calculated using the <u>drained</u> site area and <u>not</u> the application "*redline*".

6.8 A soil Type 4 (SPR 0.47) chosen to be used in the UKSuDS Greenfield estimation tool and was determined using the following parameters, the details each of which are contained in Appendix 11.4 of this report

- Met Eireann Rainfall Data (SAAR=994mm; M5/60=16.0mm; r= 0.276)

- Site investigation soakaway testing and trial pits
- GSI/Teagasc soil website data
- Flood Studies Report (NERC, 1975) SOIL indices
- Winter Rainfall Acceptance Potential (WRAP) – the Wallingford Procedure Volume 3 Maps,
- Flood Studies Report (FSR - NERC, 1975),
- Transport Infrastructure Ireland (TII) – Drainage of Runoff from Natural Catchments 2015,
- HR Wallingford website
- site specific topographical survey
- site visits by the design engineer.

6.9 The surface water drainage infrastructure for the development will collect the rainfall on the site and will treat, attenuate, store and convey the storm water run-off via roadside swales, rear garden filter drains, green roofs (intensive), tree pits, bio retention areas, permeable paving, below ground infrastructure, silt-traps and will direct the flows via a void arched attenuation systems and vortex flow restricting devices, (Hydrobrake or similar) before outfalling to the Glenamuck Stream.

6.10 The SuDS management train approach to designing the storm water network has been applied for this development and is discussed in detail in Chapter 7.

6.11 Downstream of the SuDS elements, the retained storm water flows will be stored in 3No. below ground storage areas, such as the void arched system.

6.12 The MicroDrainage software was used to generate drainage simulation models for storm events for 1 year, 30 year and 100-year return events over multiple time periods. In accordance with the DLRCC Stormwater management Policy, an allowance for an increased rainfall due to climate change of 20% was applied in the drainage design model. Furthermore, the Cv values are set to 1.0 in Microdrainage software model and are visible in the calculations included in Appendix 11.1 of this report. As noted in the DLRCC Stormwater Management Policy document, an allowance for 10% Urban Creep is required in the drainage calculations. This allowance has been applied by increasing the calculated attenuation volume by 10%. The parameters used for the calculations are summarised in Table 2 below;

Time of entry	6min
Return periods for pipework	2 years- no surcharge
	Q30 15min no flooding
	Q100 15min – storage in designated areas only
Climate Change	20%
Allowance for Urban Creep	10%
Min.velocity	1 m/s
Max.velocity	3m/s
Min.sewer size for TIC	225mm diameter
Pipe friction (Ks)	0.6mm
Minimum pipe depth	1.2m below roads 0.9m in open/grassed spaces
Standard Annual Average Rainfall (SAAR)	994mm (Met Eireann data)
M5-60	16.0mm
Ratio r (M5-60/M5-2Day)	0.276
SPR Value	0.47
QBar	32.3 l/s divided as B1=20.1l/s; B2=10 l/s; B3 =2.2l/s based on HR Wallingford greenfield runoff estimation tool
Attenuation storage	Q30 – no flooding on site Q100 – flooding on site, 500mm freeboard to FFLs of houses, flood routing plan.
Paved Area Runoff percentage	95% for hard surface directly to drains 83% Intensive Green Roofs 71% roof runoff via filter drains/permeable paving/bio-retention areas 70% from roads and paths drained to swales/bio-retention 60% parking permeable paving areas and locally drained paths 40% grassland areas drained

Table 2 - S/W Design Parameters

6.13 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 beneath the ground level. 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 to low lying landscaped areas.

6.14 In accordance with best practice, the internal drainage system has been designed as a completely separate foul and surface water system.

6.15 Based on the drained area Qbar and the paved area factors identified in Table 3 above and using the MicroDrainage software, a drainage model was generated for multiple storm events and return periods of 2, 30 and 100 years were simulated. Full model simulation results for the network and storage units are included in Appendix 11.1 of this report but are summarised in Table 3 below;

ATTENUATION STORAGE SUMMARY							
	Flow control limit (l/s)	Volume Required (m^3)				Volume Provided (m^3) and Top Water Level	
		Q30 +20% CC	Q100 +20% CC	10% Urban Creep	TOTAL Volume Required (m^3)	Storage Volume Provided (m^3)	TWL
Catchment B1	20.1	721	1000	**100**	**1100**	**1111**	97.73
Catchment B2	10	114	157	**16**	**173**	**176**	96.62
Catchment B3	2.2	69	93	**9**	**102**	**111**	96.66
TotalMax.Storage Required		$539m^3$	$740m^3$	$74m^3$	**$814m^3$**	**$839m^3$**	
		The total storage provided > required					

Table 3 – Storage Volume Summary

6.16 The freeboard between each separate storage area top water level (TWL) and the lowest level house floor slab draining to that storage is greater than the GDSDS minimum of 0.5m. A summary of the freeboards is given in Table 4 below;

FREEBOARD SUMMARY				
Storage	TWL (mOD)	FFL (mOD)	Freeboard (m)	Pass/Fail
B1	97.73	101.00	3.27	PASS
B2	96.62	98.40	1.78	PASS
B3	96.66	99.25	2.59	PASS

Table 4 - Freeboard Summary

6.17 In accordance with the GDSDS, the four principal design criteria as set out in section 6.3.4 of Volume 2 are summarized as follows;

- **Criterion 1** - River water quality protection
- **Criterion 2** – River regime protection
- **Criterion 3** – Level of service (flooding) for the site
- **Criterion 4** – River Flood protection

6.18 **Criterion 1** has been complied with by inclusion of **Interception** of at least 5mm of rainfall to prevent runoff to the receiving water. Interception has been calculated as per the GDSDS guidelines, the interception is to capture the first 5mm of rainfall from 80% of Paved Drained Area.

6.19 Interception will achieved be within the substrate of the green roofs (intensive), in the voids of the stone base of the permeable paving, in the voids of the stone base of the filter drains, in the stone below the permeable paving, in the tree pits, swales, bio-retention areas and in the stone base of the attenuation storage areas. As per the parameters laid out in the GDSDS the interception volume was calculated and is summarised in the following tables 5 & 6. Refer to Appendix 11.2 for detailed calculations.

INTERCEPTION - Glenamuck Nth - Site B - Catchment B1							
Paved Surfaces connected to the drainage system (Ha) = 2.284	Volume of Interception Required (m^3)			91.4	Gross Paved Area x 5mm x 0.8 (GDSDS E2.1.1 - Criterion 1)		
Volume of Interception Provided (m^3)	Length	Width (m)	Area (m^2)	Quantity	Depth (m)	Void Ratio	Volume (m^3)
Voids of stone below Permeable Paving overflow			2,875		0.2	0.3	172.5
Voids of stone below Filter Drains	345	0.75		1	0.15	0.4	15.5
Voids of stone below Swale overflow	230	0.6			0.15	0.4	8.3
Tree Pits			10	9	0.05	1	4.5
Green Roofs			1370	1	0.08	0.4	43.8
Bio Retention			242	1	0.1	1	24.2
Retention in Detention Basin			0	0	0.05	1	0.0
Voids of stone below Storage areas			1,375		0.2	0.4	110.0
			Volume of Interception Provided (m^3) =				378.8
			Volume of Interception Required (m^3) =				91.4
			Interception provided > Required			OK	

INTERCEPTION - Glenamuck Nth - Site B - Catchments B2							
Paved Surfaces connected to the drainage system (Ha) = 0.527	Volume of Interception Required (m^3)			21.1	Gross Paved Area x 5mm x 0.8 (GDSDS E2.1.1 - Criterion 1)		
Volume of Interception Provided (m^3)	Length	Width (m)	Area (m^2)	Quantity	Depth (m)	Void Ratio	Volume (m^3)
Voids of stone below Permeable Paving overflow			875		0.2	0.3	52.5
Voids of stone below Filter Drains	0	0.75		1	0.15	0.4	0.0
Voids of stone below Swale overflow	32	0.6			0.15	0.4	1.2
Tree Pits			0	0	0.05	1	0.0
Green Roofs			1320	1	0.08	0.4	42.2
Bio Retention			121	1	0.1	1	12.1
Retention in Detention Basin			0	1	0.05	1	0.0
Voids of stone below Storage areas			210		0.2	0.4	16.8
			Volume of Interception Provided (m^3) =				124.8
			Volume of Interception Required (m^3) =				21.1
			Interception provided > Required			OK	

INTERCEPTION - Glenamuck Nth - Site B - Catchment B3							
Paved Surfaces connected to the drainage system (Ha) = 0.187	Volume of Interception Required (m^3)			7.5	Gross Paved Area x 5mm x 0.8 (GDSDS E2.1.1 - Criterion 1)		
Volume of Interception Provided (m^3)	Length	Width (m)	Area (m^2)	Quantity	Depth (m)	Void Ratio	Volume (m^3)
Voids of stone below Permeable Paving overflow			225		0.2	0.3	13.5
Voids of stone below Filter Drains	0	0.75		1	0.15	0.4	0.0
Voids of stone below Swale overflow	0	0.6			0.15	0.4	0.0
Tree Pits			15	1	0.05	1	0.8
Green Roofs			0	1	0.08	0.4	0.0
Bio Retention			39	1	0.1	1	3.9
Retention in Detention Basin			0	1	0.05	1	0.0
Voids of stone below Storage areas			125		0.2	0.4	10.0
			Volume of Interception Provided (m^3) =				28.2
			Volume of Interception Required (m^3) =				7.5
			Interception provided > Required			OK	

Table 5 – Catchment Interception Summary

INTERCEPTION SUMMARY		
MAIN CATCHMENT	REQUIRED	PROVIDED
TOTAL	120	532

Table 6 – Full Catchment Summary

6.20 It is acknowledged that it is not always feasible to limit the contributing areas into the interception elements but this application substantially achieves that goal. A sample calculation narrative is shown in Fig.4 below and included on Dwg.2411/206.

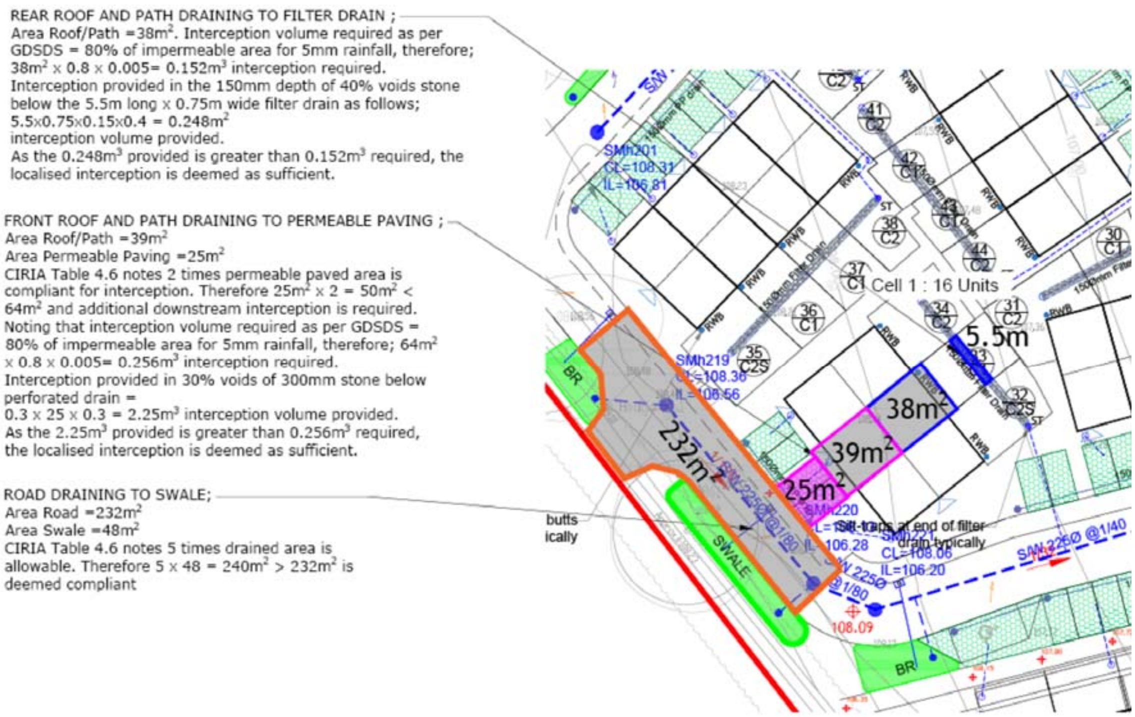


Fig – 4 Localised Interception

6.21 **Criterion 2** is complied with in applying the total allowable Qbar outfall rate of 32.3 l/s and providing more than the required volume of attenuation storage in the void arched systems, refer to Appendix 11.3 more detail.

6.22 **Criterion 3** is satisfied with as each of the 4No.sub-criterion design objectives have been met as per Table 7 the below;

Sub-criterion	*Design objective*	*Satisfied*
3.1	No flooding on site for the Q30 except where specifically planned	**OK**
3.2	No internal property flooding for site critical duration storm event.	**OK**
3.3	No internal property flooding satisfied as 500mm freeboard to house FFL's is achieved.	**OK**
3.4	No flooding of adjacent areas unless specific routing planned for the Q100 + 20% climate change	**OK**
Refer to the MicroDrainage surface water model results (Q1-Q100+20%) included in the appendix of this report for further detail		

Table 7 – Sub-criterion

6.23 **Criterion 4** River flood protection is satisfied under sub-criterion 4.3 in accordance with the application of Qbar (32.3 l/s) and therefore long-term storage is not required.

6.24 An exceedance flow routing plan can be viewed on Dwg.No.2411/206 included with this Stage 2 submission.

6.25 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 design approach.

6.26 Refer to Dwg.No.'s 2411/201 for layout of the attenuation systems.

6.27 In accordance with the requirements of the DLRCC Stormwater Management Policy, a Stage 1 SuDS audit has been completed and submitted to DLRCC Drainage Department with the LRD Stage 3 application.

7.0 Sustainable Drainage Systems - SuDS

7.0.1 SuDS addresses the water quality, water quantity, amenity, and biodiversity by the management of surface water run off in a sequence of treatment processes along the drainage infrastructure network.

7.0.2 The SuDS philosophy is illustrated in the GDSDS Volume 3 Section 6.3 as the "SuDS triangle", shown below. The principle is to reduce the storm water run-off through managed processes, improve the quality of the run-off and to replicate the natural characteristics of the rainfall run off.

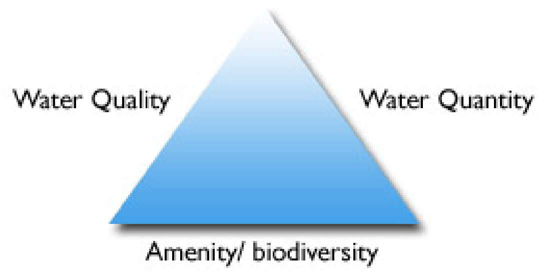


Fig.5 – The SuDS Triangle

7.0.3 Replicating the natural characteristics and providing amenity/biodiversity has been achieved in the SuDS elements included in this application. A full SuDS treatment train approach has been implemented in accordance with the CIRIA SuDS Manual, summarised as follows;

- Bio-Retention areas
- Filter drains to the rear of housing
- Swales adjacent to roads where practically feasible
- Tree pits where practically feasible
- Intensive Green Roofs
- Permeable paving to all parking spaces
- Silt-trap/catchpit manholes
- Hydrobrake limiting flow to the drained area Qbar greenfield rate
- Stone lined voided arch retention storage devices

With the inclusion of these measures, it is proposed that the SuDS treatment of the run-off has been adequately addressed.

7.0.4 The SuDS management train approach to designing the storm water network has been applied in this proposed developments design, similar in principle to Fig.6 below

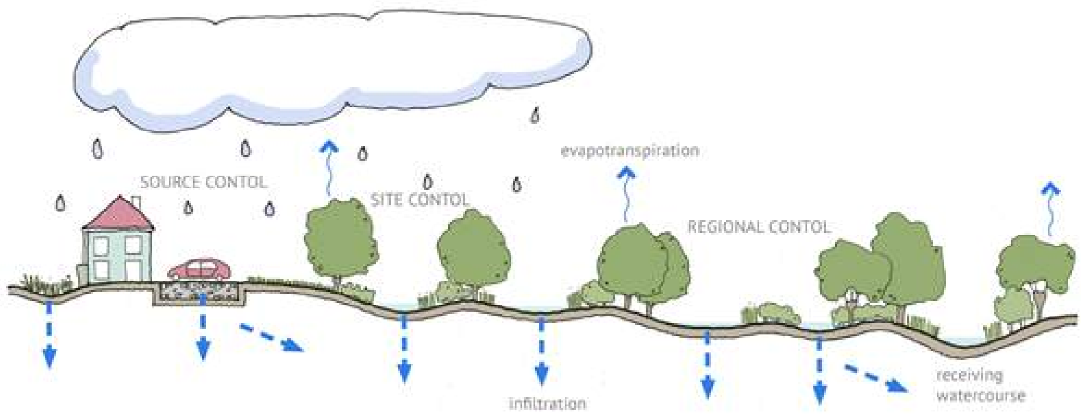


Fig.6 – Treatment Train

7.1 Source control

7.1.1 Source Control aims to detain or infiltrate runoff as close as possible to the point of origin.

7.1.2 The site investigation results (see appendix 11.7) suggest that there is little to no scope for infiltration of surface water flows as the soakaway tests failed. Even if the infiltration is very limited there is still scope to provide some level of storage, time delay and treatment as the surface water flows through the stone medium of the SuDS and storage elements.

7.1.3 It is proposed to use **permeable paving**, **filter drains, swales, tree pits, bio-retention** areas, **green roofs (intensive)** to collect run-off from the house roofs, parking areas, paths and cambered road surfaces. These SuDS elements each provide a degree of run-off retention as close to source as reasonably feasible. Surface depressions of the above noted features detain runoff and also allow infiltration where possible through the permeable medium.

7.1.4 The use of these elements will encourage run off to infiltrate directly to ground where feasible and attenuate the flowrate before the high-level connection to the main S/W drainage. Any run-off that cannot infiltrate to ground will overflow to the high-level drain and connect to the main drainage system.

7.1.5 The road cambers are to be constructed to drain flow into these tree pits/swales/bio retention areas to maximize the drained area into SuDS treatment & interception. The road cambers are shown on Dwg.No.'s 2411/200 and further illustrated on Dwg.No.2411/205.

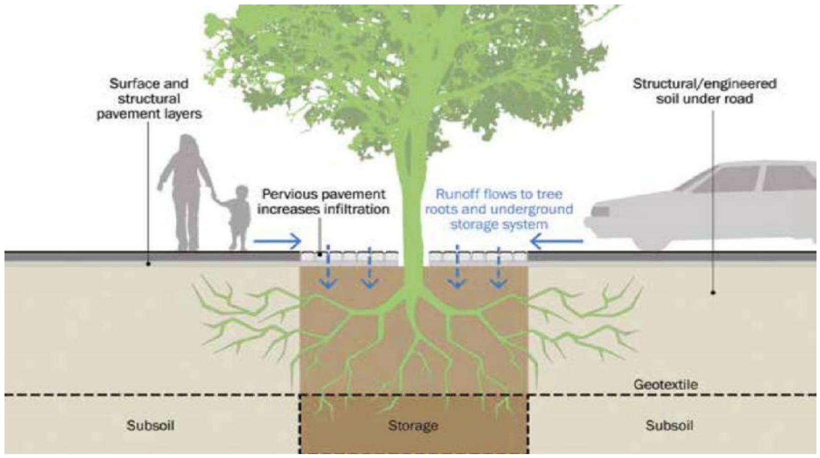


Fig.7 – Tree Pit (ex. SuDS Manual fig.19.3)

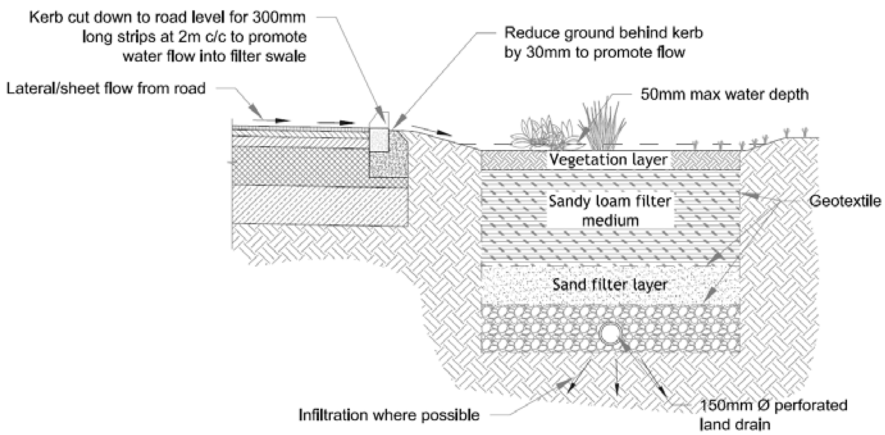


Fig.8 Bio-Retention (ex. Dwg.2411/205)

7.1.6 It is proposed to use **permeable paving** surfacing to the private driveways of the houses and in the car parking spaces of the duplex and apartment units. The front facing house roof downpipes are also directed into the permeable parking areas. This allows for the rainfall to percolate through open joints in the pavement and be strained through the unwoven geo-textile membrane beneath the paved surface. This method of surface water collection will improve water quality and prevent excessive sedimentation. There is a natural interception, attenuation and storage of surface waters flowing through the permeable paving system and an outfall pipe is provided 150mm above the bottom of the system to drain the overflow filtered/attenuated run off into the main drainage system.

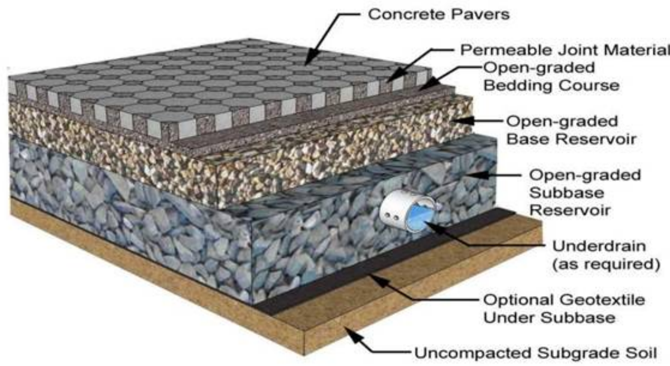


Fig.9 – Permeable Paving

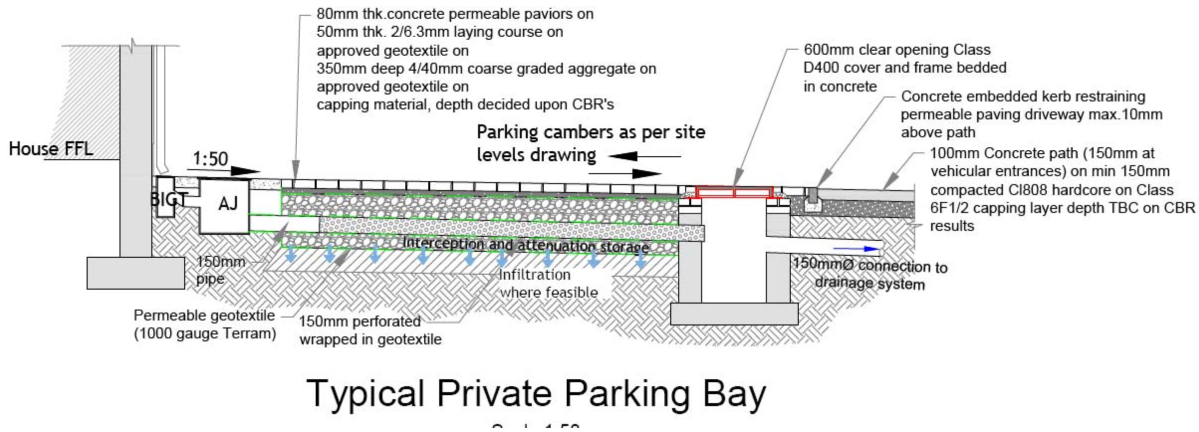


Fig.10 – Permeable Paving

7.1.7 In using these SuDS features a reduction in the runoff area is applied to the hydraulic modelling and Paved Area Factor PAF of 0.71 (71%) will apply to areas of roofs, 0.70 (70%) to roads/paths and 0.6 (60%) to permeable parking draining to these tree pits/bio-retention/filter drains/permeable paving/swales as was agreed in principle with the DLRCC Municipal Services Department. Refer Dwg.No.'s 2411/201 & 205 for location and detail of these SuDS elements.

7.1.8 An important aspect of Source Control is reducing pollution by prevention of chemicals and other pollutants from coming into contact with rainfall runoff. In this respect, it is proposed that the homeowner will be provided with information regarding the appropriate usage of the proposed drainage system.

7.1.9 In accordance with the CIRIA SuDS Manual 2015, **green roofs** can be used to treat and attenuate runoff in their substrate and support root uptake of water with appropriate planting and are an integral part of source control on a site. Green roofs can increase the indigenous biodiversity and is an encouraging environmentally design strategy, which is in accordance with the objectives as specified in the Greater Dublin Strategic Drainage Strategy (GDSDS) and in Appendix 7.2 of the DLRCC County Development Plan 2022-2028.

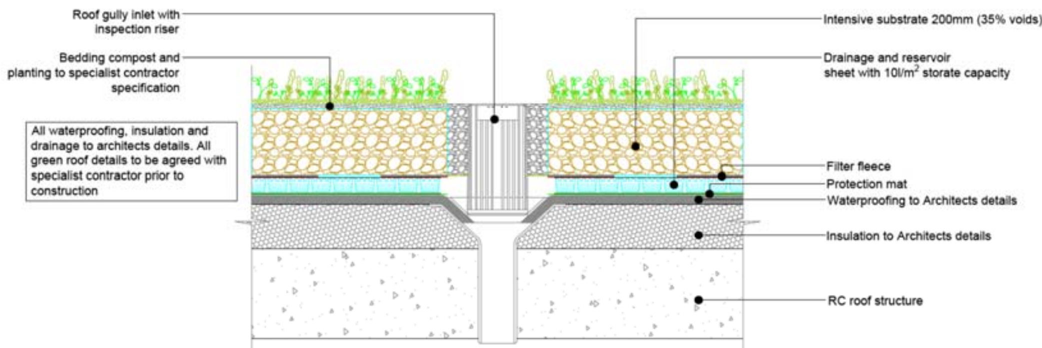


Fig.11 -Intensive Green Roof (ex. Dwg.2411/205)

7.1.10 Requirements of the green roof policy are identified in the standards GR1-GR5 which are summarised below;

GR1- Make provision for green roofs if area > 300m2

- Green Roofs (intensive) are provided to all blocks with flat roof areas greater than 300m^2 and is also included on other flat roofs where the flat roof area is less than 300m^2. Provision of same is deemed compliant with GR1

GR2- Maximize provision to achieve a minimum 70% area of building footprint

- Greater than the minimum percentage area of 50% intensive green roof has been achieved in each of the 5No.proposed blocks. PV panels are to be used for the apartment blocks only and the area of same has been subtracted from the green roof area measured for those blocks. As the bin store roof is less than 300m^2 the CDP does not require minimum percentage green roof but this application proposes to achieve c.67% coverage anyway.
- Refer to Table 8 below for summary of the percentages achieved which complies with GR2

• GREEN ROOF COVERAGE SUMMARY					
CELL REFERENCE	Intensive	Total Flat Roof Area (m^2)	% Coverage of Intensive Green Roof	Min.% Reqd.	Pass/Fail DLRCC Min. %
Apt.Blk. A	853	1181	72%	50%	PASS
Apt.Blk. B	531	750	71%	50%	PASS
Apt.Blk. C	526	732	72%	50%	PASS
Duplex A	163	213	77%	50%	PASS
Duplex B	99	127	78%	50%	PASS
Duplex C	99	127	78%	50%	PASS
Bin/Bike Store Apt Block A	167	202	83%	50%	PASS

Table 8 – Green/Blue Roof Coverage Summary

GR3- Hydraulic requirements & overflow

- The proposed intensive green roofs have a minimum 200mm substrate depth. Interception of rainfall is achieved in the green roof system and therefore a runoff factor of 83% has been applied in the drainage design accordance with the DLRCC table on page 260 of Appendix 7.2 of the CDP 2022-2028. 20% Climate change increases have been included in the stormwater hydraulic model. Exceedance flow from the green roofs is provided as part of the overall intensive green roof system proposed and is typically detailed in Appendix 11.17 of this report. It is proposed that inclusion of the above therefore complies with GR3.

GR4- Best practice

- The intensive green roof system proposed is in accordance with industry best practice details of which are shown on Dwg.No.2411/205 and in Appendix 11.17. Connections to the main drainage network are provided in overflow events and therefore form a robust, cautious design approach in principle. This is deemed to be in compliance with GR4.

GR5- Provision for Maintenance

- Access for maintenance of the green roofs will be via the internal building stairwells and a roof hatch over or using a cherry picker where stairs access is not feasible. A roof fall arrest system is to be included in the project which will be specified at the detailed design/construction stage. Detailed cross sections of the proposed roof build-up are shown on Dwg.No.2411/205 included in the submission. A maintenance scheduling regime is to be established with an appropriate specialist contractor at construction/commissioning stage. This is deemed to be in compliance with GR5.

7.1.11 The use of **rainwater butts** is another source control method in the SuDS treatment train process. It is proposed to provide 200l rainwater butts to collect rainwater from the house roofs for use as garden irrigation, therefore reducing drinking water demand and decreasing run-off from the site.

Fig 12 – Rainwater Butt

7.1.12 It is proposed to use **filter drains** in the rear gardens of the houses to cater for run off from the rear roofs and patios. The use of these filter drains will encourage run off to infiltrate directly to ground and will also provide interception storage in the c.40% voids ratio stone below the high-level drain. Any run-off that cannot infiltrate to ground will overflow to the high-level drain and connect to the main drainage system. The surface water runoff rate is also attenuated using these filter drains. A PAF of 0.71 (71%) will apply to these areas as was agreed in principle with the DLRCC Water Services Department as part of the Pre-Planning discussions. A silt-trap inspection chamber is included downstream of each filter drain. Refer to Dwg.2411/205 for further detail.

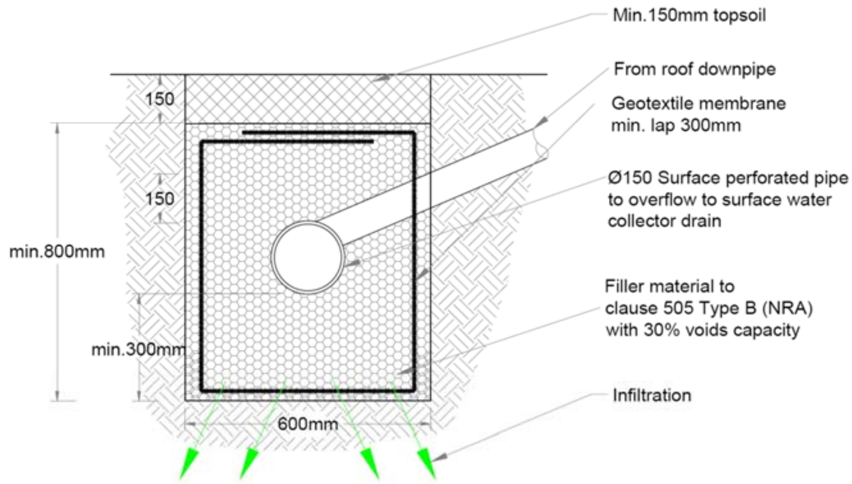


Fig.13 – Filter Drain

7.1.13 Regular maintenance of all SuDS features by the development management team is required to protect runoff and prevention of blockages until such a stage that the Local Authority take in charge the project. The following inexhaustive monitoring measures are to be implemented;

- Checking for any blockages in roof drainage inlets
- Maintaining grass levels and removing debris from the tree-pit areas
- Maintaining grass levels and removing any debris from the filter swales
- Cleaning of the joints of the permeable paving to prevent moss/silt build-up
- Clearing road gullies if required
- Checking of silt traps on the filter drains if required
- Checking and clearing the silt trap upstream of the attenuation storage
- Checking of the flow control device to ensure blockages do not occur
- Periodic inspection of the storage chambers and de-silting if required

7.2 Site Control

7.2.1 Site control in the treatment train process involves the reduction in volume and rate of surface runoff run off and provide some treatment of the runoff.

7.2.2 Roadside **filter swales** are a method of site control that reduces harmful chemical pollutants and sediment reaching the piped network. These pollutants are trapped in the grassed areas leading to the filter strip.

Filter swales reduce the surface water runoff rate and attenuate flows locally, therefore reducing stress on downstream facilities. Filter swales also facilitate interception of the "first flush" of rainfall. Fig.14 below from the CIRIA SuDS Manual illustrates the principle.

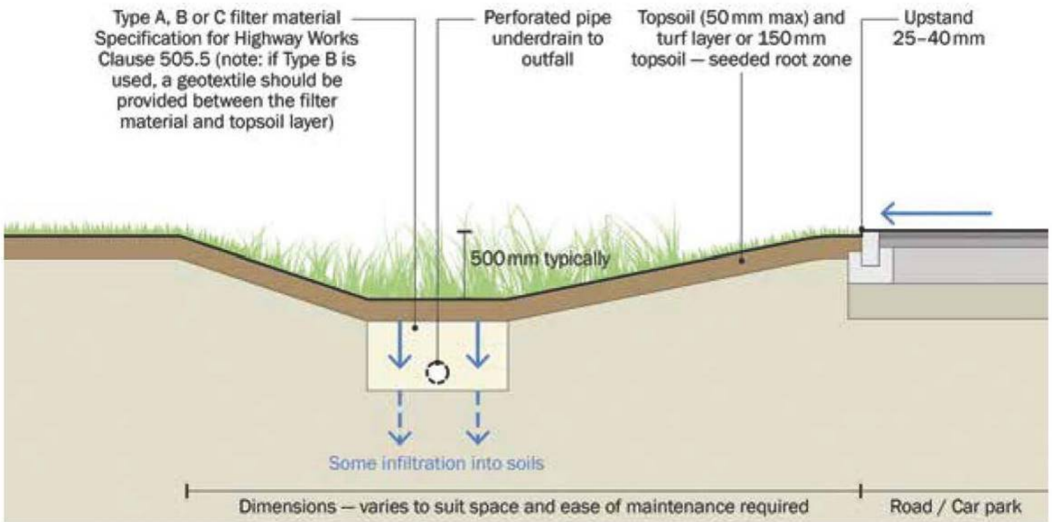


Fig.14 – Filter Swale

7.2.3 As part of the site control it is proposed to construct **filter swales** along the site roads at specified locations which will allow surface water runoff from roads to be intercepted and infiltrate to ground. In the event the ground is saturated, there are also positive drainage connections from the filter swales into the piped network. Refer to Dwg.No.'s 2411/201 & 205 for proposed locations and detail of the filter swales.

7.2.4 The road cambers are to be constructed to drain flow into these filter swales where appropriate to maximize the drained area into SuDS treatment & interception. The road cambers are shown on Dwg.No. 2411/200.

7.2.5 Silt-trap/catchpit manholes are provided upstream of the underground attenuation storage systems which will remove sediments and silts and forms part of the site control methodology used in the proposed development. Furthermore, silt-trap inspection chambers are included downstream of each bio-retention area and swale. Refer to Dwg.2411/205 for further detail.

7.3 Regional Control

7.3.1 Regional control comprises of treatment facilities to reduce pollutants from runoff and control the surface water runoff rate to pre-development rates.

7.3.2 As part of the overall regional control for the site it is proposed to use a 3No.void arched attenuation systems such as illustrated in Fig.15 below.

Fig.15 –Attenuation System

7.3.3 The flow rate of the run-off outfalling from the attenuation systems is to be controlled using vortex control devices such as Hydrobrake vortex control devices.

7.3.4 Interception of the "*first flush*" of rainfall is captured upstream of the outfalls and can infiltrate to ground where possible. The interception storage will be in the surface depressions associated with the SuDS features, within the substrate of the intensive green roofs, within the stone base of the permeable paving and filter drains, the stone below the perforated pipework below the swales/bio-retention areas and in the stone base of the attenuation storage areas. As per the parameters laid out in the GDSDS the interception volume was calculated for the total site as per Table 6 above and detailed in Appendix 11.2.

7.3.5 Prevention of pollutants and sediments entering the receiving watercourse has been achieved in providing Interception Storage throughout the proposed development. The interception will take place from the head of the catchment right down to the Hydrobrake manholes on the application lands.

7.4 SuDS Summary

7.4.1 Interception will be achieved within the voids of the stone base of the permeable paving and filter drains, in the tree pits, green roof (intensive) substrate, swales, bio-retentions and in the stone base of the attenuation storage systems. As per the parameters laid out in the GDSDS the interception volume was calculated and is summarised in paragraphs 6.19-6.20 above.

7.4.2 Replicating the natural characteristics and providing amenity/biodiversity will be encouraged by creating the green roofs, roadside grassed swales, tree pits, bio-retention areas.

7.4.3 The overall site surface water runoff rate has been restricted to the greenfield runoff rate, Qbar (32.3 l/s) and the DLRCC recommended HR Wallingford UK SuDS calculations for same can be viewed in Appendix 11.5 of this report.

7.4.4 Refer to Dwg. No's 2411/201 & 205 for the drainage layout and SuDS features details.

7.4.5 In providing the above noted features it is proposed that the SuDS treatment of the runoff has been adequately addressed.

7.4.6 In advance of the LRD Stage 3 submission and in accordance with the requirements of the Stormwater Management Policy of the DLRCC County Development Plan 2022-2028, a Stormwater Audit has been carried out for the proposed development and submitted to DLRCC Drainage Department before the Stage 3 submission.

8.0 S/W Design Conclusion

8.1 The S/W outfalls are described in detail in Section 6 of this report.

8.2 Full SuDS treatment train approach has been implemented in accordance with the CIRIA SuDS Manual as described in Section 7 above.

8.3 A thorough examination of the site characteristics were undertaken in determination of the soil type and greenfield run off rate.

8.4 The drainage design and attenuation storage volumes have been determined using an industry standard computer modelling software program MicroDrainage, for designing drainage networks as described in Section 6 above and are included in Appendix 11.1 of this report. Climate change of 20% and Urban Creep of 10% has been applied in the design and is detailed in Section 6 above.

8.5 A Site-Specific Flood Risk Assessment was completed and is included in the application as a separate report.

8.6 Pre-Planning and ongoing consultations were held with the DLRCC Roads Project Office regarding interface of services between the GDRS and the subject site.

8.7 In accordance with the requirements of the Stormwater Management Policy of the DLRCC County Development Plan 2022-2028, in advance of submission of the main planning application, a Storm Water Audit has been carried out for the proposed development and submitted to the Drainage Department of DLRCC.

9.0 Wastewater Infrastructure

9.1 Foul drainage records drawings were obtained from Uisce Éireann/DLRCC in preparation for this planning application and are included in Appendix 11.12 of this document.

9.2 A Pre-Connection Enquiry Form application (PCEA) was submitted to Uisce Éireann (UÉ) and a Confirmation of Feasibility (CoF) was received from UÉ (ref.CDS24006782) noting that a foul connection is "*feasible without infrastructure upgrade*". A copy of the Confirmation of Feasibility can be viewed in Appendix 11.14 of this report.

9.3 The minimum public sewer diameter is to be 225mm and the foul drains/sewer are to be in accordance with the Uisce Éireann Code of Practice for Wastewater Infrastructure 2020.

Foul Sewer Design Criteria	
Min.velocity	0.75m/s
Max.velocity	3m/s
Min.sewer size for TIC	225mm diameter
Pipe friction (Ks)	1.5mm
Minimum pipe depth	1.2m below roads 0.9m in open/grassed spaces
Ave.Occupancy	2.7 persons/unit
Residential loading/person/day	150 l/day
Commercial loading/person/day	50 l/d

Table 9 – Foul Sewer Design Criteria

9.4 Each individual house is to be connected to the main public foul sewer using a 100mm diameter drain with a minimum gradient of 1/60 in any one drainage connection.

9.5 There is an existing 225mm diameter foul sewer spur provided by the GDRS project located in the southeast corner of the site and it is proposed to outfall the foul drainage at that point.

9.6 There is also an existing 375/450mm diameter public trunk foul sewer falling from west to east, located within the site boundary area on the north side of the Glenamuck Stream. This existing foul sewer has already been intercepted and diverted into the new GDRS boundary as part of DLRCC roads project and is no longer a working sewer.

9.7 It is noted that the GDRS project will be completed in c.Q1 of 2026. Therefore, the above noted foul trunk diversion and spur connection are to be live and available, by the time this development requires them, subject to a successful planning application.

9.8 The proposed foul sewer crosses beneath the Glenamuck Stream falling by gravity from north to south. Greater than the minimum depth of cover has been achieved and details of this crossing are shown on Dwg.2411/217, an extract of which is shown in Fig.16 below;

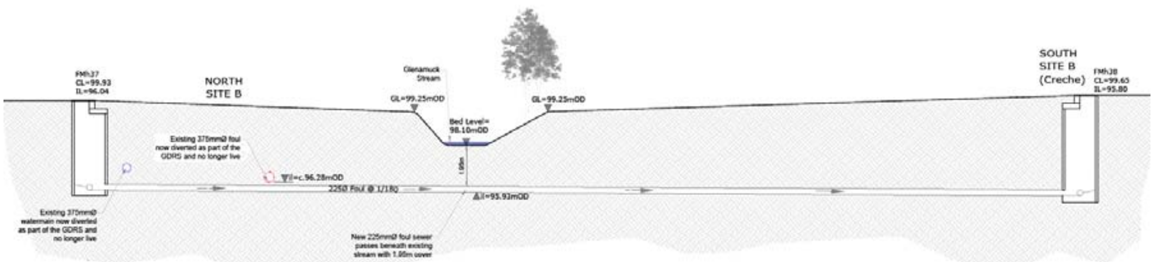


Fig 16 – Stream Crossing

9.8 Refer to Dwg.No.2411/202 for the alignment and levels of the proposed foul drainage network.

9.9 Design estimates for the foul water loading for the entire site are summarised as per Tables 10 & 11 below and refer to Appendix 11.15 for sub-catchment calculations.

Foul Wastewater Calculations

New Network - DOMESTIC Wastewater Flows -						
Usage	**Quantity**	**Occupancy (h)**	**Population (P)**	**Consumption (G) (l/h/day)**	**Loading (PxG)(l/day)**	
Residential	219 Units	2.7No./Unit	591	150	88,695	
				Total =	**88,695 l/day**	
				Flowrate per day (l/s)		**1.0l/s**
				Growth Rate	1	1
				Infiltration (I)	10%	0.01
				Dry Weather Flow	**PG + I**	**1.01 l/s**
				Peaking Factor (Pf_{Dom})	6	
				Design Foul Flow (l/s)	**Pf_{Dom} x PG**	**6.06 l/s**
				Misconnection Allowance (SW)	1.5%	0.01l/s
				Design Flow (l/s)		**6.07 l/s**

Based on Irish Water Code of Practice Wastewater Infrastructure

Table 10 – Residential Wastewater Calculations

New Network – COMMERCIAL Wastewater Flows –						
Usage	**Quantity**	**Occupancy (h)**	**Population (P)**	**Consumption (G) (l/h/day)**	**Loading (PxG)(l/day)**	
Creche	571m^2	1child/5m^2 + Staff (20%) + support accommodation	135	50	6,750	
				Total =	**6,750 l/day**	
				Flowrate per day (l/s)		**0.16l/s**
				Growth Rate	1	1
				Infiltration (I)	10%	0.02
				Dry Weather Flow	**PG + I**	**0.18 l/s**
				Peaking Factor (Pf_{Dom})	6	
				Design Foul Flow (l/s)	**Pf_{Dom} x PG**	**1.08 l/s**
				Misconnection Allowance (SW)	1.5%	0.01l/s
				Design Flow (l/s)		**1.09 l/s**

Based on Irish Water Code of Practice Wastewater Infrastructure

Table 11 –Commercial Wastewater Calculations

10.0 Drinking Water

10.1 Water infrastructure records drawings were obtained from Uisce Éireann/DLRCC in preparation for this planning application and are included in Appendix 11.11 of this document.

10.2 A Pre-Connection Enquiry Form application (PCEA) was submitted to Uisce Éireann and a confirmation of available service was received from UÉ (ref. CDS24006782) noting that the water connection is "*feasible without infrastructure upgrade*". A copy of the Confirmation of Feasibility can be viewed in Appendix 11.14 of this report.

10.3 There is an existing 300mm diameter public trunk watermain located within the site boundary along the northern side of the Glenamuck Stream. This watermain has already been intercepted and diverted into the new GDRS boundary as part of DLRCC roads project. The GDRS project works have provided a 200mm spur connection from the newly diverted watermain back into the subject site. As part of the pre-planning process, discussions have taken place with the DLRCC Roads Project Office and the spur connection and position have been agreed. Subject to a successful planning outcome to this LRD application and completion of a connection agreement with Uisce Éireann, this 200mm watermain spur will be used to serve the subject site. UÉ have provided a CoF in agreement with this principle, refer to Appendix 11.14.

10.4 Refer to Dwg.No.2411/203 for the watermain layout.

10.5 Each individual residential dwelling within the development is to be provided with a boundary box for a separate domestic water meter. The type and configuration of the water meter is to be agreed with Uisce Éireann in advance of construction commencing at the site.

10.6 Each dwelling will be fitted with a cold-water storage tank to provide 24 hours of supply.

10.7 In accordance with best practice, the use of water conservation appliances in the buildings are to be employed as part of this scheme to reduce the water demand. Although the consumption of treated water depends a lot on the behaviour of consumers, demand on the network is limited in the scheme by incorporating water saving tap valves, eco-flush toilet system and water saving appliances.

10.8. All watermain layout and details are to be in accordance with the Uisce Éireann Code of Practice for Water Infrastructure 2020 and the Water Infrastructure Standard details 2020.

10.9 Estimates of the water demand for the entire site were carried out using the guidelines in accordance with the UÉ COP for Water Infrastructure 2020 publication and are shown in Table 12 & 13 below;

Water Demand Calculations

New Network – DOMESTIC Water Demand								
Usage	**Quantity**	**Occupancy**	**Population**	**Consumption (l//h/day)**	**Ave. Daily Domestic Demand (l/day)**	**Ave. Daily Domestic Demand (l/s)**	**Ave. Day/Peak Week (l/s)**	**Peak Hour Water Demand (l/s)**
Resi'	219 Units	2.7 No./Unit	591	150	88,695	1.0	1.25	**6.25 l/s**
Peak Hour Water Demand (Domestic)								**6.3 /s**

Based on Irish Water Code of Practice for Water Infrastructure

Table 12- Residential Water Demand Calculations

New Network – COMMERCIAL Water Demand								
Usage	**Quantity**	**Occupancy**	**Population**	**Consumption (l//h/day)**	**Ave. Daily Domestic Demand (l/day)**	**Ave. Daily Domestic Demand (l/s)**	**Ave. Day/Peak Week (l/s)**	**Peak Hour Water Demand (l/s)**
Creche	571m^2	1child/5m^2 + Staff (20%) + support accommodation	135	50	6,750	0.16	0.2	**1.0 l/s**
Peak Hour Water Demand (Domestic)								**1.0 /s**

Based on Irish Water Code of Practice for Water Infrastructure

Table 13- Commercial Water Demand Calculations

11.0 APPENDIX

11.1 MicroDrainage Drainage Calculations
11.2 Interception/Swale/Tree pit Calculations
11.3 Attenuation Storage Calculations
11.4 SPR Soil Derivation Data
11.5 HR Wallingford Qbar Calculations
11.6 GSI Data
11.7 Soakaway Testing
11.8 Kilternan Glenamuck LAP Map.No.PL-25-010
11.9 DLRCC CDP Flood Map No.9
11.10 OPW Summary Report
11.11 GDRS EIAR Hydrological Model Maps 14-1 & 14-2
11.12 UÉ/DLRCC Records Drawings
11.13 Met Eireann Rainfall Data
11.14 Uisce Éireann CoF
11.15 Foul and Water Demand Calculations
11.16 Hydrobrake Calculations
11.17 Green roofs
11.18 Surface Cover Type
11.19 Stage 2 Opinion Response Table
11.20 SuDS Audit Report

Appendix 11.1

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

Time Area Diagram for Catchment B1

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.546	4-8	1.519	8-12	0.078

Total Area Contributing (ha) = 2.144

Total Pipe Volume (m³) = 75.263

Network Design Table for Catchment B1

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S200.000	22.674	0.613	37.0	0.048	6.00	0.0	0.600	o	225	Pipe/Conduit	
S200.001	25.037	0.715	35.0	0.015	0.00	0.0	0.600	o	225	Pipe/Conduit	
S200.002	14.039	0.540	26.0	0.028	0.00	0.0	0.600	o	225	Pipe/Conduit	
S200.003	30.896	1.144	27.0	0.046	0.00	0.0	0.600	o	225	Pipe/Conduit	
S200.004	30.957	0.967	32.0	0.077	0.00	0.0	0.600	o	225	Pipe/Conduit	
S200.005	19.571	0.631	31.0	0.017	0.00	0.0	0.600	o	225	Pipe/Conduit	
S200.006	43.403	1.808	24.0	0.072	0.00	0.0	0.600	o	225	Pipe/Conduit	
S200.007	36.887	1.537	24.0	0.068	0.00	0.0	0.600	o	300	Pipe/Conduit	
S200.008	10.955	0.274	40.0	0.017	0.00	0.0	0.600	o	300	Pipe/Conduit	
S200.009	35.429	0.354	100.0	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S200.000	50.00	6.18	106.810	0.048	0.0	0.0	0.0	2.16	85.8	8.7
S200.001	50.00	6.36	106.200	0.064	0.0	0.0	0.0	2.22	88.2	11.5
S200.002	50.00	6.45	105.480	0.091	0.0	0.0	0.0	2.58	102.4	16.5
S200.003	50.00	6.66	104.940	0.137	0.0	0.0	0.0	2.53	100.5	24.7
S200.004	50.00	6.88	103.790	0.214	0.0	0.0	0.0	2.32	92.3	38.7
S200.005	50.00	7.02	102.820	0.231	0.0	0.0	0.0	2.36	93.8	41.7
S200.006	50.00	7.29	102.190	0.303	0.0	0.0	0.0	2.68	106.6	54.8
S200.007	50.00	7.48	100.300	0.371	0.0	0.0	0.0	3.22	227.8	67.0
S200.008	50.00	7.55	98.760	0.388	0.0	0.0	0.0	2.49	176.2	70.1
S200.009	50.00	7.93	98.380	0.402	0.0	0.0	0.0	1.57	111.1	72.6

Network Design Table for Catchment B1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S200.010	10.339	0.517	20.0	0.212	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S200.011	30.201	0.067	450.8	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	🔒
S201.000	24.642	0.308	80.0	0.092	6.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S201.001	11.248	0.341	33.0	0.050	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S201.002	49.679	2.258	22.0	0.135	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S201.003	29.740	1.352	22.0	0.099	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S200.012	31.263	0.062	504.2	0.016	0.00	0.0	0.600	o	600	Pipe/Conduit	🔒
S202.000	22.455	0.281	79.9	0.042	6.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S202.001	11.052	0.138	80.0	0.028	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S202.002	40.320	1.090	37.0	0.107	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S203.000	9.301	0.135	68.9	0.038	6.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S203.001	22.564	0.332	68.0	0.045	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S203.002	33.274	0.333	99.9	0.133	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S202.003	21.024	0.263	80.0	0.033	0.00	0.0	0.600	o	375	Pipe/Conduit	🔒
S202.004	47.642	1.361	35.0	0.189	0.00	0.0	0.600	o	375	Pipe/Conduit	🔒
S202.005	11.282	0.451	25.0	0.066	0.00	0.0	0.600	o	375	Pipe/Conduit	🔒
S202.006	34.249	1.427	24.0	0.122	0.00	0.0	0.600	o	375	Pipe/Conduit	🔒
S202.007	34.193	1.554	22.0	0.146	0.00	0.0	0.600	o	375	Pipe/Conduit	🔒
S202.008	9.318	0.274	34.0	0.017	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
S204.000	19.586	0.245	80.0	0.045	6.00	0.0	0.600	o	225	Pipe/Conduit	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S200.010	50.00	7.98	98.020	0.614	0.0	0.0	0.0	3.53	249.6	110.8
S200.011	50.00	8.42	97.203	0.614	0.0	0.0	0.0	1.14	322.4	110.8
S201.000	50.00	6.28	102.730	0.092	0.0	0.0	0.0	1.46	58.2	16.5
S201.001	50.00	6.36	102.430	0.141	0.0	0.0	0.0	2.29	90.9	25.5
S201.002	50.00	6.66	102.100	0.277	0.0	0.0	0.0	2.80	111.4	49.9
S201.003	50.00	6.81	99.840	0.376	0.0	0.0	0.0	3.37	238.0	67.8
S200.012	50.00	8.90	97.130	1.005	0.0	0.0	0.0	1.08	304.7	181.5
S202.000	50.00	6.26	106.560	0.042	0.0	0.0	0.0	1.46	58.2	7.7
S202.001	50.00	6.38	106.280	0.071	0.0	0.0	0.0	1.46	58.2	12.7
S202.002	50.00	6.69	106.150	0.178	0.0	0.0	0.0	2.16	85.8	32.1
S203.000	50.00	6.10	105.200	0.038	0.0	0.0	0.0	1.58	62.7	6.8
S203.001	50.00	6.33	105.060	0.082	0.0	0.0	0.0	1.59	63.2	14.9
S203.002	50.00	6.69	104.650	0.215	0.0	0.0	0.0	1.57	111.2	38.9
S202.003	50.00	6.87	104.250	0.426	0.0	0.0	0.0	2.03	223.9	76.9
S202.004	50.00	7.12	104.000	0.615	0.0	0.0	0.0	3.07	339.2	111.1
S202.005	50.00	7.18	102.650	0.681	0.0	0.0	0.0	3.64	401.5	123.0
S202.006	50.00	7.33	102.190	0.803	0.0	0.0	0.0	3.71	410.0	145.0
S202.007	50.00	7.48	100.480	0.949	0.0	0.0	0.0	3.88	428.2	171.4
S202.008	50.00	7.52	98.800	0.967	0.0	0.0	0.0	3.50	556.0	174.5
S204.000	50.00	6.22	98.810	0.045	0.0	0.0	0.0	1.46	58.2	8.1

Network Design Table for Catchment B1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S204.001	8.884	0.111	80.0	0.012	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S202.009	16.742	0.419	40.0	0.028	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
S200.013	13.983	0.028	500.0	0.075	0.00	0.0	0.600	o	600	Pipe/Conduit	🔒
S200.014	6.043	0.040	151.1	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	🔒
S200.015	22.870	0.152	150.0	0.008	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S200.016	36.752	0.343	107.3	0.004	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S200.017	34.211	0.228	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S200.018	18.396	0.123	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S204.001	50.00	6.32	98.570	0.057	0.0	0.0	0.0	1.46	58.2	10.3
S202.009	50.00	7.61	98.180	1.052	0.0	0.0	0.0	3.22	512.5	189.9
S200.013	50.00	9.12	97.000	2.132	0.0	0.0	0.0	1.08	306.0«	385.0
S200.014	50.00	9.17	96.950	2.132	0.0	0.0	0.0	1.98	559.5	385.0
S200.015	50.00	9.53	96.650	2.140	0.0	0.0	0.0	1.07	42.4«	386.4
S200.016	50.00	10.01	96.520	2.144	0.0	0.0	0.0	1.26	50.2«	387.1
S200.017	50.00	10.55	96.180	2.144	0.0	0.0	0.0	1.07	42.4«	387.1
S200.018	50.00	10.83	95.760	2.144	0.0	0.0	0.0	1.07	42.4«	387.1

Area Summary for Catchment B1

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
200.000	User	-	60	0.014	0.008	0.008
	User	-	71	0.029	0.021	0.029
	User	-	70	0.016	0.011	0.040
	User	-	70	0.003	0.002	0.042
	User	-	40	0.015	0.006	0.048
200.001	User	-	40	0.009	0.004	0.004
	User	-	40	0.002	0.001	0.004
	User	-	40	0.001	0.000	0.005
	User	-	70	0.015	0.011	0.015
200.002	User	-	40	0.004	0.001	0.001
	User	-	40	0.003	0.001	0.003
	User	-	70	0.035	0.025	0.027
	User	-	70	0.001	0.000	0.028
200.003	User	-	60	0.007	0.004	0.004
	User	-	60	0.011	0.007	0.011
	User	-	71	0.017	0.012	0.023
	User	-	71	0.027	0.019	0.042
	User	-	40	0.002	0.001	0.043
	User	-	70	0.004	0.002	0.046
200.004	User	-	60	0.008	0.005	0.005
	User	-	71	0.021	0.015	0.020
	User	-	40	0.009	0.003	0.023
	User	-	40	0.002	0.001	0.024
	User	-	70	0.004	0.003	0.026
	User	-	95	0.035	0.034	0.060
	User	-	40	0.043	0.017	0.077
200.005	User	-	95	0.010	0.010	0.010
	User	-	95	0.004	0.004	0.013
	User	-	40	0.005	0.002	0.015
	User	-	40	0.005	0.002	0.017
200.006	User	-	60	0.012	0.007	0.007
	User	-	71	0.033	0.023	0.031
	User	-	40	0.003	0.001	0.032
	User	-	40	0.002	0.001	0.033
	User	-	70	0.048	0.033	0.066
	User	-	40	0.010	0.004	0.070
	User	-	40	0.005	0.002	0.072
200.007	User	-	60	0.017	0.010	0.010
	User	-	71	0.040	0.028	0.038
	User	-	40	0.002	0.001	0.039
	User	-	40	0.006	0.002	0.042
	User	-	40	0.030	0.012	0.053
	User	-	40	0.035	0.014	0.068
200.008	User	-	40	0.004	0.002	0.002
	User	-	70	0.022	0.015	0.017
200.009	User	-	70	0.016	0.011	0.011
	User	-	70	0.004	0.003	0.014
200.010	User	-	70	0.014	0.010	0.010
	User	-	70	0.016	0.011	0.021
	User	-	71	0.010	0.007	0.028
	User	-	40	0.185	0.074	0.102
	User	-	70	0.003	0.002	0.104
	User	-	40	0.014	0.006	0.110
	User	-	60	0.032	0.019	0.129
	User	-	70	0.043	0.030	0.160
	User	-	71	0.074	0.052	0.212
200.011	-	-	100	0.000	0.000	0.000
201.000	User	-	60	0.007	0.004	0.004
	User	-	60	0.011	0.007	0.011
	User	-	60	0.015	0.009	0.020

Area Summary for Catchment B1

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	71	0.020	0.014	0.035
	User	-	71	0.030	0.021	0.056
	User	-	40	0.002	0.001	0.057
	User	-	40	0.005	0.002	0.059
	User	-	70	0.024	0.017	0.076
	User	-	40	0.013	0.005	0.081
	User	-	70	0.015	0.011	0.092
201.001	User	-	60	0.007	0.004	0.004
	User	-	71	0.025	0.018	0.022
	User	-	40	0.002	0.001	0.023
	User	-	40	0.002	0.001	0.024
	User	-	40	0.024	0.009	0.033
	User	-	95	0.006	0.005	0.038
	User	-	40	0.028	0.011	0.050
201.002	User	-	60	0.014	0.009	0.009
	User	-	60	0.013	0.008	0.017
	User	-	60	0.014	0.008	0.025
	User	-	71	0.033	0.023	0.048
	User	-	71	0.032	0.023	0.071
	User	-	40	0.002	0.001	0.072
	User	-	40	0.002	0.001	0.072
	User	-	70	0.001	0.001	0.073
	User	-	40	0.007	0.003	0.076
	User	-	95	0.037	0.035	0.111
	User	-	40	0.001	0.000	0.112
	User	-	40	0.020	0.008	0.119
	User	-	40	0.040	0.016	0.135
201.003	User	-	40	0.008	0.003	0.003
	User	-	70	0.043	0.030	0.033
	User	-	83	0.042	0.035	0.068
	User	-	40	0.011	0.004	0.072
	User	-	95	0.002	0.002	0.074
	User	-	95	0.025	0.023	0.098
	User	-	95	0.002	0.002	0.099
200.012	User	-	70	0.014	0.010	0.010
	User	-	60	0.008	0.005	0.015
	User	-	40	0.002	0.001	0.016
202.000	User	-	40	0.006	0.002	0.002
	User	-	40	0.001	0.000	0.003
	User	-	70	0.028	0.020	0.023
	User	-	40	0.026	0.010	0.033
	User	-	40	0.017	0.007	0.040
	User	-	71	0.004	0.003	0.042
202.001	User	-	60	0.008	0.005	0.005
	User	-	71	0.021	0.015	0.020
	User	-	40	0.020	0.008	0.028
202.002	User	-	60	0.021	0.013	0.013
	User	-	70	0.007	0.005	0.018
	User	-	60	0.015	0.009	0.027
	User	-	95	0.023	0.022	0.049
	User	-	71	0.003	0.002	0.051
	User	-	71	0.048	0.034	0.085
	User	-	40	0.021	0.008	0.093
	User	-	83	0.006	0.005	0.099
	User	-	40	0.022	0.009	0.107
203.000	User	-	60	0.009	0.005	0.005
	User	-	71	0.014	0.010	0.015
	User	-	40	0.005	0.002	0.017
	User	-	40	0.004	0.002	0.019
	User	-	40	0.004	0.001	0.020

Area Summary for Catchment B1

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	70	0.025	0.017	0.038
203.001	User	-	60	0.014	0.009	0.009
	User	-	60	0.013	0.008	0.017
	User	-	71	0.031	0.022	0.038
	User	-	40	0.015	0.006	0.045
203.002	User	-	60	0.017	0.010	0.010
	User	-	71	0.013	0.010	0.020
	User	-	71	0.032	0.023	0.042
	User	-	71	0.037	0.026	0.069
	User	-	95	0.045	0.043	0.111
	User	-	40	0.026	0.011	0.122
	User	-	40	0.028	0.011	0.133
202.003	User	-	71	0.010	0.007	0.007
	User	-	40	0.002	0.001	0.008
	User	-	60	0.012	0.007	0.015
	User	-	70	0.018	0.013	0.028
	User	-	95	0.005	0.004	0.032
	User	-	40	0.002	0.001	0.033
202.004	User	-	60	0.025	0.015	0.015
	User	-	60	0.019	0.012	0.027
	User	-	40	0.001	0.000	0.027
	User	-	40	0.001	0.000	0.027
	User	-	40	0.005	0.002	0.029
	User	-	40	0.002	0.001	0.030
	User	-	40	0.024	0.009	0.039
	User	-	70	0.030	0.021	0.060
	User	-	70	0.020	0.014	0.074
	User	-	95	0.025	0.023	0.098
	User	-	95	0.028	0.026	0.124
	User	-	95	0.008	0.007	0.132
	User	-	40	0.002	0.001	0.132
	User	-	40	0.007	0.003	0.135
	User	-	40	0.006	0.003	0.138
	User	-	40	0.004	0.002	0.139
	User	-	40	0.001	0.000	0.140
	User	-	40	0.012	0.005	0.145
	User	-	40	0.007	0.003	0.147
	User	-	71	0.029	0.021	0.168
	User	-	70	0.006	0.004	0.173
	User	-	40	0.001	0.000	0.173
	User	-	70	0.001	0.001	0.174
	User	-	83	0.010	0.008	0.181
	User	-	83	0.010	0.008	0.189
202.005	User	-	71	0.039	0.028	0.028
	User	-	40	0.023	0.009	0.037
	User	-	95	0.017	0.017	0.054
	User	-	95	0.009	0.008	0.062
	User	-	40	0.001	0.001	0.062
	User	-	40	0.002	0.001	0.063
	User	-	40	0.007	0.003	0.066
202.006	User	-	60	0.014	0.008	0.008
	User	-	60	0.022	0.013	0.022
	User	-	70	0.041	0.029	0.050
	User	-	70	0.018	0.013	0.063
	User	-	71	0.019	0.013	0.077
	User	-	40	0.048	0.019	0.096
	User	-	83	0.016	0.013	0.109
	User	-	70	0.001	0.001	0.110
	User	-	40	0.002	0.001	0.111
	User	-	40	0.003	0.001	0.112

Area Summary for Catchment B1

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	40	0.006	0.002	0.114
	User	-	40	0.003	0.001	0.115
	User	-	70	0.009	0.006	0.122
	User	-	70	0.000	0.000	0.122
202.007	User	-	60	0.013	0.008	0.008
	User	-	70	0.038	0.027	0.034
	User	-	95	0.038	0.036	0.071
	User	-	83	0.010	0.008	0.079
	User	-	83	0.043	0.035	0.114
	User	-	40	0.020	0.008	0.122
	User	-	40	0.015	0.006	0.128
	User	-	70	0.002	0.001	0.129
	User	-	70	0.010	0.007	0.136
	User	-	95	0.009	0.008	0.144
	User	-	95	0.002	0.002	0.146
202.008	User	-	40	0.004	0.001	0.001
	User	-	40	0.029	0.012	0.013
	User	-	40	0.011	0.004	0.017
204.000	User	-	60	0.012	0.007	0.007
	User	-	60	0.012	0.007	0.014
	User	-	60	0.008	0.005	0.019
	User	-	95	0.002	0.002	0.021
	User	-	95	0.019	0.018	0.039
	User	-	40	0.001	0.000	0.039
	User	-	40	0.014	0.006	0.045
204.001	User	-	60	0.004	0.003	0.003
	User	-	70	0.004	0.003	0.005
	User	-	95	0.007	0.007	0.012
202.009	User	-	40	0.011	0.005	0.005
	User	-	40	0.009	0.004	0.008
	User	-	70	0.029	0.020	0.028
200.013	User	-	70	0.009	0.006	0.006
	User	-	70	0.009	0.007	0.013
	User	-	70	0.021	0.014	0.027
	User	-	40	0.054	0.022	0.049
	User	-	40	0.036	0.014	0.064
	User	-	40	0.029	0.012	0.075
200.014	-	-	100	0.000	0.000	0.000
200.015	User	-	40	0.019	0.008	0.008
200.016	User	-	95	0.004	0.004	0.004
200.017	-	-	100	0.000	0.000	0.000
200.018	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				3.466	2.144	2.144

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 (m^3): 5.9

Unit Reference	MD-SHE-0199-2010-1000-2010
Design Head (m)	1.000
Design Flow (l/s)	20.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	199
Invert Level (m)	96.650
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.000	20.1	Kick-Flo®	0.721	17.2
Flush-Flo™	0.341	20.1	Mean Flow over Head Range	-	16.9

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	6.9	0.800	18.1	2.000	28.0	4.000	39.1	7.000	51.2
0.200	18.8	1.000	20.1	2.200	29.3	4.500	41.4	7.500	53.0
0.300	20.0	1.200	21.9	2.400	30.5	5.000	43.5	8.000	54.7
0.400	20.0	1.400	23.6	2.600	31.7	5.500	45.6	8.500	56.3
0.500	19.6	1.600	25.1	3.000	34.0	6.000	47.5	9.000	57.9
0.600	19.0	1.800	26.6	3.500	36.6	6.500	49.4	9.500	59.4

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 Cv (Summer) 1.000
Region Scotland and Ireland Ratio R 0.276 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) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
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	15 minute 2 year Summer I+20%	108.310	106.860	-0.175	0.000	0.11		0.051
S200.001	S202	15 minute 2 year Summer I+20%	107.700	106.256	-0.169	0.000	0.14		0.074
S200.002	S203	15 minute 2 year Summer I+20%	106.970	105.544	-0.161	0.000	0.18		0.080
S200.003	S204	15 minute 2 year Summer I+20%	106.480	105.017	-0.148	0.000	0.25		0.094
S200.004	S205	15 minute 2 year Summer I+20%	105.290	103.893	-0.122	0.000	0.42		0.126
S200.005	S206	15 minute 2 year Summer I+20%	104.370	102.928	-0.117	0.000	0.46		0.141
S200.006	S207	15 minute 2 year Summer I+20%	103.920	102.304	-0.111	0.000	0.50		0.155
S200.007	S208	15 minute 2 year Summer I+20%	102.120	100.413	-0.187	0.000	0.30		0.124
S200.008	S209	15 minute 2 year Summer I+20%	100.730	98.911	-0.149	0.000	0.50		0.220
S200.009	S217	15 minute 2 year Summer I+20%	100.250	98.558	-0.122	0.000	0.66		0.215
S200.010	S218	15 minute 2 year Summer I+20%	100.870	98.182	-0.138	0.000	0.56		0.434
S200.011	S17	30 minute 2 year Summer I+20%	99.750	97.698	-0.105	0.000	0.37		0.937
S201.000	S210	15 minute 2 year Summer I+20%	104.240	102.815	-0.140	0.000	0.31		0.091
S201.001	S211	15 minute 2 year Summer I+20%	104.040	102.518	-0.137	0.000	0.32		0.153
S201.002	S212	15 minute 2 year Summer I+20%	103.600	102.206	-0.119	0.000	0.44		0.157
S201.003	S213	15 minute 2 year Summer I+20%	101.270	99.952	-0.188	0.000	0.29		0.140
S200.012	S13	30 minute 2 year Summer I+20%	100.100	97.676	-0.054	0.000	0.63		7.771
S202.000	S219	15 minute 2 year Summer I+20%	108.360	106.616	-0.169	0.000	0.14		0.058
S202.001	S220	15 minute 2 year Summer I+20%	108.050	106.357	-0.148	0.000	0.25		0.122
S202.002	S221	15 minute 2 year Summer I+20%	107.970	106.246	-0.129	0.000	0.37		0.163
S203.000	S222	15 minute 2 year Summer I+20%	106.680	105.254	-0.171	0.000	0.13		0.056
S203.001	S223	15 minute 2 year Summer I+20%	106.560	105.136	-0.149	0.000	0.25		0.108
S203.002	S224	15 minute 2 year Summer I+20%	106.230	104.775	-0.175	0.000	0.36		0.152
S202.003	S225	15 minute 2 year Summer I+20%	106.560	104.412	-0.213	0.000	0.38		0.319
S202.004	S226	15 minute 2 year Summer I+20%	105.940	104.150	-0.225	0.000	0.33		0.478
S202.005	S227	15 minute 2 year Summer I+20%	104.200	102.824	-0.201	0.000	0.44		0.405
S202.006	S228	15 minute 2 year Summer I+20%	103.920	102.348	-0.217	0.000	0.37		0.281
S202.007	S229	15 minute 2 year Summer I+20%	102.050	100.649	-0.206	0.000	0.41		0.235
S202.008	S230	15 minute 2 year Summer I+20%	100.300	99.039	-0.211	0.000	0.55		0.367
S204.000	S231	15 minute 2 year Summer I+20%	100.320	98.869	-0.166	0.000	0.15		0.061

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	1.3	8.7	OK
S200.001	S202	1.5	11.2	OK
S200.002	S203	1.7	15.8	OK
S200.003	S204	2.0	23.4	OK
S200.004	S205	2.1	36.2	OK
S200.005	S206	2.1	39.2	OK
S200.006	S207	2.6	51.3	OK
S200.007	S208	2.6	62.5	OK
S200.008	S209	1.9	65.5	OK
S200.009	S217	1.5	67.2	OK
S200.010	S218	2.6	101.3	OK
S200.011	S17	0.5	98.0	OK
S201.000	S210	1.2	16.5	OK
S201.001	S211	1.7	24.6	OK
S201.002	S212	2.6	47.1	OK
S201.003	S213	2.7	63.6	OK
S200.012	S13	0.6	158.6	OK
S202.000	S219	1.0	7.7	OK
S202.001	S220	1.0	12.3	OK
S202.002	S221	1.9	30.1	OK
S203.000	S222	0.9	6.8	OK
S203.001	S223	1.2	14.2	OK
S203.002	S224	1.3	36.4	OK
S202.003	S225	1.6	72.3	OK
S202.004	S226	2.6	103.8	OK
S202.005	S227	2.3	115.0	OK
S202.006	S228	3.1	135.1	OK
S202.007	S229	3.3	159.0	OK
S202.008	S230	1.9	161.8	OK
S204.000	S231	1.0	8.1	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 (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)
S204.001	S232	15 minute 2 year Summer I+20%	100.160	98.641	-0.154	0.000	0.21		0.118
S202.009	S233	15 minute 2 year Summer I+20%	100.070	98.400	-0.230	0.000	0.48		0.308
S200.013	S234	30 minute 2 year Summer I+20%	99.550	97.633	0.033	0.000	2.06		8.496
S200.014	S35	15 minute 2 year Summer I+20%	99.550	97.550	0.000	0.000	1.11		4.244
S200.015	S235	360 minute 2 year Summer I+20%	99.250	97.232	0.357	0.000	0.51		320.018
S200.016	S236	30 minute 2 year Summer I+20%	98.680	96.623	-0.122	0.000	0.43		0.317
S200.017	S237	30 minute 2 year Summer I+20%	97.830	96.295	-0.110	0.000	0.52		0.237
S200.018	S238	30 minute 2 year Summer I+20%	97.250	95.878	-0.107	0.000	0.54		0.128

PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S204.001	S232	0.9	10.1	OK
S202.009	S233	2.3	176.0	OK
S200.013	S234	1.2	338.5	SURCHARGED
S200.014	S35	1.2	331.4	OK
S200.015	S235	1.1	20.0	SURCHARGED
S200.016	S236	1.2	20.6	OK
S200.017	S237	1.0	20.6	OK
S200.018	S238	1.0	20.6	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 Cv (Summer) 1.000
Region Scotland and Ireland Ratio R 0.276 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) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
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	30 minute 30 year Summer I+20%	108.310	106.879	-0.156	0.000	0.20		0.072
S200.001	S202	15 minute 30 year Summer I+20%	107.700	106.280	-0.145	0.000	0.27		0.108
S200.002	S203	15 minute 30 year Summer I+20%	106.970	105.576	-0.129	0.000	0.37		0.122
S200.003	S204	15 minute 30 year Summer I+20%	106.480	105.061	-0.104	0.000	0.55		0.159
S200.004	S205	15 minute 30 year Summer I+20%	105.290	104.025	0.010	0.000	0.94		0.376
S200.005	S206	15 minute 30 year Summer I+20%	104.370	103.230	0.185	0.000	0.98		0.812
S200.006	S207	15 minute 30 year Summer I+20%	103.920	102.622	0.207	0.000	1.05		0.850
S200.007	S208	15 minute 30 year Summer I+20%	102.120	100.485	-0.115	0.000	0.63		0.224
S200.008	S209	15 minute 30 year Summer I+20%	100.730	99.937	0.877	0.000	0.98		2.997
S200.009	S217	15 minute 30 year Summer I+20%	100.250	99.689	1.009	0.000	1.30		2.165
S200.010	S218	15 minute 30 year Summer I+20%	100.870	99.160	0.840	0.000	1.01		3.703
S200.011	S17	15 minute 30 year Summer I+20%	99.750	98.596	0.793	0.000	0.71		3.088
S201.000	S210	30 minute 30 year Summer I+20%	104.240	102.852	-0.103	0.000	0.56		0.132
S201.001	S211	15 minute 30 year Summer I+20%	104.040	102.564	-0.091	0.000	0.65		0.288
S201.002	S212	15 minute 30 year Summer I+20%	103.600	102.280	-0.045	0.000	0.98		0.302
S201.003	S213	15 minute 30 year Summer I+20%	101.270	100.022	-0.118	0.000	0.67		0.261
S200.012	S13	15 minute 30 year Summer I+20%	100.100	98.555	0.825	0.000	1.20		10.642
S202.000	S219	30 minute 30 year Summer I+20%	108.360	106.638	-0.147	0.000	0.26		0.083
S202.001	S220	15 minute 30 year Summer I+20%	108.050	106.396	-0.109	0.000	0.51		0.205
S202.002	S221	15 minute 30 year Summer I+20%	107.970	106.311	-0.064	0.000	0.85		0.354
S203.000	S222	30 minute 30 year Summer I+20%	106.680	105.275	-0.150	0.000	0.24		0.079
S203.001	S223	15 minute 30 year Summer I+20%	106.560	105.177	-0.108	0.000	0.53		0.184
S203.002	S224	15 minute 30 year Summer I+20%	106.230	104.862	-0.088	0.000	0.83		0.323
S202.003	S225	15 minute 30 year Summer I+20%	106.560	104.526	-0.099	0.000	0.88		0.857
S202.004	S226	15 minute 30 year Summer I+20%	105.940	104.253	-0.122	0.000	0.77		1.104
S202.005	S227	15 minute 30 year Summer I+20%	104.200	103.017	-0.008	0.000	1.00		1.234
S202.006	S228	15 minute 30 year Summer I+20%	103.920	102.457	-0.108	0.000	0.84		0.578
S202.007	S229	15 minute 30 year Summer I+20%	102.050	100.837	-0.018	0.000	0.95		0.522
S202.008	S230	15 minute 30 year Summer I+20%	100.300	99.394	0.144	0.000	1.26		1.487
S204.000	S231	15 minute 30 year Summer I+20%	100.320	98.959	-0.076	0.000	0.28		0.163

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	1.6	16.0	OK
S200.001	S202	1.8	22.0	OK
S200.002	S203	2.1	33.3	OK
S200.003	S204	2.4	52.0	OK
S200.004	S205	2.5	81.1	SURCHARGED
S200.005	S206	2.3	83.2	SURCHARGED
S200.006	S207	2.8	107.2	SURCHARGED
S200.007	S208	3.1	132.1	OK
S200.008	S209	2.0	128.1	SURCHARGED
S200.009	S217	1.9	133.3	SURCHARGED
S200.010	S218	2.8	181.8	SURCHARGED
S200.011	S17	0.7	187.5	SURCHARGED
S201.000	S210	1.4	30.1	OK
S201.001	S211	2.1	49.7	OK
S201.002	S212	3.1	104.7	OK
S201.003	S213	3.3	145.0	OK
S200.012	S13	1.1	300.1	SURCHARGED
S202.000	S219	1.1	13.9	OK
S202.001	S220	1.2	25.1	OK
S202.002	S221	2.3	69.1	OK
S203.000	S222	1.1	12.5	OK
S203.001	S223	1.5	30.7	OK
S203.002	S224	1.6	84.8	OK
S202.003	S225	1.9	165.9	OK
S202.004	S226	3.1	241.4	OK
S202.005	S227	2.7	263.5	OK
S202.006	S228	3.7	307.1	OK
S202.007	S229	3.9	363.9	OK
S202.008	S230	2.3	372.5	SURCHARGED
S204.000	S231	1.2	14.7	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)
S204.001	S232	15 minute 30 year Summer I+20%	100.160	98.935	0.140	0.000	0.64		1.064
S202.009	S233	15 minute 30 year Summer I+20%	100.070	98.922	0.292	0.000	1.04		2.082
S200.013	S234	15 minute 30 year Summer I+20%	99.550	98.462	0.862	0.000	4.26		13.215
S200.014	S35	15 minute 30 year Summer I+20%	99.550	97.967	0.417	0.000	2.35		5.318
S200.015	S235	360 minute 30 year Winter I+20%	99.250	97.521	0.646	0.000	0.51		719.554
S200.016	S236	15 minute 30 year Summer I+20%	98.680	96.626	-0.119	0.000	0.45		0.331
S200.017	S237	15 minute 30 year Summer I+20%	97.830	96.298	-0.107	0.000	0.54		0.250
S200.018	S238	15 minute 30 year Summer I+20%	97.250	95.881	-0.104	0.000	0.57		0.132

PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S204.001	S232	1.1	30.2	SURCHARGED
S202.009	S233	2.6	377.9	SURCHARGED
S200.013	S234	2.5	698.7	SURCHARGED
S200.014	S35	2.5	698.3	SURCHARGED
S200.015	S235	1.1	20.0	SURCHARGED
S200.016	S236	1.2	21.5	OK
S200.017	S237	1.0	21.5	OK
S200.018	S238	1.0	21.5	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 Cv (Summer) 1.000
Region Scotland and Ireland Ratio R 0.276 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) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
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	30 minute 100 year Summer I+20%	108.310	106.889	-0.146	0.000	0.27		0.084
S200.001	S202	15 minute 100 year Summer I+20%	107.700	106.293	-0.132	0.000	0.35		0.125
S200.002	S203	15 minute 100 year Summer I+20%	106.970	105.592	-0.113	0.000	0.48		0.148
S200.003	S204	15 minute 100 year Summer I+20%	106.480	105.174	0.009	0.000	0.71		0.370
S200.004	S205	15 minute 100 year Summer I+20%	105.290	104.760	0.745	0.000	1.02		1.963
S200.005	S206	15 minute 100 year Summer I+20%	104.370	103.811	0.766	0.000	1.05		2.180
S200.006	S207	15 minute 100 year Summer I+20%	103.920	103.165	0.750	0.000	1.09		1.829
S200.007	S208	30 minute 100 year Summer I+20%	102.120	101.048	0.448	0.000	0.65		1.350
S200.008	S209	30 minute 100 year Summer I+20%	100.730	100.481	1.421	0.000	1.08		4.395
S200.009	S217	30 minute 100 year Summer I+20%	100.250	100.212	1.532	0.000	1.46		2.756
S200.010	S218	15 minute 100 year Summer I+20%	100.870	99.647	1.327	0.000	1.17		4.254
S200.011	S17	30 minute 100 year Summer I+20%	99.750	98.936	1.133	0.000	0.78		3.689
S201.000	S210	15 minute 100 year Summer I+20%	104.240	103.023	0.068	0.000	0.75		0.325
S201.001	S211	15 minute 100 year Summer I+20%	104.040	102.871	0.216	0.000	0.81		1.373
S201.002	S212	15 minute 100 year Summer I+20%	103.600	102.685	0.360	0.000	1.08		1.067
S201.003	S213	15 minute 100 year Summer I+20%	101.270	100.039	-0.101	0.000	0.76		0.290
S200.012	S13	30 minute 100 year Summer I+20%	100.100	98.891	1.161	0.000	1.42		11.587
S202.000	S219	30 minute 100 year Summer I+20%	108.360	106.651	-0.134	0.000	0.34		0.098
S202.001	S220	15 minute 100 year Summer I+20%	108.050	106.491	-0.014	0.000	0.66		0.522
S202.002	S221	15 minute 100 year Summer I+20%	107.970	106.441	0.066	0.000	1.03		0.699
S203.000	S222	30 minute 100 year Summer I+20%	106.680	105.287	-0.138	0.000	0.32		0.093
S203.001	S223	15 minute 100 year Summer I+20%	106.560	105.199	-0.086	0.000	0.69		0.239
S203.002	S224	15 minute 100 year Summer I+20%	106.230	105.019	0.069	0.000	1.02		0.856
S202.003	S225	15 minute 100 year Summer I+20%	106.560	104.680	0.055	0.000	1.05		2.004
S202.004	S226	15 minute 100 year Summer I+20%	105.940	104.403	0.028	0.000	0.90		2.231
S202.005	S227	15 minute 100 year Summer I+20%	104.200	103.343	0.318	0.000	1.17		2.925
S202.006	S228	15 minute 100 year Summer I+20%	103.920	102.762	0.197	0.000	0.97		1.681
S202.007	S229	15 minute 100 year Summer I+20%	102.050	101.498	0.643	0.000	1.05		2.832
S202.008	S230	15 minute 100 year Summer I+20%	100.300	99.823	0.573	0.000	1.35		3.100
S204.000	S231	15 minute 100 year Summer I+20%	100.320	99.395	0.360	0.000	0.36		0.656

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	1.7	20.9	OK
S200.001	S202	1.9	28.5	OK
S200.002	S203	2.2	43.2	OK
S200.003	S204	2.5	66.4	SURCHARGED
S200.004	S205	2.4	88.2	SURCHARGED
S200.005	S206	2.3	89.0	SURCHARGED
S200.006	S207	2.8	111.1	SURCHARGED
S200.007	S208	3.2	135.8	SURCHARGED
S200.008	S209	2.0	142.1	SURCHARGED
S200.009	S217	2.2	149.8	FLOOD RISK
S200.010	S218	3.0	209.9	SURCHARGED
S200.011	S17	0.7	204.5	SURCHARGED
S201.000	S210	1.4	40.2	SURCHARGED
S201.001	S211	2.0	62.4	SURCHARGED
S201.002	S212	3.0	114.8	SURCHARGED
S201.003	S213	3.4	165.0	OK
S200.012	S13	1.3	354.0	SURCHARGED
S202.000	S219	1.2	18.2	OK
S202.001	S220	1.2	32.6	OK
S202.002	S221	2.3	83.6	SURCHARGED
S203.000	S222	1.2	16.3	OK
S203.001	S223	1.6	39.7	OK
S203.002	S224	1.6	103.5	SURCHARGED
S202.003	S225	1.9	198.6	SURCHARGED
S202.004	S226	3.2	281.9	SURCHARGED
S202.005	S227	2.8	308.3	SURCHARGED
S202.006	S228	3.8	355.5	SURCHARGED
S202.007	S229	3.8	403.2	SURCHARGED
S202.008	S230	2.5	399.0	SURCHARGED
S204.000	S231	1.2	18.9	SURCHARGED

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)
S204.001	S232	15 minute 100 year Summer I+20%	100.160	99.356	0.561	0.000	0.74		1.620
S202.009	S233	15 minute 100 year Summer I+20%	100.070	99.329	0.699	0.000	1.17		3.204
S200.013	S234	30 minute 100 year Summer I+20%	99.550	98.764	1.164	0.000	4.88		13.959
S200.014	S35	30 minute 100 year Summer I+20%	99.550	98.119	0.569	0.000	2.69		5.587
S200.015	S235	360 minute 100 year Winter I+20%	99.250	97.725	0.850	0.000	0.54		999.766
S200.016	S236	15 minute 100 year Summer I+20%	98.680	96.628	-0.117	0.000	0.46		0.337
S200.017	S237	15 minute 100 year Summer I+20%	97.830	96.299	-0.106	0.000	0.55		0.257
S200.018	S238	15 minute 100 year Summer I+20%	97.250	95.883	-0.102	0.000	0.58		0.133

PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S204.001	S232	1.1	34.9	SURCHARGED
S202.009	S233	2.7	426.1	SURCHARGED
S200.013	S234	2.8	800.3	SURCHARGED
S200.014	S35	2.8	800.1	SURCHARGED
S200.015	S235	1.1	20.8	SURCHARGED
S200.016	S236	1.2	22.0	OK
S200.017	S237	1.0	22.0	OK
S200.018	S238	1.0	22.0	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

Time Area Diagram for Catchment B2

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.319	4-8	0.123

Total Area Contributing (ha) = 0.442

Total Pipe Volume (m³) = 12.665

Network Design Table for Catchment B2

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S300.000	19.212	0.461	41.7	0.028	6.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S300.001	17.232	0.311	55.4	0.039	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S300.002	40.974	0.630	65.0	0.050	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S300.003	9.937	0.083	119.7	0.097	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S300.004	20.869	0.104	200.7	0.004	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
S301.000	30.432	0.378	80.5	0.055	6.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S301.001	30.001	0.345	87.0	0.042	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S301.002	14.535	0.121	120.0	0.003	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S301.003	4.741	0.040	120.0	0.008	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S300.000	50.00	6.16	97.590	0.028	0.0	0.0	0.0	2.03	80.8	5.0
S300.001	50.00	6.32	97.129	0.066	0.0	0.0	0.0	1.76	70.0	11.9
S300.002	50.00	6.74	96.818	0.116	0.0	0.0	0.0	1.62	64.6	20.9
S300.003	50.00	6.88	96.200	0.213	0.0	0.0	0.0	1.19	47.5	38.5
S300.004	50.00	7.12	96.120	0.217	0.0	0.0	0.0	1.43	227.7	39.3
S301.000	50.00	6.35	96.910	0.055	0.0	0.0	0.0	1.46	58.0	9.9
S301.001	50.00	6.70	96.530	0.096	0.0	0.0	0.0	1.40	55.8	17.4
S301.002	50.00	6.91	96.180	0.100	0.0	0.0	0.0	1.19	47.4	18.0
S301.003	50.00	6.97	96.060	0.108	0.0	0.0	0.0	1.19	47.4	19.4

Network Design Table for Catchment B2

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S300.005	12.124	0.061	198.8	0.103	0.00	0.0	0.600	o	450	Pipe/Conduit	🔒
S300.006	19.484	0.130	150.0	0.014	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S300.005	50.00	7.26	96.000	0.428	0.0	0.0	0.0	1.44	228.8	77.3
S300.006	50.00	7.57	95.850	0.442	0.0	0.0	0.0	1.07	42.4«	79.9

Area Summary for Catchment B2

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
300.000	User	-	60	0.016	0.009	0.009
	User	-	60	0.030	0.018	0.028
300.001	User	-	70	0.029	0.020	0.020
	User	-	70	0.023	0.016	0.036
	User	-	40	0.006	0.002	0.039
300.002	User	-	60	0.012	0.007	0.007
	User	-	95	0.017	0.016	0.023
	User	-	83	0.019	0.016	0.039
	User	-	40	0.022	0.009	0.048
	User	-	40	0.004	0.002	0.050
300.003	User	-	60	0.011	0.007	0.007
	User	-	70	0.001	0.000	0.007
	User	-	70	0.001	0.001	0.008
	User	-	70	0.044	0.030	0.038
	User	-	70	0.014	0.010	0.048
	User	-	70	0.001	0.001	0.049
	User	-	95	0.005	0.005	0.054
	User	-	95	0.002	0.002	0.055
	User	-	95	0.002	0.002	0.057
	User	-	83	0.032	0.027	0.084
	User	-	40	0.029	0.011	0.095
	User	-	40	0.003	0.001	0.097
	User	-	40	0.002	0.001	0.097
300.004	User	-	37	0.002	0.001	0.001
	User	-	40	0.002	0.001	0.002
	User	-	40	0.007	0.003	0.004
301.000	User	-	60	0.005	0.003	0.003
	User	-	60	0.006	0.004	0.007
	User	-	95	0.032	0.030	0.037
	User	-	37	0.001	0.000	0.037
	User	-	71	0.009	0.006	0.044
	User	-	95	0.001	0.001	0.045
	User	-	40	0.025	0.010	0.055
301.001	User	-	70	0.055	0.038	0.038
	User	-	70	0.005	0.003	0.042
301.002	User	-	70	0.005	0.003	0.003
301.003	User	-	40	0.020	0.008	0.008
300.005	User	-	60	0.013	0.008	0.008
	User	-	60	0.019	0.011	0.019
	User	-	83	0.081	0.067	0.086
	User	-	70	0.016	0.011	0.098
	User	-	70	0.002	0.002	0.099
	User	-	95	0.002	0.002	0.101
	User	-	40	0.002	0.001	0.102
	User	-	70	0.002	0.001	0.103
300.006	User	-	40	0.005	0.002	0.002
	User	-	70	0.015	0.011	0.012
	User	-	40	0.004	0.002	0.014
				Total	Total	Total
				0.658	0.442	0.442

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-0146-1000-1000-1000
Design Head (m)	1.000
Design Flow (l/s)	10.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	146
Invert Level (m)	95.850
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	10.0	Kick-Flo®	0.673	8.3
Flush-Flo™	0.306	9.9	Mean Flow over Head Range	-	8.6

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	5.2	0.800	9.0	2.000	13.9	4.000	19.3	7.000	25.2
0.200	9.6	1.000	10.0	2.200	14.5	4.500	20.4	7.500	26.1
0.300	9.9	1.200	10.9	2.400	15.1	5.000	21.5	8.000	26.9
0.400	9.8	1.400	11.7	2.600	15.7	5.500	22.5	8.500	27.7
0.500	9.6	1.600	12.5	3.000	16.8	6.000	23.4	9.000	28.5
0.600	9.1	1.800	13.2	3.500	18.1	6.500	24.4	9.500	29.2

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

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment B2

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	Cv (Summer)	1.000
Region	Scotland and Ireland	Ratio R	0.276	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)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
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)
S300.000	S300	15 minute 2 year Summer I+20%	99.090	97.628	-0.187	0.000	0.07		0.038
S300.001	S301	15 minute 2 year Summer I+20%	98.630	97.194	-0.160	0.000	0.18		0.085
S300.002	S302	15 minute 2 year Summer I+20%	98.320	96.906	-0.137	0.000	0.32		0.125
S300.003	S303	15 minute 2 year Summer I+20%	97.530	96.370	-0.055	0.000	0.91		0.382
S300.004	S304	15 minute 2 year Summer I+20%	97.350	96.262	-0.308	0.000	0.20		0.349
S301.000	S305	15 minute 2 year Summer I+20%	98.410	96.974	-0.161	0.000	0.18		0.067
S301.001	S306	15 minute 2 year Summer I+20%	98.170	96.618	-0.137	0.000	0.32		0.138
S301.002	S307	15 minute 2 year Summer I+20%	97.700	96.281	-0.124	0.000	0.42		0.159
S301.003	S308	15 minute 2 year Summer I+20%	97.300	96.219	-0.066	0.000	0.62		0.399
S300.005	S309	15 minute 2 year Summer I+20%	97.250	96.205	-0.245	0.000	0.42		1.160
S300.006	S310	180 minute 2 year Summer I+20%	97.250	96.134	0.059	0.000	0.26		57.661

PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S300.000	S300	1.1	5.0	OK
S300.001	S301	1.2	11.4	OK
S300.002	S302	1.4	19.7	OK
S300.003	S303	1.1	35.9	OK
S300.004	S304	0.9	36.5	OK
S301.000	S305	1.0	9.8	OK
S301.001	S306	1.2	16.7	OK
S301.002	S307	1.0	17.2	OK
S301.003	S308	0.6	18.5	OK
S300.005	S309	1.0	70.4	OK
S300.006	S310	0.9	9.9	SURCHARGED

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment B2

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 Cv (Summer) 1.000
Region Scotland and Ireland Ratio R 0.276 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) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
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)
S300.000	S300	30 minute 30 year Summer I+20%	99.090	97.643	-0.172	0.000	0.12		0.054
S300.001	S301	15 minute 30 year Summer I+20%	98.630	97.228	-0.126	0.000	0.40		0.133
S300.002	S302	15 minute 30 year Summer I+20%	98.320	97.019	-0.024	0.000	0.70		0.397
S300.003	S303	15 minute 30 year Summer I+20%	97.530	96.714	0.289	0.000	2.00		1.614
S300.004	S304	240 minute 30 year Summer I+20%	97.350	96.413	-0.157	0.000	0.14		0.753
S301.000	S305	30 minute 30 year Summer I+20%	98.410	97.000	-0.135	0.000	0.33		0.096
S301.001	S306	15 minute 30 year Summer I+20%	98.170	96.666	-0.089	0.000	0.65		0.267
S301.002	S307	15 minute 30 year Summer I+20%	97.700	96.484	0.079	0.000	0.82		0.940
S301.003	S308	240 minute 30 year Summer I+20%	97.300	96.413	0.128	0.000	0.41		0.919
S300.005	S309	240 minute 30 year Summer I+20%	97.250	96.411	-0.039	0.000	0.29		3.201
S300.006	S310	240 minute 30 year Summer I+20%	97.250	96.409	0.334	0.000	0.26		114.120

PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S300.000	S300	1.3	9.1	OK
S300.001	S301	1.5	24.9	OK
S300.002	S302	1.6	42.7	OK
S300.003	S303	2.0	78.8	SURCHARGED
S300.004	S304	0.8	26.2	OK
S301.000	S305	1.2	17.9	OK
S301.001	S306	1.4	33.9	OK
S301.002	S307	1.0	34.1	SURCHARGED
S301.003	S308	0.6	12.3	SURCHARGED
S300.005	S309	0.9	49.2	OK
S300.006	S310	0.9	9.9	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment B2

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 Cv (Summer) 1.000
Region Scotland and Ireland Ratio R 0.276 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) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
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)
S300.000	S300	30 minute 100 year Summer I+20%	99.090	97.651	-0.164	0.000	0.16		0.063
S300.001	S301	15 minute 100 year Summer I+20%	98.630	97.384	0.030	0.000	0.48		0.496
S300.002	S302	15 minute 100 year Summer I+20%	98.320	97.324	0.281	0.000	0.79		1.201
S300.003	S303	15 minute 100 year Summer I+20%	97.530	96.931	0.506	0.000	2.29		2.334
S300.004	S304	240 minute 100 year Summer I+20%	97.350	96.625	0.055	0.000	0.18		1.064
S301.000	S305	30 minute 100 year Summer I+20%	98.410	97.014	-0.121	0.000	0.43		0.112
S301.001	S306	15 minute 100 year Summer I+20%	98.170	96.835	0.080	0.000	0.76		0.910
S301.002	S307	15 minute 100 year Summer I+20%	97.700	96.651	0.246	0.000	1.00		1.579
S301.003	S308	240 minute 100 year Summer I+20%	97.300	96.624	0.339	0.000	0.50		1.164
S300.005	S309	240 minute 100 year Summer I+20%	97.250	96.623	0.173	0.000	0.36		4.127
S300.006	S310	240 minute 100 year Summer I+20%	97.250	96.620	0.545	0.000	0.26		156.852

PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S300.000	S300	1.4	11.9	OK
S300.001	S301	1.6	30.1	SURCHARGED
S300.002	S302	1.6	48.6	SURCHARGED
S300.003	S303	2.3	90.4	SURCHARGED
S300.004	S304	0.8	32.2	SURCHARGED
S301.000	S305	1.3	23.3	OK
S301.001	S306	1.4	39.5	SURCHARGED
S301.002	S307	1.0	41.4	SURCHARGED
S301.003	S308	0.6	15.0	SURCHARGED
S300.005	S309	0.9	60.2	SURCHARGED
S300.006	S310	0.9	9.9	SURCHARGED

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

Time Area Diagram for Catchment B3

Time (mins)	**Area (ha)**	**Time (mins)**	**Area (ha)**
0-4	0.126	4-8	0.068

Total Area Contributing (ha) = 0.194

Total Pipe Volume (m³) = 2.444

Network Design Table for Catchment B3

PN	**Length (m)**	**Fall (m)**	**Slope (1:X)**	**I.Area (ha)**	**T.E. (mins)**	**Base Flow (l/s)**	**k (mm)**	**HYD SECT**	**DIA (mm)**	**Section Type**	**Auto Design**
S400.000	21.629	0.721	30.0	0.138	6.00	0.0	0.600	o	225	Pipe/Conduit	
S400.001	8.111	0.054	150.2	0.057	0.00	0.0	0.600	o	300	Pipe/Conduit	
S400.002	7.828	0.058	135.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S400.003	17.588	0.117	150.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	**Rain (mm/hr)**	**T.C. (mins)**	**US/IL (m)**	**Σ I.Area (ha)**	**Σ Base Flow (l/s)**	**Foul (l/s)**	**Add Flow (l/s)**	**Vel (m/s)**	**Cap (l/s)**	**Flow (l/s)**
S400.000	50.00	6.15	97.330	0.138	0.0	0.0	0.0	2.40	95.3	24.8
S400.001	50.00	6.26	96.100	0.194	0.0	0.0	0.0	1.28	90.5	35.0
S400.002	50.00	6.37	95.900	0.194	0.0	0.0	0.0	1.12	44.7	35.0
S400.003	50.00	6.65	95.760	0.194	0.0	0.0	0.0	1.06	42.3	35.0

Area Summary for Catchment B3

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
400.000	User	-	60	0.006	0.004	0.004
	User	-	60	0.006	0.004	0.007
	User	-	95	0.050	0.048	0.055
	User	-	71	0.043	0.030	0.086
	User	-	95	0.030	0.029	0.114
	User	-	40	0.059	0.023	0.138
400.001	User	-	60	0.012	0.007	0.007
	User	-	70	0.040	0.028	0.035
	User	-	40	0.040	0.016	0.051
	User	-	40	0.013	0.005	0.057
400.002	-	-	100	0.000	0.000	0.000
400.003	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.299	0.194	0.194

Free Flowing Outfall Details for Catchment B3

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S400.003	S	97.500	95.643	95.640	0	0

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-0074-2200-0750-2200
Design Head (m)	0.750
Design Flow (l/s)	2.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	74
Invert Level (m)	95.900
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.750	2.2	Kick-Flo®	0.484	1.8
Flush-Flo™	0.226	2.2	Mean Flow over Head Range	-	1.9

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	2.0	0.800	2.3	2.000	3.4	4.000	4.8	7.000	6.2
0.200	2.2	1.000	2.5	2.200	3.6	4.500	5.0	7.500	6.4
0.300	2.2	1.200	2.7	2.400	3.8	5.000	5.3	8.000	6.6
0.400	2.1	1.400	2.9	2.600	3.9	5.500	5.5	8.500	6.8
0.500	1.8	1.600	3.1	3.000	4.2	6.000	5.8	9.000	7.0
0.600	2.0	1.800	3.3	3.500	4.5	6.500	6.0	9.500	7.2

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	Cv (Summer)	1.000
Region	Scotland and Ireland	Ratio R	0.276	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)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
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	15 minute 2 year Summer I+20%	99.150	97.412	-0.143	0.000	0.29		0.087
S400.001	S401	15 minute 2 year Summer I+20%	97.750	96.261	-0.139	0.000	0.56		0.177
S400.002	S402	360 minute 2 year Summer I+20%	97.750	96.179	0.054	0.000	0.06		33.972
S400.003	S403	120 minute 2 year Summer I+20%	96.750	95.795	-0.190	0.000	0.06		0.034

PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S400.000	S400	1.9	24.8	OK
S400.001	S401	0.9	34.1	OK
S400.002	S402	0.6	2.2	SURCHARGED
S400.003	S403	0.6	2.2	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 Cv (Summer) 1.000
Region Scotland and Ireland Ratio R 0.276 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)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
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	30 minute 30 year Summer I+20%	99.150	97.446	-0.109	0.000	0.52		0.126
S400.001	S401	480 minute 30 year Summer I+20%	97.750	96.470	0.070	0.000	0.24		0.413
S400.002	S402	480 minute 30 year Summer I+20%	97.750	96.469	0.344	0.000	0.06		69.422
S400.003	S403	15 minute 30 year Winter I+20%	96.750	95.795	-0.190	0.000	0.06		0.034

PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S400.000	S400	2.2	45.4	OK
S400.001	S401	0.7	14.6	SURCHARGED
S400.002	S402	0.6	2.2	SURCHARGED
S400.003	S403	0.6	2.2	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	Cv (Summer)	1.000
Region	Scotland and Ireland	Ratio R	0.276	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)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
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	30 minute 100 year Summer I+20%	99.150	97.467	-0.088	0.000	0.68		0.150
S400.001	S401	360 minute 100 year Winter I+20%	97.750	96.662	0.262	0.000	0.24		0.639
S400.002	S402	360 minute 100 year Winter I+20%	97.750	96.660	0.535	0.000	0.07		92.575
S400.003	S403	360 minute 100 year Winter I+20%	96.750	95.795	-0.190	0.000	0.06		0.034

PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S400.000	S400	2.3	59.3	OK
S400.001	S401	0.7	15.0	SURCHARGED
S400.002	S402	0.6	2.2	SURCHARGED
S400.003	S403	0.6	2.2	OK

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 (m^3): 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	Cv (Summer)	1.000
Region	Scotland and Ireland	Ratio R	0.276	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 (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)
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 Cv (Summer) 1.000
Region Scotland and Ireland Ratio R 0.276 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 Cv (Summer) 1.000
Region Scotland and Ireland Ratio R 0.276 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	Cv (Summer)	1.000
Region	Scotland and Ireland	Ratio R	0.276	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 Cv (Summer) 1.000
Region Scotland and Ireland Ratio R 0.276 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	Cv (Summer)	1.000
Region	Scotland and Ireland	Ratio R	0.276	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 11.2

Interception/SwaleTree Pit Calculations

INTERCEPTION - Glenamuck Nth - Site B - Catchment B1

Paved Surfaces connected to the drainage system (Ha) =	2.284	Volume of Interception Required (m^3)	91.4	Gross Paved Area x 5mm x 0.8 (GDSDS E2.1.1 - Criterion 1)

Volume of Interception Provided (m^3)	Length	Width (m)	Area (m^2)	Quantity	Depth (m)	Void Ratio	Volume (m^3)
Voids of stone below Permeable Paving overflow			2,875		0.2	0.3	172.5
Voids of stone below Filter Drains	345	0.75		1	0.15	0.4	15.5
Voids of stone below Swale overflow	230	0.6			0.15	0.4	8.3
Tree Pits			10	9	0.05	1	4.5
Green Roofs			1370	1	0.08	0.4	43.8
Bio Retention			242	1	0.1	1	24.2
Retention in Detention Basin			0	0	0.05	1	0.0
Voids of stone below Storage areas			1,375		0.2	0.4	110.0
						Volume of Interception Provided (m^3) =	**378.8**
						Volume of Interception Required (m^3) =	**91.4**
						Interception provided > Required	**OK**

INTERCEPTION - Glenamuck Nth - Site B - Catchments B2

Paved Surfaces connected to the drainage system (Ha) =	0.527	Volume of Interception Required (m^3)	21.1	Gross Paved Area x 5mm x 0.8 (GDSDS E2.1.1 - Criterion 1)

Volume of Interception Provided (m^3)	Length	Width (m)	Area (m^2)	Quantity	Depth (m)	Void Ratio	Volume (m^3)
Voids of stone below Permeable Paving overflow			875		0.2	0.3	52.5
Voids of stone below Filter Drains	0	0.75		1	0.15	0.4	0.0
Voids of stone below Swale overflow	32	0.6			0.15	0.4	1.2
Tree Pits			0	0	0.05	1	0.0
Green Roofs			1320	1	0.08	0.4	42.2
Bio Retention			121	1	0.1	1	12.1
Retention in Detention Basin			0	1	0.05	1	0.0
Voids of stone below Storage areas			210		0.2	0.4	16.8
						Volume of Interception Provided (m^3) =	**124.8**
						Volume of Interception Required (m^3) =	**21.1**
						Interception provided > Required	**OK**

INTERCEPTION - Glenamuck Nth - Site B - Catchment B3

Paved Surfaces connected to the drainage system (Ha) =	0.187	Volume of Interception Required (m^3)	7.5	Gross Paved Area x 5mm x 0.8 (GDSDS E2.1.1 - Criterion 1)

Volume of Interception Provided (m^3)	Length	Width (m)	Area (m^2)	Quantity	Depth (m)	Void Ratio	Volume (m^3)
Voids of stone below Permeable Paving overflow			225		0.2	0.3	13.5
Voids of stone below Filter Drains	0	0.75		1	0.15	0.4	0.0
Voids of stone below Swale overflow	0	0.6			0.15	0.4	0.0
Tree Pits			15	1	0.05	1	0.8
Green Roofs			0	1	0.08	0.4	0.0
Bio Retention			39	1	0.1	1	3.9
Retention in Detention Basin			0	1	0.05	1	0.0
Voids of stone below Storage areas			125		0.2	0.4	10.0
						Volume of Interception Provided (m^3) =	**28.2**
						Volume of Interception Required (m^3) =	**7.5**
						Interception provided > Required	**OK**

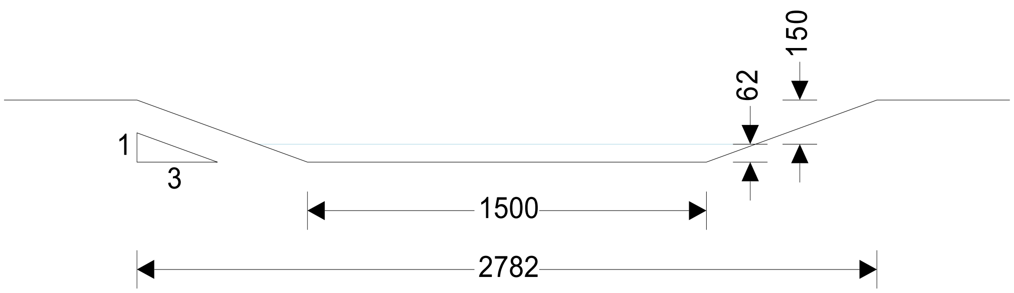
SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

Width of swale base	w = **1.500** m
Longitudinal gradient of swale	S = **0.010**
Side slope gradient of swale	s = **0.330**
Manning number	n = **0.25**
Length of swale	L = **20** m



Cross section of swale

Outlet pipe details

Height of outlet pipe above invert	d_{outlet} = **50** mm

Design rainfall intensity

Location of catchment area	Other
Storm duration	D = **1** hr
Return period	Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.276**
5-year return period rainfall of 60 minutes duration	M5_60min = **60.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **20** %
Factor Z1 (Wallingford procedure)	Z1 = **1.00**
Rainfall for 1hr storm with 5 year return period	$M5\_1hr_i = Z1 \times M5\_60min \times (1 + p_{climate})$ = **72.0** mm
Factor Z2 (Wallingford procedure)	Z2 = **1.63**
Rainfall for 1hr storm with 100 year return period	$M100\_1hr = Z2 \times M5\_1hr_i$ = **117.5** mm
Design rainfall intensity	I_{max} = M100_1hr / D = **117.5** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **192** m^2
Percentage of area that is impermeable	p = **95** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **6.0** l/s

Calculate depth of flow using iteration of Manning's formula

Minimum depth of flow	x = **62** mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow	$A = (w + x / s) \times x$ = **0.104** m^2
Perimeter of flow	$P = w + 2 \times \sqrt{x^2 + (x / s)^2}$ = **1.893** m
Hydraulic radius	R = A / P = **0.055** m

Check flow using Manning equation $Q_{check} = A \times (R / 1\ m)^{2/3} \times S^{1/2} \times 1\ m/s / n =$ **6.0** l/s

Maximum velocity of flow $V_{max} = Q_{max} / A =$ **0.057** m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

Minimum width

Freeboard $d_{free} =$ **150** mm

Minimum required swale width $w_{total,min} = 2 \times (x + d_{free}) / s + w =$ **2.782** m

Storage

Infiltration capacity of the base f = **0.000014** m/s

Flow into swale $V_{in} = Q_{max} \times D =$ **21.4** m^3

Infiltration area of swale (assume flat base only) $A_{infil} = L \times w =$ **30.0** m^2

Infiltration volume of swale $V_{infil} = f \times D \times A_{infil} =$ **1.5** m^3

Interception storage volume required $V_{infil\_req} = V_{in} - V_{infil} =$ **19.9** m^3

Interception storage volume provided $V_{infil\_prov} = L \times w \times d_{outlet} / 2 =$ **0.8** m^3

Interception volume required exceeds volume provided. Additional interception storage will be required.

SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

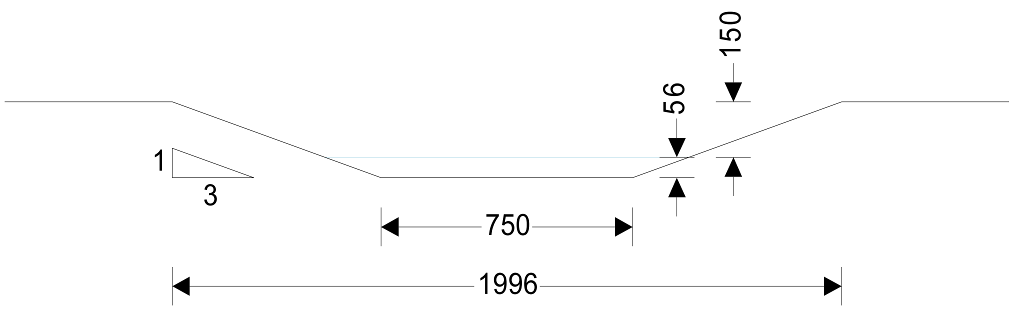
Width of swale base — $w = \mathbf{0.750}$ m

Longitudinal gradient of swale — $S = \mathbf{0.008}$

Side slope gradient of swale — $s = \mathbf{0.330}$

Manning number — $n = \mathbf{0.25}$

Length of swale — $L = \mathbf{7}$ m



Cross section of swale

Outlet pipe details

Height of outlet pipe above invert — $d_{outlet} = \mathbf{50}$ mm

Design rainfall intensity

Location of catchment area — Other

Storm duration — $D = \mathbf{1}$ hr

Return period — Period = **100** yr

Ratio 60 min to 2 day rainfall of 5 yr return period — $r = \mathbf{0.276}$

5-year return period rainfall of 60 minutes duration — M5_60min = **60.0** mm

Increase of rainfall intensity due to global warming — $p_{climate} = \mathbf{20}$ %

Factor Z1 (Wallingford procedure) — $Z1 = \mathbf{1.00}$

Rainfall for 1hr storm with 5 year return period — $M5\_1hr_i = Z1 \times M5\_60min \times (1 + p_{climate}) = \mathbf{72.0}$ mm

Factor Z2 (Wallingford procedure) — $Z2 = \mathbf{1.63}$

Rainfall for 1hr storm with 100 year return period — $M100\_1hr = Z2 \times M5\_1hr_i = \mathbf{117.5}$ mm

Design rainfall intensity — $I_{max} = M100\_1hr / D = \mathbf{117.5}$ mm/hr

Maximum surface water runoff

Catchment area — $A_{catch} = \mathbf{75}$ m^2

Percentage of area that is impermeable — $p = \mathbf{95}$ %

Maximum surface water runoff — $Q_{max} = A_{catch} \times p \times I_{max} = \mathbf{2.3}$ l/s

Calculate depth of flow using iteration of Manning's formula

Minimum depth of flow — $x = \mathbf{56}$ mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow — $A = (w + x / s) \times x = \mathbf{0.051}$ m^2

Perimeter of flow — $P = w + 2 \times \sqrt{(x^2 + (x / s)^2)} = \mathbf{1.104}$ m

Hydraulic radius — $R = A / P = \mathbf{0.046}$ m

Check flow using Manning equation $Q_{check} = A \times (R / 1\ m)^{2/3} \times S^{1/2} \times 1\ m/s / n = \mathbf{2.3}$ l/s

Maximum velocity of flow $V_{max} = Q_{max} / A = \mathbf{0.046}$ m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

Minimum width

Freeboard $d_{free} = \mathbf{150}$ mm

Minimum required swale width $w_{total,min} = 2 \times (x + d_{free}) / s + w = \mathbf{1.996}$ m

Storage

Infiltration capacity of the base f = **0.000014** m/s

Flow into swale $V_{in} = Q_{max} \times D = \mathbf{8.4}\ m^3$

Infiltration area of swale (assume flat base only) $A_{infil} = L \times w = \mathbf{5.3}\ m^2$

Infiltration volume of swale $V_{infil} = f \times D \times A_{infil} = \mathbf{0.3}\ m^3$

Interception storage volume required $V_{infil\_req} = V_{in} - V_{infil} = \mathbf{8.1}\ m^3$

Interception storage volume provided $V_{infil\_prov} = L \times w \times d_{outlet} / 2 = \mathbf{0.1}\ m^3$

Interception volume required exceeds volume provided. Additional interception storage will be required.

SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

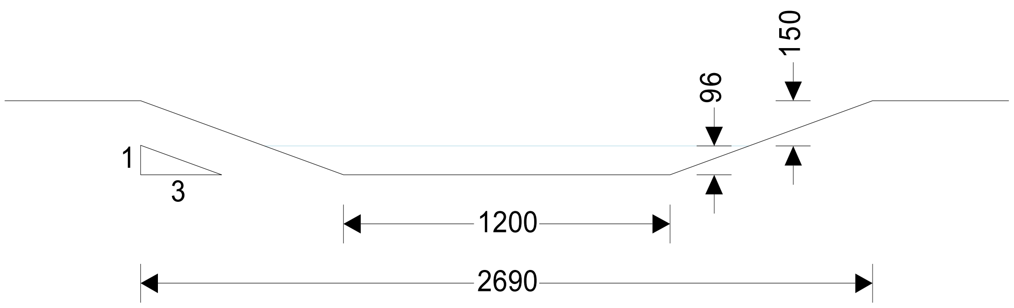
Width of swale base — $w = \mathbf{1.200}$ m

Longitudinal gradient of swale — $S = \mathbf{0.008}$

Side slope gradient of swale — $s = \mathbf{0.330}$

Manning number — $n = \mathbf{0.25}$

Length of swale — $L = \mathbf{40}$ m



Cross section of swale

Outlet pipe details

Height of outlet pipe above invert — $d_{outlet} = \mathbf{50}$ mm

Design rainfall intensity

Location of catchment area — Other

Storm duration — $D = \mathbf{1}$ hr

Return period — Period = **100** yr

Ratio 60 min to 2 day rainfall of 5 yr return period — $r = \mathbf{0.276}$

5-year return period rainfall of 60 minutes duration — M5_60min = **60.0** mm

Increase of rainfall intensity due to global warming — $p_{climate} = \mathbf{20}$ %

Factor Z1 (Wallingford procedure) — Z1 = **1.00**

Rainfall for 1hr storm with 5 year return period — $M5\_1hr_i = Z1 \times M5\_60min \times (1 + p_{climate}) = \mathbf{72.0}$ mm

Factor Z2 (Wallingford procedure) — Z2 = **1.63**

Rainfall for 1hr storm with 100 year return period — $M100\_1hr = Z2 \times M5\_1hr_i = \mathbf{117.5}$ mm

Design rainfall intensity — $I_{max} = M100\_1hr / D = \mathbf{117.5}$ mm/hr

Maximum surface water runoff

Catchment area — $A_{catch} = \mathbf{300}$ m^2

Percentage of area that is impermeable — $p = \mathbf{95}$ %

Maximum surface water runoff — $Q_{max} = A_{catch} \times p \times I_{max} = \mathbf{9.3}$ l/s

Calculate depth of flow using iteration of Manning's formula

Minimum depth of flow — $x = \mathbf{96}$ mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow — $A = (w + x / s) \times x = \mathbf{0.143}$ m^2

Perimeter of flow — $P = w + 2 \times \sqrt{(x^2 + (x / s)^2)} = \mathbf{1.812}$ m

Hydraulic radius — $R = A / P = \mathbf{0.079}$ m

Check flow using Manning equation $Q_{check} = A \times (R / 1\ m)^{2/3} \times S^{1/2} \times 1\ m/s / n = \mathbf{9.4}$ l/s

Maximum velocity of flow $V_{max} = Q_{max} / A = \mathbf{0.065}$ m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

Minimum width

Freeboard $d_{free} = \mathbf{150}$ mm

Minimum required swale width $w_{total,min} = 2 \times (x + d_{free}) / s + w = \mathbf{2.690}$ m

Storage

Infiltration capacity of the base $f = \mathbf{0.000014}$ m/s

Flow into swale $V_{in} = Q_{max} \times D = \mathbf{33.5}\ m^3$

Infiltration area of swale (assume flat base only) $A_{infil} = L \times w = \mathbf{48.0}\ m^2$

Infiltration volume of swale $V_{infil} = f \times D \times A_{infil} = \mathbf{2.4}\ m^3$

Interception storage volume required $V_{infil\_req} = V_{in} - V_{infil} = \mathbf{31.1}\ m^3$

Interception storage volume provided $V_{infil\_prov} = L \times w \times d_{outlet} / 2 = \mathbf{1.2}\ m^3$

Interception volume required exceeds volume provided. Additional interception storage will be required.

SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

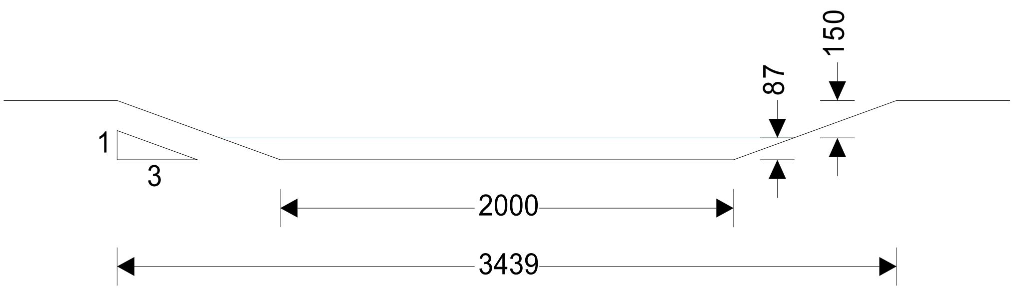
Width of swale base — w = **2.000** m

Longitudinal gradient of swale — S = **0.010**

Side slope gradient of swale — s = **0.330**

Manning number — n = **0.25**

Length of swale — L = **150** m



Cross section of swale

Outlet pipe details

Height of outlet pipe above invert — d_{outlet} = **50** mm

Design rainfall intensity

Location of catchment area — Other

Storm duration — D = **2** hr

Return period — Period = **30** yr

Ratio 60 min to 2 day rainfall of 5 yr return period — r = **0.276**

5-year return period rainfall of 60 minutes duration — M5_60min = **60.0** mm

Increase of rainfall intensity due to global warming — $p_{climate}$ = **20** %

Factor Z1 (Wallingford procedure) — Z1 = **1.27**

Rainfall for 2hr storm with 5 year return period — $M5\_2hr_i = Z1 \times M5\_60min \times (1 + p_{climate})$ = **91.2** mm

Factor Z2 (Wallingford procedure) — Z2 = **1.31**

Rainfall for 2hr storm with 30 year return period — $M30\_2hr = Z2 \times M5\_2hr_i$ = **119.1** mm

Design rainfall intensity — $I_{max} = M30\_2hr / D$ = **59.5** mm/hr

Maximum surface water runoff

Catchment area — A_{catch} = **910** m^2

Percentage of area that is impermeable — p = **95** %

Maximum surface water runoff — $Q_{max} = A_{catch} \times p \times I_{max}$ = **14.3** l/s

Calculate depth of flow using iteration of Manning's formula

Minimum depth of flow — x = **87** mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow — $A = (w + x / s) \times x$ = **0.198** m^2

Perimeter of flow — $P = w + 2 \times \sqrt{(x^2 + (x / s)^2)}$ = **2.558** m

Hydraulic radius — $R = A / P$ = **0.077** m

Check flow using Manning equation $Q_{check} = A \times (R / 1\ m)^{2/3} \times S^{1/2} \times 1\ m/s / n =$ **14.4** l/s

Maximum velocity of flow $V_{max} = Q_{max} / A =$ **0.072** m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

Minimum width

Freeboard $d_{free} =$ **150** mm

Minimum required swale width $w_{total,min} = 2 \times (x + d_{free}) / s + w =$ **3.439** m

Storage

Infiltration capacity of the base f = **0.000014** m/s

Flow into swale $V_{in} = Q_{max} \times D =$ **102.9** m^3

Infiltration area of swale (assume flat base only) $A_{infil} = L \times w =$ **300.0** m^2

Infiltration volume of swale $V_{infil} = f \times D \times A_{infil} =$ **29.8** m^3

Interception storage volume required $V_{infil\_req} = V_{in} - V_{infil} =$ **73.1** m^3

Interception storage volume provided $V_{infil\_prov} = L \times w \times d_{outlet} / 2 =$ **7.5** m^3

Interception volume required exceeds volume provided. Additional interception storage will be required.

SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

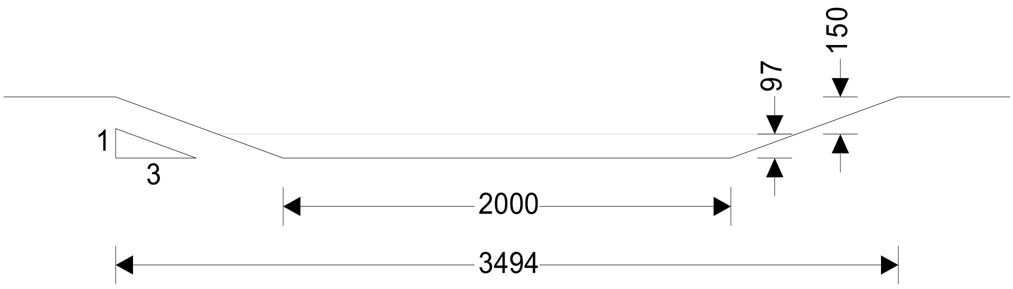
Width of swale base $w = \mathbf{2.000}$ m

Longitudinal gradient of swale $S = \mathbf{0.008}$

Side slope gradient of swale $s = \mathbf{0.330}$

Manning number $n = \mathbf{0.25}$

Length of swale $L = \mathbf{54}$ m



Cross section of swale

Outlet pipe details

Height of outlet pipe above invert $d_{outlet} = \mathbf{50}$ mm

Design rainfall intensity

Location of catchment area Other

Storm duration $D = \mathbf{1}$ hr

Return period Period = **100** yr

Ratio 60 min to 2 day rainfall of 5 yr return period $r = \mathbf{0.276}$

5-year return period rainfall of 60 minutes duration M5_60min = **60.0** mm

Increase of rainfall intensity due to global warming $p_{climate} = \mathbf{20}$ %

Factor Z1 (Wallingford procedure) Z1 = **1.00**

Rainfall for 1hr storm with 5 year return period $M5\_1hr_i = Z1 \times M5\_60min \times (1 + p_{climate}) = \mathbf{72.0}$ mm

Factor Z2 (Wallingford procedure) Z2 = **1.63**

Rainfall for 1hr storm with 100 year return period $M100\_1hr = Z2 \times M5\_1hr_i = \mathbf{117.5}$ mm

Design rainfall intensity $I_{max} = M100\_1hr / D = \mathbf{117.5}$ mm/hr

Maximum surface water runoff

Catchment area $A_{catch} = \mathbf{492}$ m^2

Percentage of area that is impermeable $p = \mathbf{95}$ %

Maximum surface water runoff $Q_{max} = A_{catch} \times p \times I_{max} = \mathbf{15.3}$ l/s

Calculate depth of flow using iteration of Manning's formula

Minimum depth of flow $x = \mathbf{97}$ mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow $A = (w + x / s) \times x = \mathbf{0.221}$ m^2

Perimeter of flow $P = w + 2 \times \sqrt{(x^2 + (x / s)^2)} = \mathbf{2.616}$ m

Hydraulic radius $R = A / P = \mathbf{0.085}$ m

Check flow using Manning equation $Q_{check} = A \times (R / 1\ m)^{2/3} \times S^{1/2} \times 1\ m/s / n =$ **15.3** l/s

Maximum velocity of flow $V_{max} = Q_{max} / A =$ **0.069** m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

Minimum width

Freeboard $d_{free} =$ **150** mm

Minimum required swale width $w_{total,min} = 2 \times (x + d_{free}) / s + w =$ **3.494** m

Storage

Infiltration capacity of the base f = **0.000014** m/s

Flow into swale $V_{in} = Q_{max} \times D =$ **54.9** m^3

Infiltration area of swale (assume flat base only) $A_{infil} = L \times w =$ **108.0** m^2

Infiltration volume of swale $V_{infil} = f \times D \times A_{infil} =$ **5.4** m^3

Interception storage volume required $V_{infil\_req} = V_{in} - V_{infil} =$ **49.6** m^3

Interception storage volume provided $V_{infil\_prov} = L \times w \times d_{outlet} / 2 =$ **2.7** m^3

Interception volume required exceeds volume provided. Additional interception storage will be required.

SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

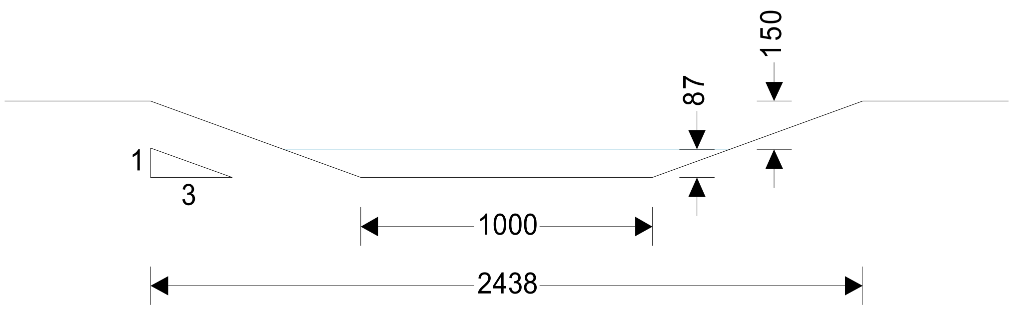
Width of swale base — w = **1.000** m

Longitudinal gradient of swale — S = **0.020**

Side slope gradient of swale — s = **0.330**

Manning number — n = **0.25**

Length of swale — L = **30** m



Cross section of swale

Outlet pipe details

Height of outlet pipe above invert — d_{outlet} = **50** mm

Design rainfall intensity

Location of catchment area — Other

Storm duration — D = **1** hr

Return period — Period = **100** yr

Ratio 60 min to 2 day rainfall of 5 yr return period — r = **0.276**

5-year return period rainfall of 60 minutes duration — M5_60min = **60.0** mm

Increase of rainfall intensity due to global warming — $p_{climate}$ = **20** %

Factor Z1 (Wallingford procedure) — Z1 = **1.00**

Rainfall for 1hr storm with 5 year return period — $M5\_1hr_i = Z1 \times M5\_60min \times (1 + p_{climate})$ = **72.0** mm

Factor Z2 (Wallingford procedure) — Z2 = **1.63**

Rainfall for 1hr storm with 100 year return period — $M100\_1hr = Z2 \times M5\_1hr_i$ = **117.5** mm

Design rainfall intensity — $I_{max} = M100\_1hr / D$ = **117.5** mm/hr

Maximum surface water runoff

Catchment area — A_{catch} = **344** m^2

Percentage of area that is impermeable — p = **95** %

Maximum surface water runoff — $Q_{max} = A_{catch} \times p \times I_{max}$ = **10.7** l/s

Calculate depth of flow using iteration of Manning's formula

Minimum depth of flow — x = **87** mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow — $A = (w + x / s) \times x$ = **0.110** m^2

Perimeter of flow — $P = w + 2 \times \sqrt{(x^2 + (x / s)^2)}$ = **1.557** m

Hydraulic radius — $R = A / P$ = **0.071** m

Check flow using Manning equation $Q_{check} = A \times (R / 1\ m)^{2/3} \times S^{1/2} \times 1\ m/s / n =$ **10.7** l/s

Maximum velocity of flow $V_{max} = Q_{max} / A =$ **0.097** m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

Minimum width

Freeboard $d_{free} =$ **150** mm

Minimum required swale width $w_{total,min} = 2 \times (x + d_{free}) / s + w =$ **2.438** m

Storage

Infiltration capacity of the base f = **0.000014** m/s

Flow into swale $V_{in} = Q_{max} \times D =$ **38.4** m^3

Infiltration area of swale (assume flat base only) $A_{infil} = L \times w =$ **30.0** m^2

Infiltration volume of swale $V_{infil} = f \times D \times A_{infil} =$ **1.5** m^3

Interception storage volume required $V_{infil\_req} = V_{in} - V_{infil} =$ **36.9** m^3

Interception storage volume provided $V_{infil\_prov} = L \times w \times d_{outlet} / 2 =$ **0.8** m^3

Interception volume required exceeds volume provided. Additional interception storage will be required.

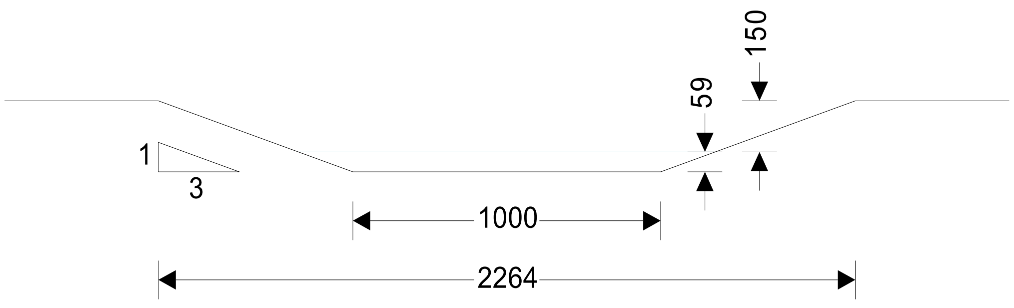
SWALE AND FILTER STRIP DESIGN

In accordance with CIRIA publication C753 - The SUDS Manual

Tedds calculation version 2.0.03

Swale details

Width of swale base	w = **1.000** m
Longitudinal gradient of swale	S = **0.010**
Side slope gradient of swale	s = **0.330**
Manning number	n = **0.25**
Length of swale	L = **18** m



Cross section of swale

Outlet pipe details

Height of outlet pipe above invert	d_{outlet} = **50** mm

Design rainfall intensity

Location of catchment area	Other
Storm duration	D = **1** hr
Return period	Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.276**
5-year return period rainfall of 60 minutes duration	M5_60min = **60.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **20** %
Factor Z1 (Wallingford procedure)	Z1 = **1.00**
Rainfall for 1hr storm with 5 year return period	$M5\_1hr_i = Z1 \times M5\_60min \times (1 + p_{climate})$ = **72.0** mm
Factor Z2 (Wallingford procedure)	Z2 = **1.63**
Rainfall for 1hr storm with 100 year return period	$M100\_1hr = Z2 \times M5\_1hr_i$ = **117.5** mm
Design rainfall intensity	$I_{max} = M100\_1hr / D$ = **117.5** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **120** m^2
Percentage of area that is impermeable	p = **95** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **3.7** l/s

Calculate depth of flow using iteration of Manning's formula

Minimum depth of flow	x = **59** mm

Depth of flow is less than or equal to 100 mm so filtration is effective (cl.17.4)

Area of flow	$A = (w + x / s) \times x$ = **0.069** m^2
Perimeter of flow	$P = w + 2 \times \sqrt{(x^2 + (x / s)^2)}$ = **1.374** m
Hydraulic radius	$R = A / P$ = **0.050** m

Check flow using Manning equation $Q_{check} = A \times (R / 1\ m)^{2/3} \times S^{1/2} \times 1\ m/s / n =$ **3.8** l/s

Maximum velocity of flow $V_{max} = Q_{max} / A =$ **0.054** m/s

PASS - velocity is small enough to encourage settlement and prevent erosion (cl.17.4.1)

Minimum width

Freeboard $d_{free} =$ **150** mm

Minimum required swale width $w_{total,min} = 2 \times (x + d_{free}) / s + w =$ **2.264** m

Storage

Infiltration capacity of the base f = **0.000014** m/s

Flow into swale $V_{in} = Q_{max} \times D =$ **13.4** m^3

Infiltration area of swale (assume flat base only) $A_{infil} = L \times w =$ **18.0** m^2

Infiltration volume of swale $V_{infil} = f \times D \times A_{infil} =$ **0.9** m^3

Interception storage volume required $V_{infil\_req} = V_{in} - V_{infil} =$ **12.5** m^3

Interception storage volume provided $V_{infil\_prov} = L \times w \times d_{outlet} / 2 =$ **0.5** m^3

Interception volume required exceeds volume provided. Additional interception storage will be required.

Roger Mullarkey & Associates

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Address Duncreevan, web:

Project	Glenamuck Nth Site B		
Ref	2411		
Sheet	1		
Date	Jan'26		
By	RM	Revised	

Tree Pit Interception Volume	No.1	
Length	5	m
Width	3.5	m
Storage depth	0.1	m
Interception Volume Available	**1.75**	m^3
Interception Volume Required *	A x 0.8 x I	
Drained Impermeable Area (A)	280	m^2
Rainfall depth (i)	5	mm
Interception Volume Required	**1.12**	m^3
Volume Required =	1.120	**PASS**
Volume Provided =	1.750	
** GDSDS E2.1.1*		

Tree Pit Interception Volume	No.2	
Length	5	m
Width	2	m
Storage depth	0.1	m
Interception Volume Available	**1**	m^3
Interception Volume Required *	A x 0.8 x I	
Drained Impermeable Area (A)	118	m^2
Rainfall depth (i)	5	mm
Interception Volume Required	**0.472**	m^3
Volume Required =	0.472	**PASS**
Volume Provided =	1	
** GDSDS E2.1.1*		

Tree Pit Interception Volume	No.3	
Length	5.000	m
Width	2.000	m
Storage depth	0.100	m
Interception Volume Available	**1.000**	m^3
Interception Volume Required *	A x 0.8 x I	
Drained Impermeable Area (A)	115.000	m^2
Rainfall depth (i)	5.000	mm
Interception Volume Required	**0.460**	m^3
Volume Required =	0.460	**PASS**
Volume Provided =	1.000	
** GDSDS E2.1.1*		

Tree Pit Interception Volume	No.4	
Length	5.000	m
Width	3.100	m
Storage depth	0.100	m
Interception Volume Available	**1.550**	m^3
Interception Volume Required *	A x 0.8 x I	
Drained Impermeable Area (A)	317.000	m^2
Rainfall depth (i)	5.000	mm
Interception Volume Required	**1.268**	m^3
Volume Required =	1.268	**PASS**
Volume Provided =	1.550	
** GDSDS E2.1.1*		

Tree Pit Interception Volume	No.5	
Length	5.000	m
Width	4.750	m
Storage depth	0.100	m
Interception Volume Available	**2.375**	m^3
Interception Volume Required *	A x 0.8 x I	
Drained Impermeable Area (A)	191.000	m^2
Rainfall depth (i)	5.000	mm
Interception Volume Required	**0.764**	m^3
Volume Required =	0.764	**PASS**
Volume Provided =	2.375	
** GDSDS E2.1.1*		

Tree Pit Interception Volume	No.6	
Length	5.000	m
Width	1.500	m
Storage depth	0.100	m
Interception Volume Available	**0.750**	m^3
Interception Volume Required *	A x 0.8 x I	
Drained Impermeable Area (A)	109.000	m^2
Rainfall depth (i)	5.000	mm
Interception Volume Required	**0.436**	m^3
Volume Required =	0.436	**PASS**
Volume Provided =	0.750	
** GDSDS E2.1.1*		

Appendix 11.3

Attenuation Storage Calculations

CubicM3 Stormwater Management System Design Tool

Ver: June 2025

PROJECT REF:	Glenamuck North Site B -2411
PROJECT:	Storage Catchment B1
DATE:	21-Jan-26
CREATED BY:	RM

SYSTEM PARAMETERS

Required Total Storage	1100	m^3
Attenuation Chamber Model	RT-720	
Filtration Permeable Geo or Impermeable Geo	Filter geo - TS1000	
Number of Separator Rows (IR)	1	

SITE PARAMETERS

			Minimum Requirement
Stone Porosity	45%		
Excavation Batter Angle (degrees)	60	°	
Stone Above Chambers	0.3	m	0.15
Stone Below Chambers	0.3	m	0.15 if cover <= 2.5m or 0.2 for bigger cover
In-between Row Spacing	0.15	m	0.15
Additional Storage outside Excavation. E.g manholes, Header Pipe	5	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Perp to IR	
Diameter of Header Pipe	0.6	m
Length of Header Pipe	0	m

CHAMBER SYSTEM DIMENSIONS

	Calculated	Adopted	
Number of Rows		16	ea
Number of units per Row		27	ea
System Installed Storage Depth (effective storage depth)	1.320		m
Tank overall installed Width at base	21.65	22	m
Tank overall installed Length at Base	60.455	60.5	m
Total Effective System Storage	1098.0	1111.3	m^3

SYSTEM DETAIL

Chamber Model	RT-720	
Unit Width	1.15	m
Unit Length	2.175	m
Unit Height	0.72	m
Min Cover Over System	0.3	m
Max Cover Over Chamber	4.5	m
Chamber Internal Storage Vol.	1.16	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

STONE AND EXCAVATION DETAIL

Volume of Dig for System	1841	m^3
Width at base	22.00	m
Width at top	23.52	m
Length at base	60.50	m
Length at top	62.02	m
Depth Of System	1.32	m
Area of Dig at Base of System	1331	m^2
Area of Dig at Top of System	1459	m^2
Void Ratio	60%	
Stone Requirement - m3	1337	m^3
Stone Requirement - tonne	2025	tonne

SYSTEM ITEM LIST

Item	Product	Calculated	Adopted	unit	€/unit	Total	Comments
Storage							
Chamber Type	RT-720	432	432	ea	€ -	€ -	
Endcap Type	RT-720 ec	32	32	ea	€ -	€ -	

CubicM3 Stormwater Management System Design Tool

Ver: June 2025

PROJECT REF:	Glenamuck North Site B -2411
PROJECT:	Storage Catchment B2
DATE:	21-Jan-26
CREATED BY:	RM

SYSTEM PARAMETERS

Required Total Storage	173	m^3
Attenuation Chamber Model	RT-720	
Filtration Permeable Geo or Impermeable Geo	Filter geo - TS1000	
Number of Separator Rows (IR)	1	

SITE PARAMETERS

			Minimum Requirement
Stone Porosity	45%		
Excavation Batter Angle (degrees)	60	°	
Stone Above Chambers	0.3	m	0.15
Stone Below Chambers	0.3	m	0.15 if cover <= 2.5m or 0.2 for bigger cover
In-between Row Spacing	0.15	m	0.15
Additional Storage outside Excavation. E.g manholes, Header Pipe	5	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Perp to IR	
Diameter of Header Pipe	0.6	m
Length of Header Pipe	0	m

CHAMBER SYSTEM DIMENSIONS

	Calculated	Adopted	
Number of Rows		4	ea
Number of units per Row		14	ea
System Installed Storage Depth (effective storage depth)	1.320		m
Tank overall installed Width at base	6.05	6.1	m
Tank overall installed Length at Base	32.18	32.2	m
Total Effective System Storage	174.6	175.7	m^3

SYSTEM DETAIL

Chamber Model	RT-720	
Unit Width	1.15	m
Unit Length	2.175	m
Unit Height	0.72	m
Min Cover Over System	0.3	m
Max Cover Over Chamber	4.5	m
Chamber Internal Storage Vol.	1.16	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

STONE AND EXCAVATION DETAIL

Volume of Dig for System	299	m^3
Width at base	6.10	m
Width at top	7.62	m
Length at base	32.20	m
Length at top	33.72	m
Depth Of System	1.32	m
Area of Dig at Base of System	196	m^2
Area of Dig at Top of System	257	m^2
Void Ratio	59%	
Stone Requirement - m3	233	m^3
Stone Requirement - tonne	353	tonne

SYSTEM ITEM LIST

Item	Product	Calculated	Adopted	unit	€/unit	Total	Comments
Storage							
Chamber Type	RT-720	56	56	ea	€ -	€ -	
Endcap Type	RT-720 ec	8	8	ea	€ -	€ -	

CubicM3 Stormwater Management System Design Tool

Ver: June 2025

PROJECT REF:	Glenamuck North Site B -2411
PROJECT:	Storage Catchment B3
DATE:	21-Jan-26
CREATED BY:	RM

SYSTEM PARAMETERS

Required Total Storage	102	m^3
Attenuation Chamber Model	RT-720	
Filtration Permeable Geo or Impermeable Geo	Filter geo - TS1000	
Number of Separator Rows (IR)	1	

SITE PARAMETERS

			Minimum Requirement
Stone Porosity	45%		
Excavation Batter Angle (degrees)	60	°	
Stone Above Chambers	0.3	m	0.15
Stone Below Chambers	0.3	m	0.15 if cover <= 2.5m or 0.2 for bigger cover
In-between Row Spacing	0.15	m	0.15
Additional Storage outside Excavation. E.g manholes, Header Pipe	5	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Perp to IR	
Diameter of Header Pipe	0.6	m
Length of Header Pipe	0	m

CHAMBER SYSTEM DIMENSIONS

	Calculated	Adopted	
Number of Rows		3	ea
Number of units per Row		8	ea
System Installed Storage Depth (effective storage depth)	1.320		m
Tank overall installed Width at base	4.75	6	m
Tank overall installed Length at Base	19.13	20	m
Total Effective System Storage	85.9	104.2	m^3

SYSTEM DETAIL

Chamber Model	RT-720	
Unit Width	1.15	m
Unit Length	2.175	m
Unit Height	0.72	m
Min Cover Over System	0.3	m
Max Cover Over Chamber	4.5	m
Chamber Internal Storage Vol.	1.16	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

STONE AND EXCAVATION DETAIL

Volume of Dig for System	186	m^3
Width at base	6.00	m
Width at top	7.52	m
Length at base	20.00	m
Length at top	21.52	m
Depth Of System	1.32	m
Area of Dig at Base of System	120	m^2
Area of Dig at Top of System	162	m^2
Void Ratio	56%	
Stone Requirement - m3	157	m^3
Stone Requirement - tonne	238	tonne

SYSTEM ITEM LIST

Item	Product	Calculated	Adopted	unit	€/unit	Total	Comments
Storage							
Chamber Type	RT-720	24	24	ea	€ -	€ -	
Endcap Type	RT-720 ec	6	6	ea	€ -	€ -	

STORMWATER MANAGEMENT SYSTEMS

PRODUCT BROCHURE

CubicM3, a leader in sustainable stormwater management with over two decades of international expertise, introduces RainSafe, an innovative range of attenuation chambers crafted for sustainable and efficient stormwater management. With thousands of systems installed across three continents, CubicM3 has leveraged its extensive experience to develop RainSafe in collaboration with top-tier global specialists in geotechnical engineering, structural analysis, design for manufacture, and product testing. Utilizing cutting-edge Finite Element modeling, the chambers are optimized for structural efficiency and durability.

Manufactured in Europe through precision injection molding, RainSafe ensures uniform wall thickness and exceptional quality, meeting or surpassing stringent European and national standards such as Eurocode, ASTM, and CIRIA. The product has undergone exhaustive independent material and performance testing to secure CSTB certification, affirming its reliability.

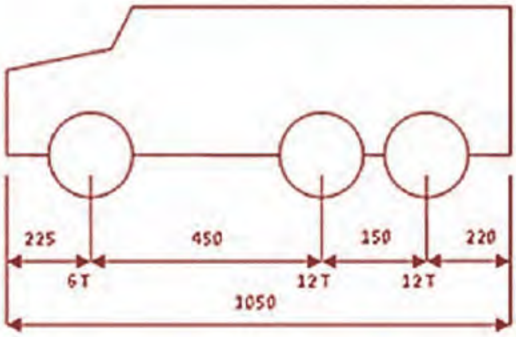
Rainsafe Chambers Key Features :

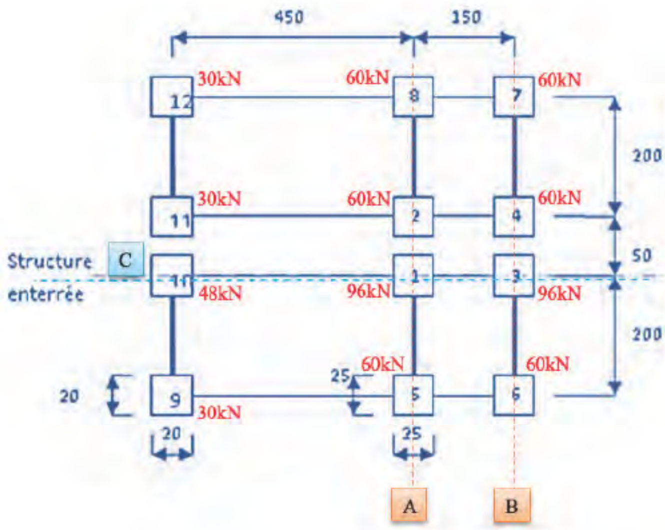
- ***Industry-leading structural capacity*** for both live traffic loads (e.g., heavy vehicles) and long-term dead loads in deep cover scenarios.
- ***CSTB certification ensure full compliance with relevant European*** and local regulatory codes.
- ***Modular design with innovative button-tab features*** enables rapid, adaptable assembly on-site, saving time and labor.
- ***Environmentally conscious European production*** reduces carbon footprint, with optimized sizing for containerized shipping and compact storage.
- ***Lightweight design (RT-1140 weighs under 50 kg)*** with integrated handles ensures compliance with European health and safety manual handling regulations, allowing safe lifting by two operatives.
- ***A dedicated Filtration and Maintenance Row captures suspended solids,*** offering easy access for cost-effective maintenance to maintain tank performance and enhance discharge water quality.
- ***Built-in vents prevent air entrapment,*** ensuring maximum storage capacity is always available.
- ***Swift lead times,*** with delivery possible within as little as one week from order placement.

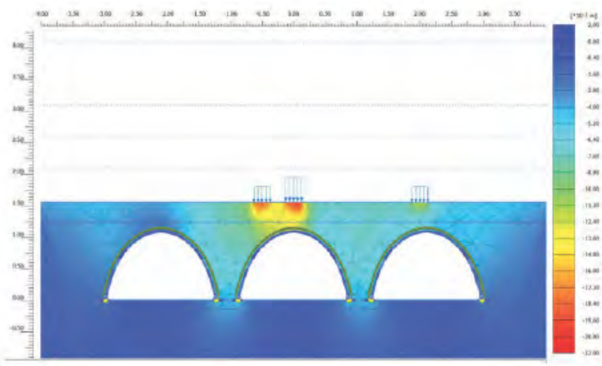
CUBICM³

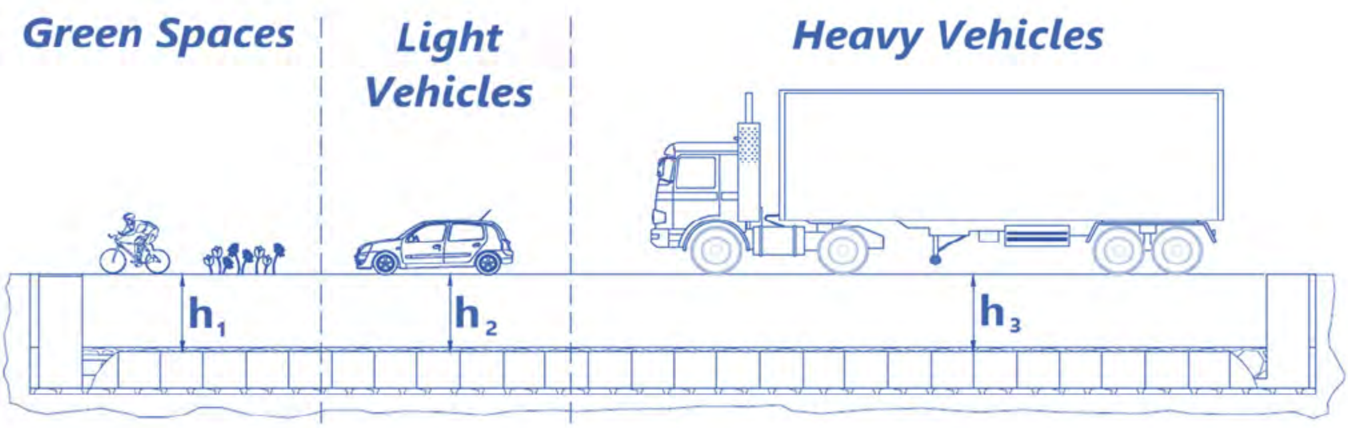
Structural Performance:

RainSafe is engineered to excel under the most rigorous structural demands, adhering to the strictest interpretation of Eurocode LM1 and LM2 vehicle loading scenarios, as outlined in the French Fascicule F70 Standard. This includes simulations of multiple vehicles exerting simultaneous vertical and horizontal forces, as well as traffic moving in varied directions—factors often overlooked in less comprehensive guidelines like ASTM and CIRIA. These alternative standards typically impose lower surface pressure requirements, yet RainSafe's unique design surpasses them all. Independently evaluated and certified by CSTB, RainSafe significantly exceeds these loading benchmarks, making it an ideal solution for high-traffic areas such as roadways and logistics parks, as well as deep-burial installations.







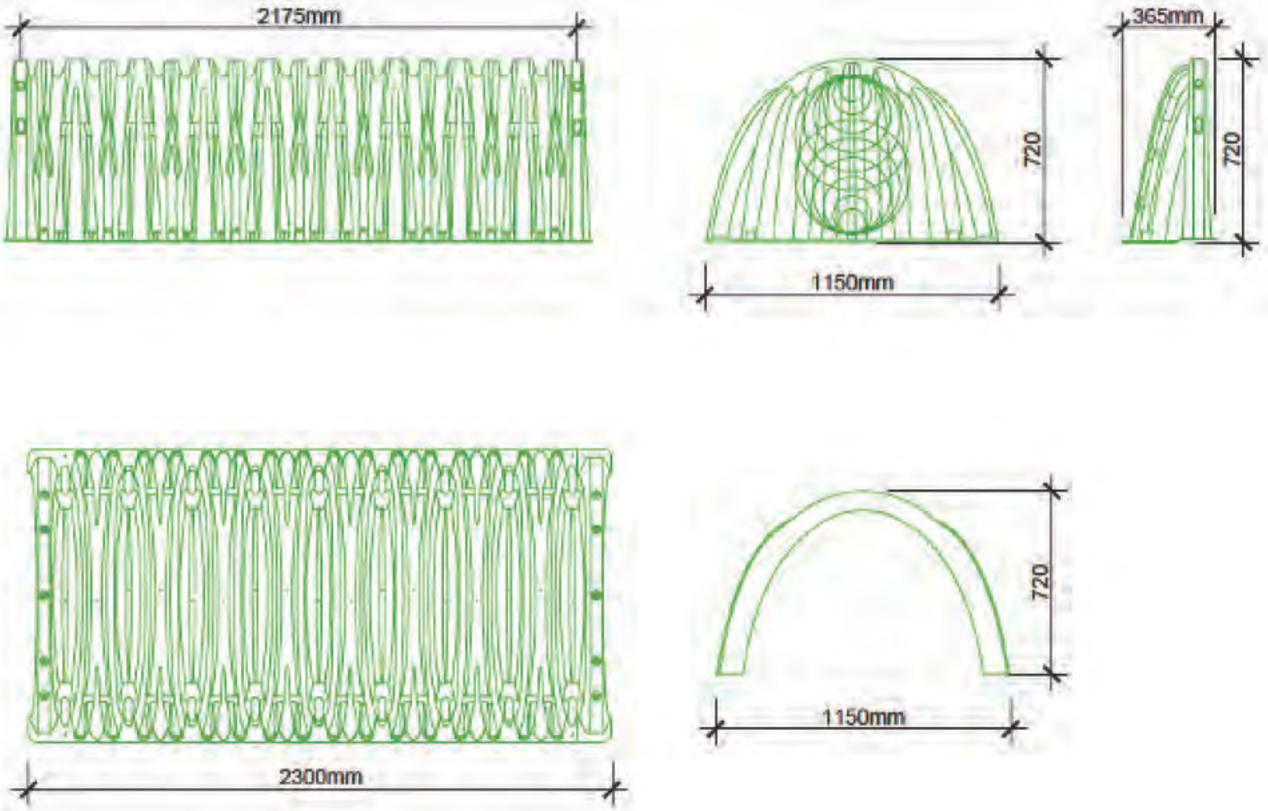


RainSafe RT-720 Chamber Specifications

RainSafe RT-720 chambers were developed by CubicM3 to provide the ideal solution for managing stormwater in virtually all scenarios faced by developers, engineers and contractors. Designed to exceed the most demanding European industry standards, RainSafe RT-720 chambers combine market-leading structural performance with cost-efficiency and ease of use. Capability of supporting HGV traffic (LM1 and LM2) and deep cover loads requirements make RainSafe chambers the best in the market.

RainSafe RT-720 Nominal Specifications:	
Dimensions(L x W x H)	2175 x 1150 x 720 mm
Chamber Capacity	1.16 m^3
Weight	25.2 kg
Min. Base Stone*	150 - 200 mm
Min. Stone Above	150 mm
Min. Row Spacing	150 mm
Min. Total Cover**	450 mm
Max. Total Cover	4500 mm

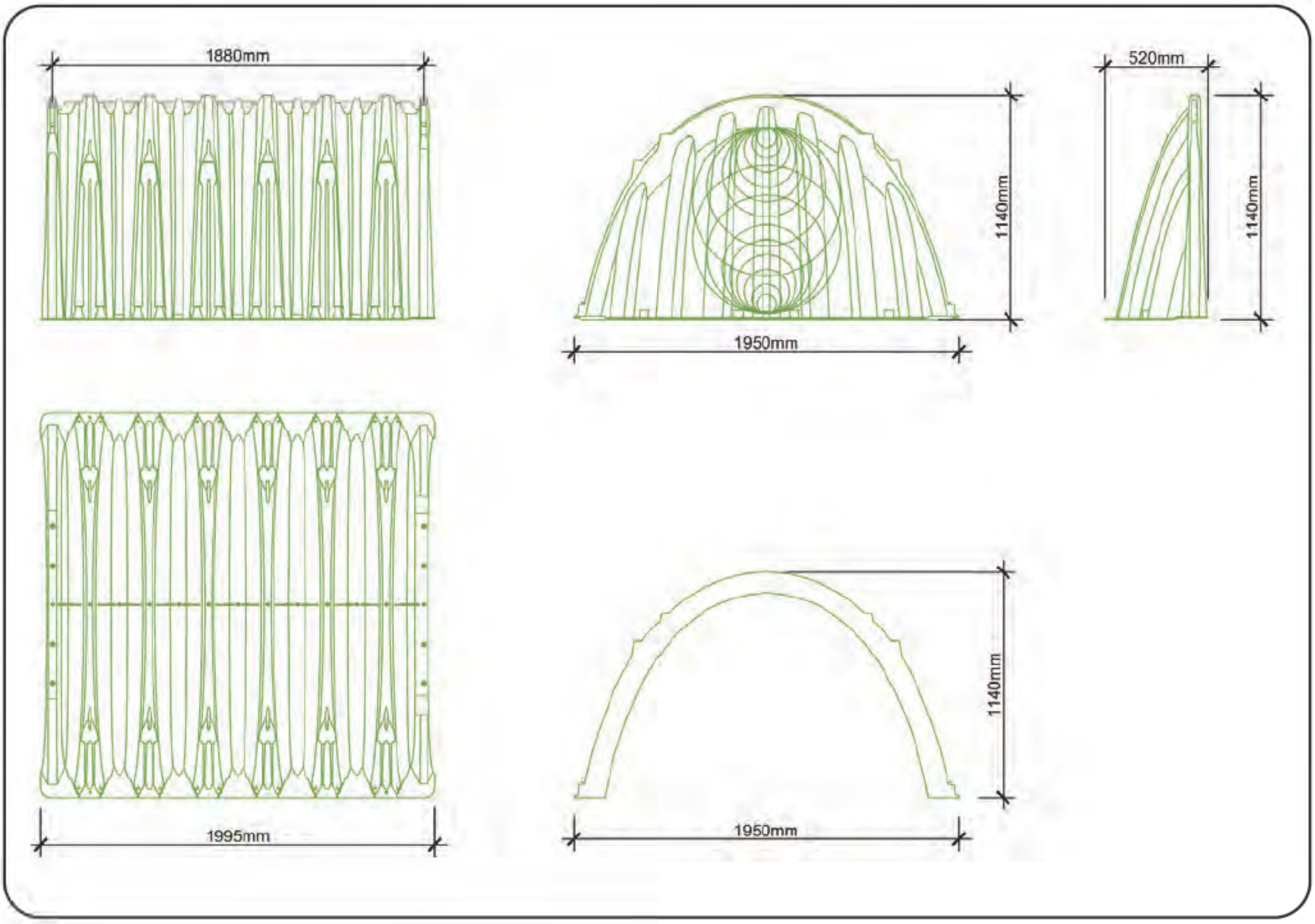
*Base stone depth varies with total cover depth
**Min cover is to support HGV traffic



RainSafe RT-1140 Chamber Specifications

RainSafe RT-1140 chambers were developed by CubicM3 to provide the ideal solution for managing stormwater in virtually all scenarios faced by developers, engineers and contractors. Designed to exceed the most demanding European industry standards, RainSafe RT-720 chambers combine market-leading structural performance with cost-efficiency and ease of use. Capability of supporting HGV traffic (LM1 and LM2) and deep cover loads requirements make RainSafe chambers the best in the market.

RainSafe RT-1140 Nominal Specifications:	
Dimensions(L x W x H)	1880 x 1950 x 1140 mm
Chamber Capacity	2.67 m^3
Weight	48.75 kg
Min. Base Stone*	200 - 250 mm
Min. Stone Above	150 mm
Min. Row Spacing	300 mm
Min. Total Cover**	450 mm
Max. Total Cover	4000 mm
*Base stone depth varies with total cover depth **Min cover is to support HGV traffic	



Structural rigidity and maximum allowable construction loads

Rainsafe storm attenuation systems from Cubic M3 are engineered for strength and durability, offering exceptional load-bearing performance in even the most demanding environments. Designed to withstand the weight of heavy machinery and traffic, Rainsafe is ideal for installation beneath car parks, roadways, and commercial yards.

Whether exposed to occasional HGV movements or constant industrial operations, the system's **robust modular structure** ensures long-term stability without compromise. Independent load testing confirms that Rainsafe meets and exceeds relevant structural standards, giving you **peace of mind and flexibility** in project planning.

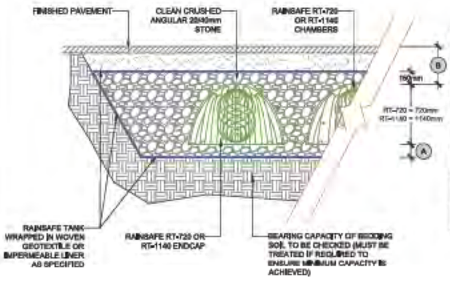
With Rainsafe, there's no need to limit your surface usage—**functionality above ground doesn't come at the expense of performance below.**

Zone	Fill Depth over Chambers	Maximum Allowable Wheel Loads		Maximum Allowable Track Loads		Max Allowable Roller Loads
		Max Axle Load Kg(kN)	Max Wheel Loads	Track Width	Max Ground Pressure (kPa)	Max Drum Weight or Dynamic Force Kg(kPa)
Surround Stone	Upto 150mm	3,500 (35)	Not Allowed	Not Allowed	Not Allowed	Not Allowed
	150mm to 300mm	7,000 (70)	Not Allowed	300 450 600 750	55 35 35 30	Drum weight no to exceed 1,350 kgs Max allowable pressure 55 kPa
Initial Fill Material	300mm to 450mm	15,000 (150)	7,000 (70)	300 450 600 750	100 75 60 55	Drum weight no to exceed 2,500 kgs Max allowable pressure 104 kPa
	450mm to 600mm Loose	15,000 (150)	7,000 (70)	300 450 600 750 900	110 80 65 55 50	Drum weight no to exceed 8,000 kgs Max allowable pressure 182 kPa
	450mm to 600mm Compacted	15,000 (150)	7,000 (70)	300 450 600 750 900	120 85 70 60 55	Drum weight no to exceed 10,000 kgs Max allowable pressure 233 kPa
Final Fill Material	450mm to 900mm Compacted	15,000 (150)	7,000 (70)	300 450 600 750 900	165 115 90 75 65	17,500 (170)

Easy Inspection & Efficient Cleaning

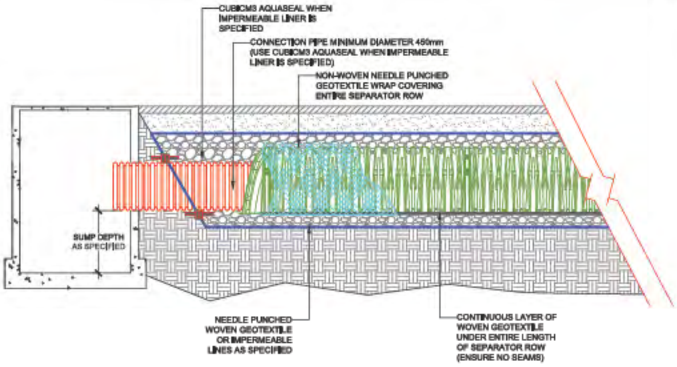
Cubic M3's **Rainsafe system** is designed with **quick, visual inspections and access for maintenance** in mind—allowing users to assess sediment build-up easily without the need for invasive procedures. When maintenance is needed, the **straightforward jetting process** makes cleaning simple, effective, and fast. Using a self-propelling jetting unit, silt and debris are efficiently flushed and removed, ensuring optimal system performance.

Photographic records and maintenance logs help track system condition over time, making it easier to **optimise inspection schedules** and **reduce unnecessary servicing**. With clear guidance and minimal disruption, Rainsafe helps keep your stormwater system operating smoothly and compliantly.



BED AND COVER DEPTHS

REQUIREMENT	RT-720	RT-1140	DRAWING REFERENCE
TOTAL COVER UP TO 2500mm	150mm	250mm	A
TOTAL COVER OVER 2500mm	200mm	[illegible]	
MIN. COVER (GREEN AREA)	450mm		B
MIN. COVER (TRAFFICABLE AREA)	[illegible]		
MAX. COVER	[illegible]	[illegible]	



Full Engineering Design Support

Ver: May 2025

+353-1-808 4330 www.cubicm3.com sales@cubicm3.com

RainSafe Technical Notice and FAQs

June 2025

To Whom it May Concern,

CubicM3 is the leading provider of products and solutions in the Stormwater management sector in Ireland. We are very proud to present RainSafe, our own range of attenuation chambers, to the Irish market.

For over 20 years we have been sourcing and promoting leading products from reputable suppliers and over that time we have built up considerable expertise in the sector. This was recognised in 2019 when CubicM3 was asked to review BS 9298 prior to its publication in 2020. In 2022 we decided to develop our own product range with the intent of incorporating various innovations and improvements and providing a superior solution specifically designed for and manufactured in Europe. As you may be aware, earlier this year CubicM3 began offering RainSafe chambers for stormwater management systems.

We developed RainSafe from the outset with several objectives:

- Improve structural efficiency and performance;
- Design in Europe to European codes and standards (in particular the updated application of LM1 and LM2, which is significantly more stringent than the old interpretations);
- Manufacture in Europe for reduced carbon footprint;
- Optimise sizing for transport and handling.

This development process was carried undertaken in the context of the new ISO-4982 and working closely in conjunction with CSTB who from prior experience are the most experienced and stringent national standards authority for stormwater management products. For reference, the CSTB approval was the underpinning approval, under which we marketed Stormtech for years and was the base approval for Stormtech's BBA and DIBt certificates. We also worked closely with Ireland's leading geotechnical firm, Advanced Geotechnics Ltd, to provide finite element modelling and independent analysis of the structural performance of RainSafe chambers.

CSTB's review of RainSafe generally made reference to the testing and performance requirements detailed in ISO-4982, except where their existing requirements were already more stringent and included:

- Raw material testing for both short and long term properties,
- Product testing per ISO-4982,
- Detailed review of structural analyses and modelling,
- Production facilities and quality control measures,
- Installation and Maintenance guidelines.

RainSafe meets or exceeds all the necessary specifications and outperforms other comparable products in all relevant parameters. We are confident the testing and analyses of our products has been more thorough and in compliance with the latest standards than other products on the market today.

We recognise that given RainSafe is a new product, our clients and their consultant engineers will have questions and will need to carry out due diligence to satisfy themselves as to RainSafe suitability for use on their projects. To assist in this, in addition to the standard material we are issuing with our proposals – CSTB cert, Product Brochure, Installation and Maintenance Guidelines, etc we are providing the following answers to some frequently asked questions (FAQs) appended below.

CubicM3 is extremely proud of the RainSafe and if you have a query or concern that is not addressed below, please contact us and we would be happy to address this directly with you.

Yours sincerely,

Justin Elliott,
Managing Director, CubicM3 and RainSafe
CEng, MBA, BA, BAI

RAINSAFE™ STORMWATER MANAGEMENT SYSTEMS

CUBICM³ SUSTAINABLE ENGINEERING SOLUTIONS

Frequently Asked Questions

Is RainSafe able to take Traffic Loading?

RainSafe is the strongest attenuation system in the market and is suitable for use in areas subject to Heavy Goods Vehicle traffic and Emergency Vehicle loading. There are numerous design codes and standards that apply to assessing structural capacities of buried structures. We had RainSafe independently assessed by AGL Consulting who demonstrated compliance with French Bc Convoi Loading (as specified in Fascicules 61 & 70). We selected the French standard because it is more realistic in that it assesses multiple wheel loads simultaneously and in un-balanced configurations, significantly exceeding the loading regimes under the pan-European LM1 and LM2 loading regimes. RainSafe complies with all these standards with significant factors of safety when installed correctly.

What plant can be used above RainSafe tanks during construction?

In general once the specified minimum levels of cover are in place RainSafe can take typical construction traffic loading. However, if construction traffic is expected to transit a RainSafe tank in advance of final surfacing being in place it may be necessary to provide a means to prevent rutting impacting effective cover during wet periods. Similarly, suitable measures may be required for construction plant that use outriggers or generate abnormally concentrated loads. CubicM3 has extensive experience in this area and can provide assistance with for non-standard loading situations.

How deep can you bury RainSafe chambers?

RainSafe was specifically designed to provide market-leading structural performance. RainSafe RT-720s is approved to carry up to 4.5m and up to 4.0m of cover at a minimum chamber spacing of 150mm for RT-1140s.

Are RainSafe chamber walls thinner than some other chambers and is this a problem?

Yes, some other chambers have thicker walls than RainSafe. However, wall thickness is not a relevant engineering consideration in its own right. It is included as a criteria in certain design codes, originally drafted nearly 20 years ago. Since then it has ceased to be relevant under engineering consideration.

Wall thickness is a contributing factor to both structural capacity and impact resistance but is not the only metric that should be taken into consideration. CSTB do not consider wall thickness in isolation in their evaluation of attenuation arches. RainSafe has been determined to meet and exceed the requirements for both structural capacity and impact resistance.

RainSafe's structural performance was independently evaluated by Advanced Geotechnics Ltd (Ireland's leading geotechnical consulting engineers) and verified by CSTB to meet Eurocode 1 traffic loads (LM1 and LM2) meaning it considerably exceeds the structural capacity of other chambers on the market both for live loading and deep burial. AGL used Eurocode 7 in their evaluation which is more onerous than the ASTM code F2787.

Where is RainSafe made?

RainSafe was designed in Ireland and is manufactured by injection moulding in France in one of the most advanced manufacturing facilities of its kind in Europe. Manufacturing in France enables us to serve the European market with a much smaller carbon footprint and a significantly reduced lead-time than competing products in the market being imported from Asia and the US

Is RainSafe manufactured in an ISO certified factory?

ISO QA systems are one of many systems that may be used for controlling and measuring quality in manufacturing. CSTB has assessed the RainSafe quality assurance program that is in place for the manufacture for RainSafe (in exactly the same way they would in an ISO facility) and deemed it to be appropriate and adequate to ensure the necessary quality and performance criteria are maintained. Under CSTB certification this quality plan is subject to regular audit by QB.

If RainSafe is a new product, how can we be sure of its long term capabilities?

Long term deep burial was a requirement when design codes for corrugated arches were originally drafted nearly 20 years ago. Over the years, testing methods have been developed to enable highly accurate prediction of long-term structural performance of polymers. The high-quality virgin polypropylene material qualified for use in RainSafe underwent rigorous testing as required under ISO 4982 (ISO 899-2) the new International Standard governing Arch-shaped, corrugated wall chambers and also under ASTM 6992, a well-established methodology, relied on for years by other leading products in the industry, including Stormtech and recycled polymer pipe products. Again, the results of these tests were evaluated and accepted by CSTB.

Has RainSafe been used before in Ireland?

RainSafe has been approved by consulting engineers and adopted in over 200 projects to date in Ireland and the UK. These include installations for county councils and other public sector clients, on projects multinationals and other mission-critical installations such as at airports and power stations.

What is the Design Life of RainSafe chambers

The standard design is the same as for plastic pipes where the Factor of Safety for RainSafe is verified as sufficient at 50 years. Please contact CubicM3 if your project requires an extended design life.

How easy is it to install RainSafe tanks?

RainSafe chambers were designed for ease of use and handling. Their modular design means tanks can be designed to meet virtually any site layout. The chambers come stacked on pallets for compact storage on site. For installation the chambers fit together to from storage tunnels within the tank. Based on years of experience of installing attenuation tanks we included features to help make installation easier and more accurate such as lifting handles on the larger RT-1140 model, which we also kept under 50kg to allow a safe two-man lift and locating buttons on the overlap joins to ensure a firm connection.

Can RainSafe tanks be used for Soakaways?

Yes, this is a very common application also known as *detention* storage. Simply wrapping a RainSafe tank in a permeable geotextile will allow Stormwater held in the tank to permeate into the surrounding soil. Thanks to RainSafe's Separator Row stormwater can infiltrate through the floor of the tank as well as the walls. This is different to and an improvement over traditional methods where infiltration through the floor is excluded from consideration due to potential silt build-up.

Can RainSafe tanks be made to be impermeable?

RainSafe tanks can be designed for *retention* storage where it is required to prevent stormwater from infiltrating into the surrounding ground. This can be achieved using Geo-synthetic Clay Liners (GCLs) or High-density Polyethylene (HDPE) liners. CubicM3 has extensive experience working with both types of liners but in general our customers have a preference for GCLs due to their ease of use.

How close can RainSafe be installed to buildings and structures?

As with all buried stormwater management systems, due care needs to be taken for installations in close proximity to buildings and structures. For tanks with permeable outer membranes (ie soakaway-type systems), these should be kept a minimum of 5m from the nearest structural elements that are founded in the surrounding soil. It is possible to install closer than this with impermeable membranes with appropriate design consideration.

Do RainSafe Tanks provide any water treatment?

Yes. Our Separator Row provides a means of capturing any remaining water-borne silt or suspended solids that have not been removed by upstream measures, retaining them and preventing them from reducing the hydraulic performance of the tank. The Separator Row enables easy access for inspection and maintenance and removal of any build of material that accumulates over time. CubicM3 previously commissioned the Scottish Environmental Protection Agency to carry out an independent evaluation of a similar system that concluded that over 90% of suspended solids are captured in this way. Please refer to the RainSafe Operation and Maintenance manual for further information.

Is RainSafe CE certified?

There is no CE in place yet for corrugated arch chambers so it is not yet possible to provide a CE mark for RainSafe. In these cases where CE marking is not available, products intended for use in the Irish Construction Industry must be evaluated by a recognized EU national standards authority. Therefore, the CSTB provide the necessary Technical Opinion that RainSafe complies with their requirements and is suitable for use .

Does RainSafe carry BBA Certification?

No. As we developed RainSafe after Brexit had occurred we opted to use CSTB for certification as they provide EU recognized standards and are the most experienced national standards authority at evaluating corrugated arch attenuation systems and carry out the most rigorous evaluations.

Whats the difference between CSTB and NSAI?

Both organisations are national standards authorities. We decided to work with CSTB from the outset for two reasons. First, from our experience of working with CSTB on Stormtech, we knew that CSTB have extensive experience working with corrugated arch attenuation chambers and provide the most stringent assessment requirements for certification and we wanted to use this to demonstrate RainSafe's superior performance. Second, it made sense to work with CSTB as we manufacture RainSafe in France and it is easier for them to carry out quality audits on our manufacturing facilities.

If RainSafe is new, how can we be sure of its long-term performance?

Over the years testing methods have been developed to enable highly accurate prediction of long-term structural performance of polymers. The polypropylene material qualified for use in RainSafe underwent rigorous testing as required under ISO 4982 (ISO 899-2)the new International Standard governing Arch-shaped, corrugated wall chambers and also under ASTM 6992, a well-established methodology, relied on for years by other leading products in the industry, including Stormtech.

Has RainSafe undergone a 10,000 hour test?

This is not required under ISO 4982. By using the methodology prescribed in that standard and others such as ASTM 6992, the certifying national and European standards authorities, such as CSTB, can evaluate long-term structural performance with confidence and without the need for extended sites testing.

What is the Design Life of RainSafe chambers

The standard design life for RainSafe is 50 years. However, it is possible to extend this up to 120 years based on project-specific information. Please contact CubicM3 if your project requires and extended design life.

What is ISO 4982 and why is it important?

ISO 4982 was introduced in 2023 to provide clarity on the requirements for injection moulded corrugated arch-shaped chambers to be used in underground systems for retention, detention, transportation and storage of non-potable water (eg stormwater). While these types of stormwater products have been used for many years there has been a lack of such a unified standard and ISO 4982 is seen as a first step towards being able to introduce a CE mark for this type of product.

Why doesn't RainSafe have a CE mark?

At present CE marking is not available for arch-shaped attenuation systems as there has not been a unified standard in place against which to certify them. With the introduction of ISO-4982 in 2023 we expect that this situation will change in the near future. However, in the absence of a CE mark, CubicM3 developed RainSafe in compliance with all the relevant European and US standards and obtained the French CSTB certification as this is generally accepted as the most stringent assessment available for these types of products.

What warranty does CubicM3 offer for RainSafe installations

We provide a standard limited 10-year warranty on all installations.

RAINSAFE™
STORMWATER MANAGEMENT SYSTEMS

CUBICM³
SUSTAINABLE ENGINEERING SOLUTIONS

Does CubicM3 carry out its own design and does it have Professional Indemnity cover?

We have a dedicated team of qualified and experienced engineers and technicians and over the years we have developed a reputation for value engineering and reliability. This is why over 70% of our business is with repeat customers. We carry our own Professional Indemnity cover of €1.5m.

What are the dimensions and storage capacity of RainSafe chambers?

RainSafe currently offers two chamber types as follows:

- RT-720 L: 2175mm x W: 1150mm x H: 720mm, providing 1.16m³ storage and weighing 26.4kg,
- RT-1140 L: 1880mm x W: 1950mm x H: 1140mm, providing 2.67m³ storage and weighing 48.5kg.

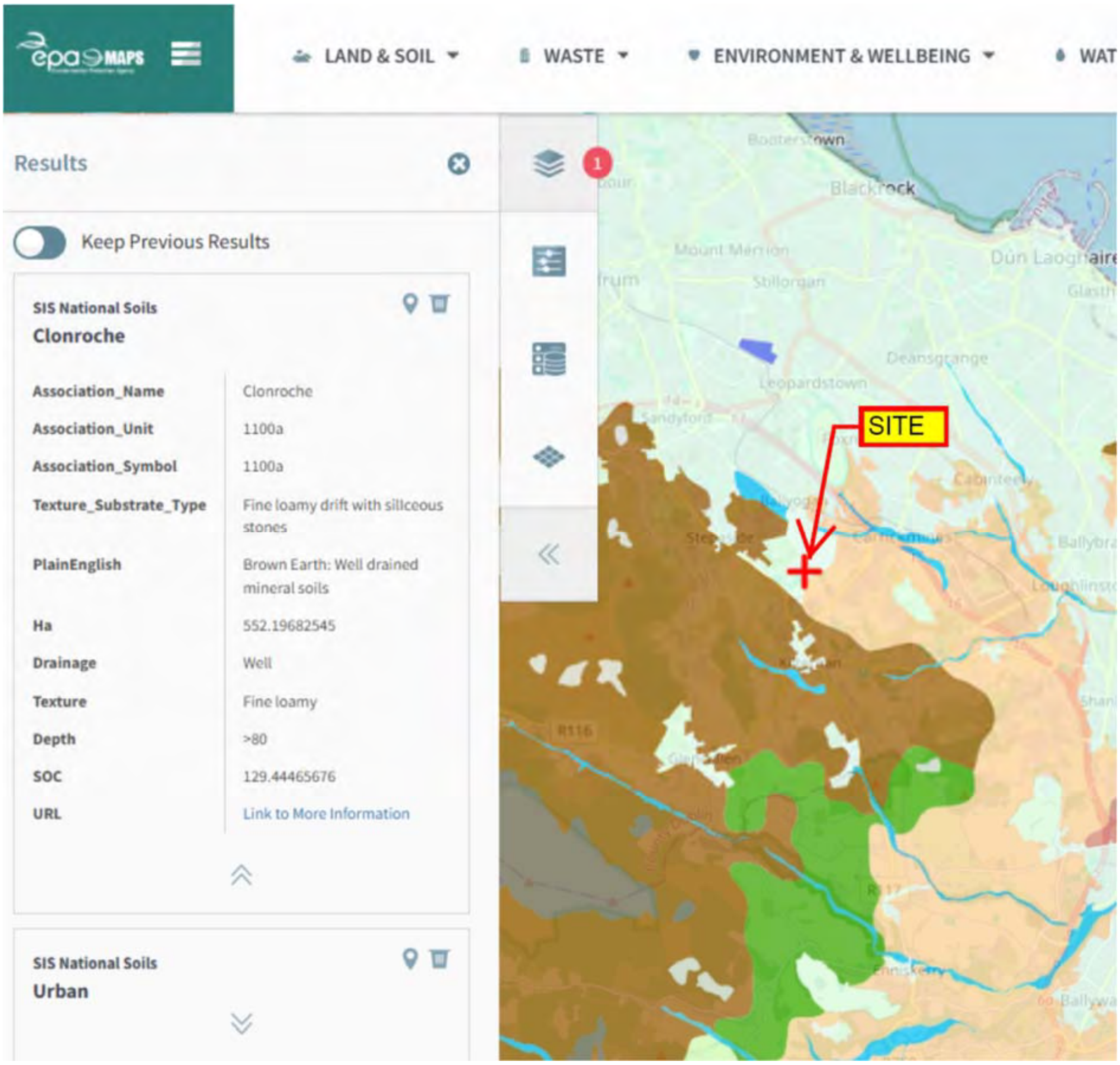
(Please refer to the RainSafe website at www.rainsafe.ue for product literature and further information)

Does CubicM3 do CPDs for RainSafe?

Yes – we are a Registered CPD Training Provider with Engineers Ireland and would be glad to set up a CPD with your team. This can be arranged by contacting sales@cubicm3.com

Appendix 11.4

SPR Soil Derivation Data



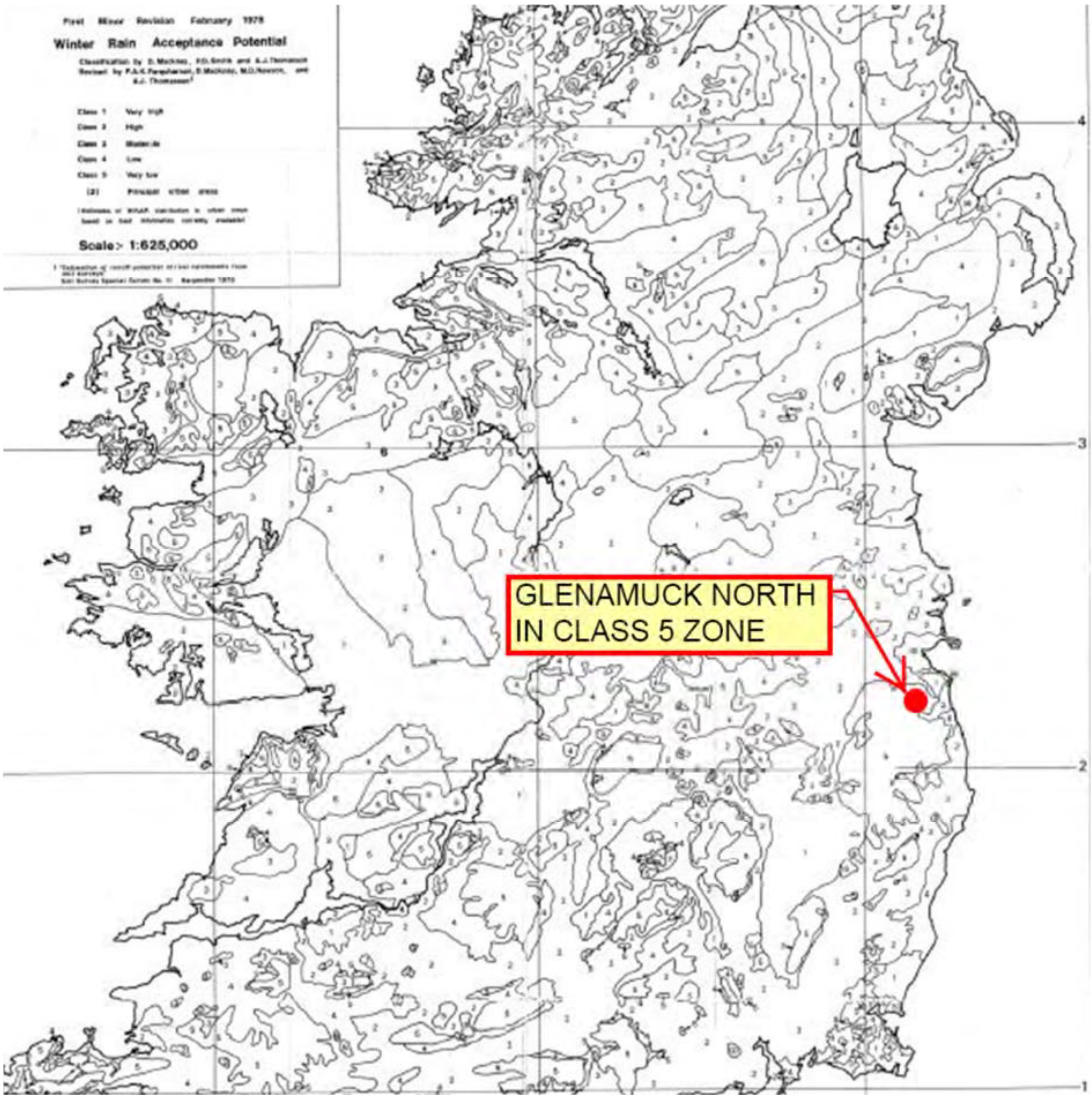
GSI/Teagasc Soil Data

Using the results of the site investigation trial holes as well as the Teagasc data sets noted previously, a Soil class of S3 ort S4 could be interpolated.

FSR Soil Indices	
Soil Type 1	Well drained permeable sandy or loamy soils and shallower analogues over highly permeable limestone, chalk, sandstone, and related drifts. Earth peat soils drained by dykes and pumps Less permeable loamy over clayey soils on plateaux adjacent to very permeable soils in valleys
Soil Type 2	Very permeable soils with shallow ground water Permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils. Moderately permeable soils, some with slowly permeable sub-soils
Soil Type 3	Relatively impermeable soils in boulder and sedimentary clays, and in alluvium. Permeable soils with shallow ground water in low lying areas. Mixed areas of impermeable and permeable soils in approximately equal proportions.
Soil Type 4	Clayey, or loamy over clayey soils with an impermeable layer at shallow depth.
Soil Type 5	Soils of wet uplands with peaty or humose surface horizons and impermeable layers at shallow depth Deep raw peat associated with gentle upland slopes or basin sites Bare rock cliffs and screes (iv) shallow, permeable rocky soils on steep slopes.

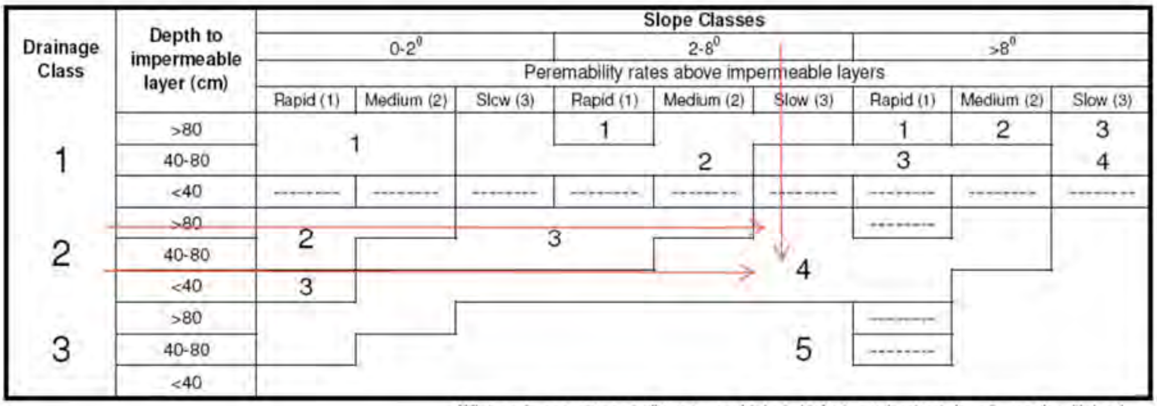
Flood Studies Report

Based on the above definitions a SOIL Type 3 or 4 could be chosen for the Glenamuck North development site



Winter Rain Acceptance Potential (WRAP) Map

Based on the WRAP map a SOIL value of 5 could be interpreted but is not applied for this site. It is noted that SOIL type 5 is rarely applied and is more associated with exposed rock or peat wetlands.



Winter rain acceptance indices:1, very high; 2, high; 3, moderate; 4, low; 5, very low Upland peat and peaty soils are in Class 5. Urban areas are unclassified.

Flood Studies Report (FSR)

From the FSR table, reproduced above showing the noted drainage and slope classes, the Soil type could be interpolated between a type 4 and a type 3.

General soil description	Runoff potential	Soil class
Well drained sandy, loamy or earthy peat soils Less permeable loamy soils over clayey soils on plateaux adjacent to very permeable soils in valleys	Very low	S_1
Very permeable soils (e.g. gravel, sand) with shallow groundwater Permeable soils over rocks Moderately permeable soils some with slowly permeable subsoils	Low	S_2
Very fine sands, silts and sedimentary clays Permeable soils (e.g. gravel, sand) with shallow groundwater in low lying areas Mixed areas of permeable and impermeable soils in similar proportions	Moderate	S_3
Clayey or loamy soils	High	S4
Soils of the wet uplands: Bare rocks or cliffs Shallow, permeable rocky soils on steep slopes Peats with impermeable layers at shallow depth	Very high	S_5

Transport Infrastructure Ireland -TII publication Drainage of Runoff from Natural Catchments 2015, Volume 4 Sections 2 of the Design Manual for Roads and Bridges (DMRB)

COHESIVE DEPOSITS: Cohesive deposits were encountered beneath the topsoil and were described typically as *brown / greyish brown / brown mottled grey / grey sandy gravelly CLAY with low cobble and boulder content*. The secondary sand and gravel constituents varied across the site and with depth, with granular lenses occasionally present in the glacial till matrix. These deposits had low (<5%), medium (5%-20%) or high (20%-50%) cobble and boulder content, where noted on the exploratory hole logs.

Site investigation results when compared to the TII publication suggest that a SOIL type 4 could be chosen.

HR Wallingford Greenfield Runoff Estimation Tool

It is noted that a SOIL type 2 was the default value given for the input site coordinates

IH124

	My value		Map value
SAAR (mm)	994	mm	1021
How should SPR be derived?	WRAP soil type		
WRAP soil type	4		2
SPR	0.47		
QBar (IH124) (l/s)	30.1	l/s	

Based on interpretation of each of the above data sets a Soil Type 2, 3,4, or 5 could be interpreted. **Type 4 soil** was chosen as appropriate for this site.

Appendix 11.5

HRWallingford Qbar Calculations

Greenfield runoff rate estimation tool

www.uksuds.com | Greenfield runoff rate estimation tool (https://www.uksuds.com/)

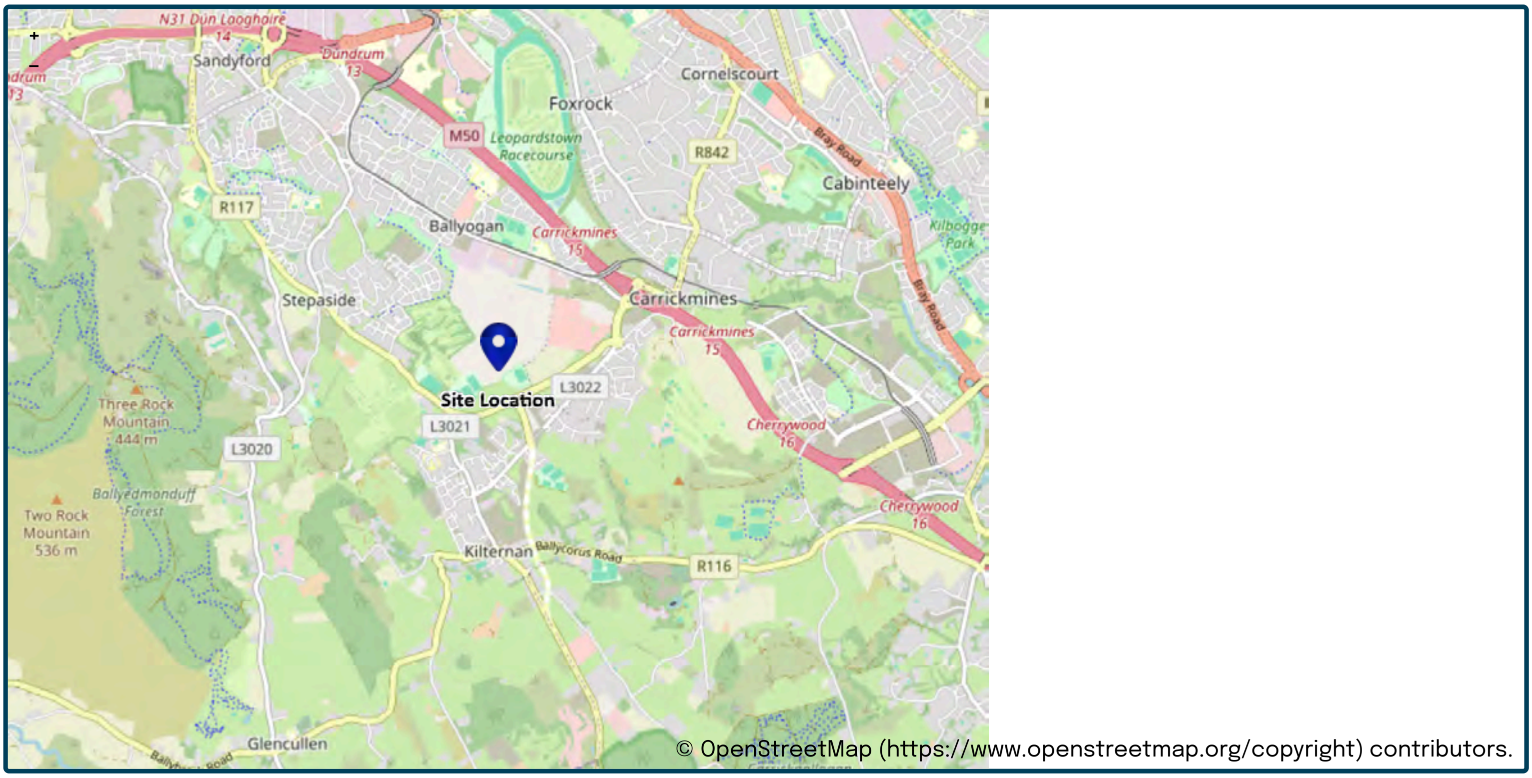
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Project details

Date	15/01/2026
Calculated by	Roger Mullarkey
Reference	2411B
Model version	2.2.2

Location

Site name	Glenamuck Nth
Site location	Site B(catch B1 & B2)



Site easting (Irish Grid)	320638
Site northing (Irish Grid)	223291
Site easting (Irish Transverse Mercator)	720563
Site northing (Irish Transverse Mercator)	723319

Site details

Total site area (ha)	4.14 ha

Greenfield runoff

Method

Method	IH124

IH124

	My value		Map value
SAAR (mm)	994	mm	1021
How should SPR be derived?	WRAP soil type		
WRAP soil type	4		2
SPR	0.47		
QBar (IH124) (l/s)	30.1	l/s	

Growth curve factors

	My value	Map value
Hydrological region	12	12
1 year growth factor	0.85	
2 year growth factor	0.95	
10 year growth factor	1.72	
30 year growth factor	2.13	
100 year growth factor	2.61	
200 year growth factor	2.86	

Results

Method	IH124	
Flow rate 1 year (l/s)	25.6	l/s
Flow rate 2 year (l/s)	28.6	l/s
Flow rate 10 years (l/s)	51.8	l/s
Flow rate 30 years (l/s)	64.2	l/s
Flow rate 100 years (l/s)	78.6	l/s
Flow rate 200 years (l/s)	86.2	l/s

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent 'zero' figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

Disclaimer

Greenfield runoff rate estimation tool

hr wallingford

www.uksuds.com | Greenfield runoff rate estimation tool (https://www.uksuds.com/)

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Project details

Date	09/01/2026
Calculated by	Roger Mullarkey
Reference	2411B
Model version	2.2.2

Location

Site name	Glenamuck North
Site location	Site B3

Site easting (Irish Grid)	320604
Site northing (Irish Grid)	223283
Site easting (Irish Transverse Mercator)	720529
Site northing (Irish Transverse Mercator)	723312

Site details

Total site area (ha)	0.3 ha

Greenfield runoff

Method

Method	IH124

IH124

	My value		Map value
SAAR (mm)	994	mm	1021
How should SPR be derived?	WRAP soil type		
WRAP soil type	4		2
SPR	0.47		
QBar (IH124) (l/s)	2.2	l/s	

Growth curve factors

	My value	Map value
Hydrological region	12	12
1 year growth factor	0.85	
2 year growth factor	0.95	
10 year growth factor	1.72	
30 year growth factor	2.13	
100 year growth factor	2.61	
200 year growth factor	2.86	

Results

Method	IH124	
Flow rate 1 year (l/s)	1.9	l/s
Flow rate 2 year (l/s)	2.1	l/s
Flow rate 10 years (l/s)	3.8	l/s
Flow rate 30 years (l/s)	4.6	l/s
Flow rate 100 years (l/s)	5.7	l/s
Flow rate 200 years (l/s)	6.2	l/s

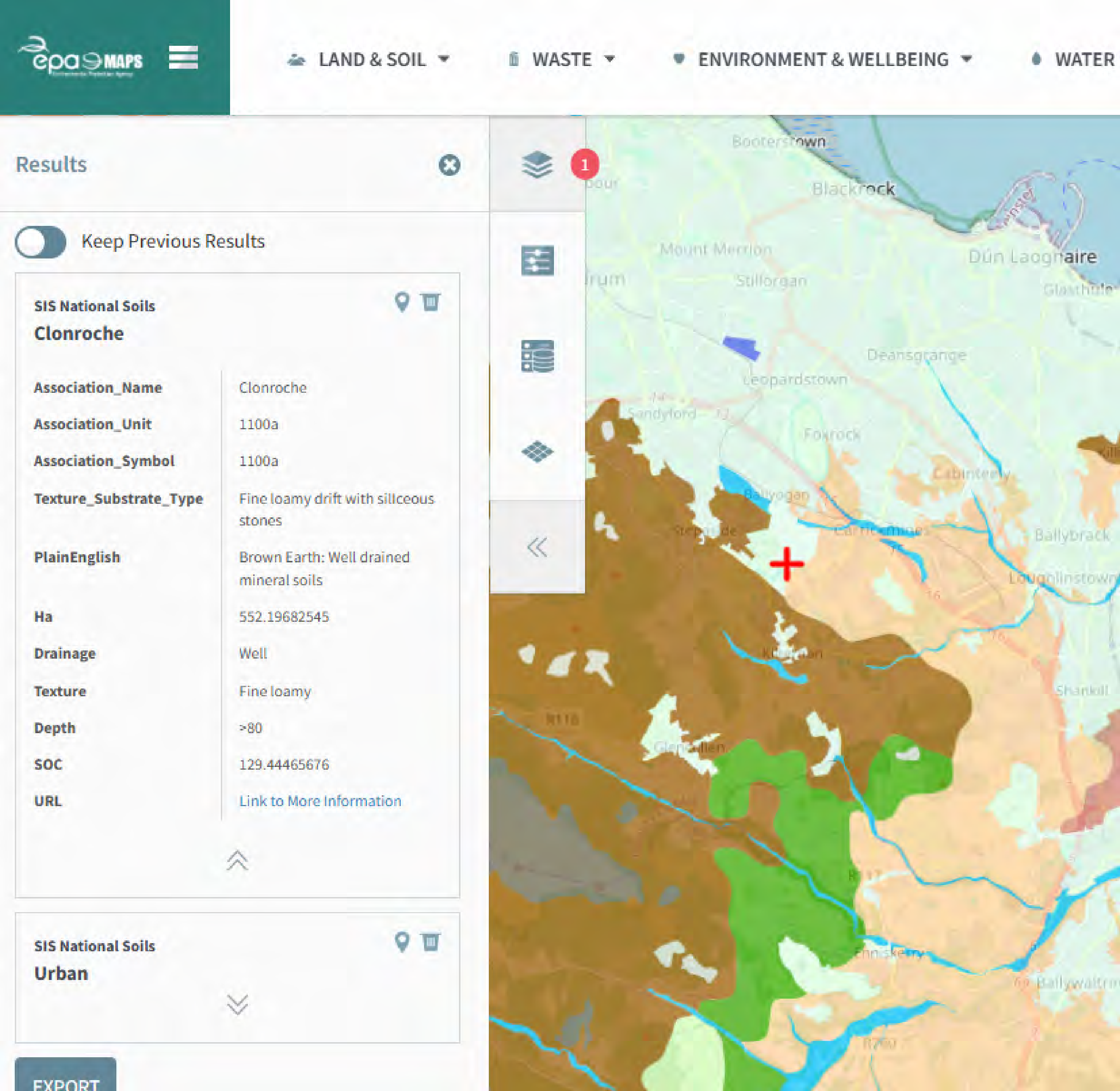
Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent 'zero' figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

Disclaimer

This report was produced using the Greenfield runoff rate estimation tool (2.2.2) developed by HR Wallingford and available at uksuds.com (https://www.uksuds.com/). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at uksuds.com/terms-conditions (https://www.uksuds.com/terms-conditions). The outputs from this tool have been used to estimate Greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

Appendix 11.6

GSI Data


epa MAPS
LAND & SOIL
WASTE
ENVIRONMENT & WELLBEING
WATER
Results
Keep Previous Results
SIS National Soils
Clonroche
Association_Name Clonroche
Association_Unit 1100a
Association_Symbol 1100a
Texture_Substrate_Type Fine loamy drift with siliceous stones
PlainEnglish Brown Earth: Well drained mineral soils
Ha 552.19682545
Drainage Well
Texture Fine loamy
Depth >80
SOC 129.44465676
URL Link to More Information
SIS National Soils
Urban
EXPORT
Booterstown
Blackrock
Mount Merrion
Dún Laoghaire
Stillorgan
Deansgrange
Leopardstown
Sandyford
Foxrock
Cabinteely
Ballyogan
Ballybrack
Loughlinstown
Shankill
Glencullen
Enniskerry

LAND & SOIL | WASTE | ENVIRONMENT & WELLBEING | WATER | NATURE | SUSTAINABLE ECON

Results

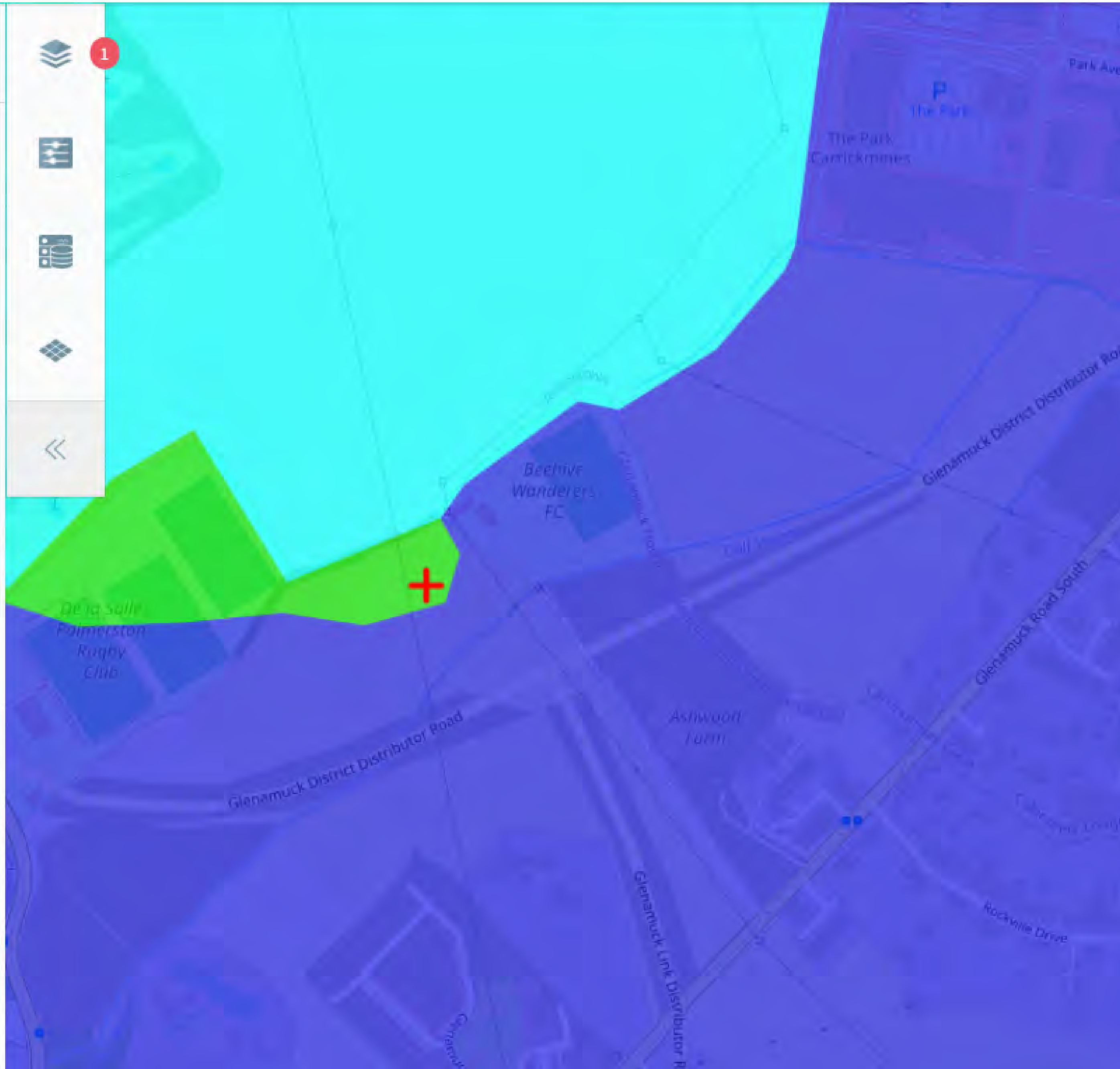
Keep Previous Results

Subsoils

1934.34462

PERIMETER	1934.34462
PAR_MAT	GGr
COUNTY	DUBLIN
CATEGORY	Sand and Gravels type
DESCRIPT	Granite sands and gravels
TEXTURE	Gravelly
Class	Glaciofluvial sands and gravels
PlainEnglish	The subsoils are sands and gravels deposited by glaciers.

EXPORT



Results

Keep Previous Results

Subsoils

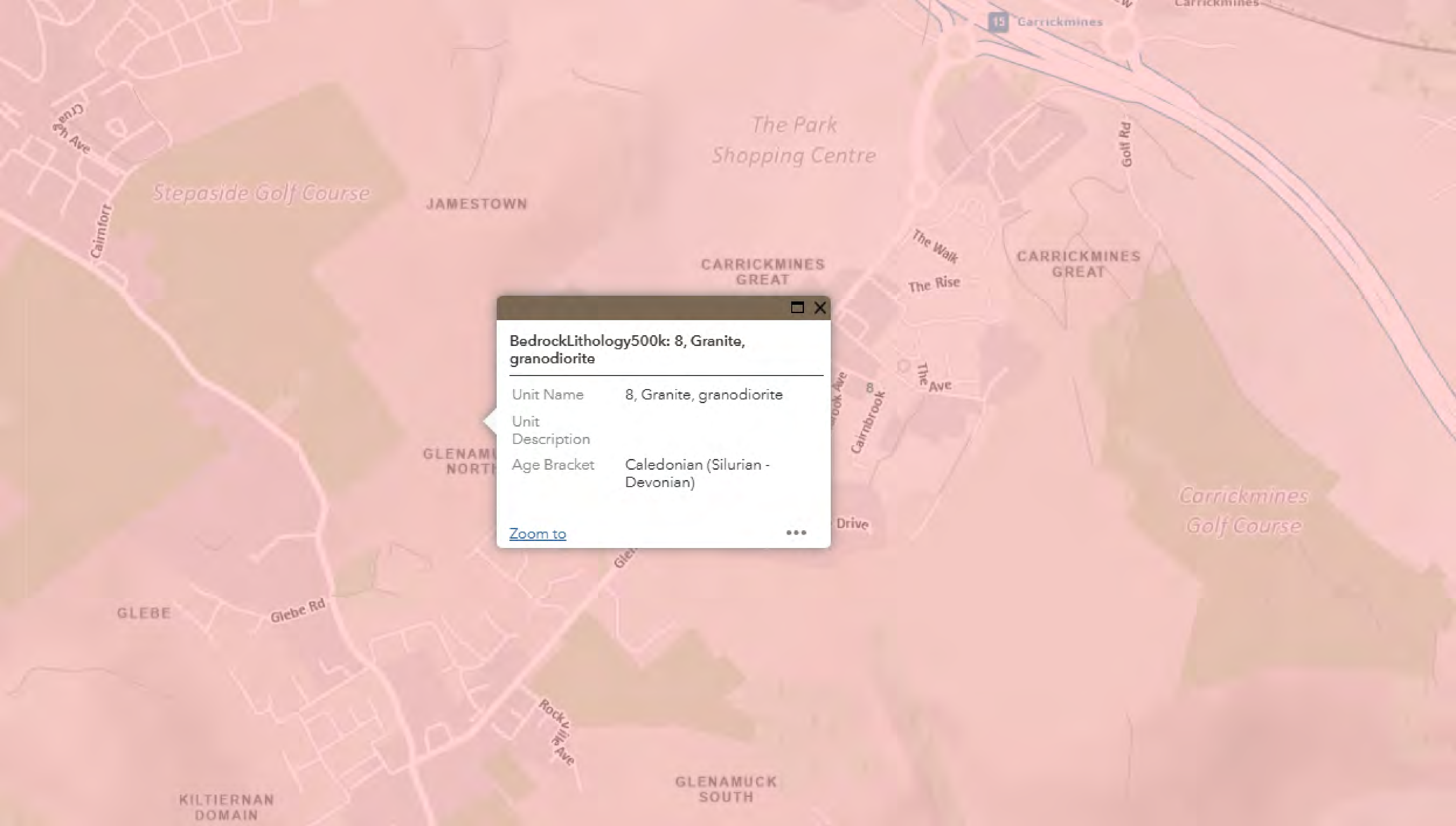
1934.34462

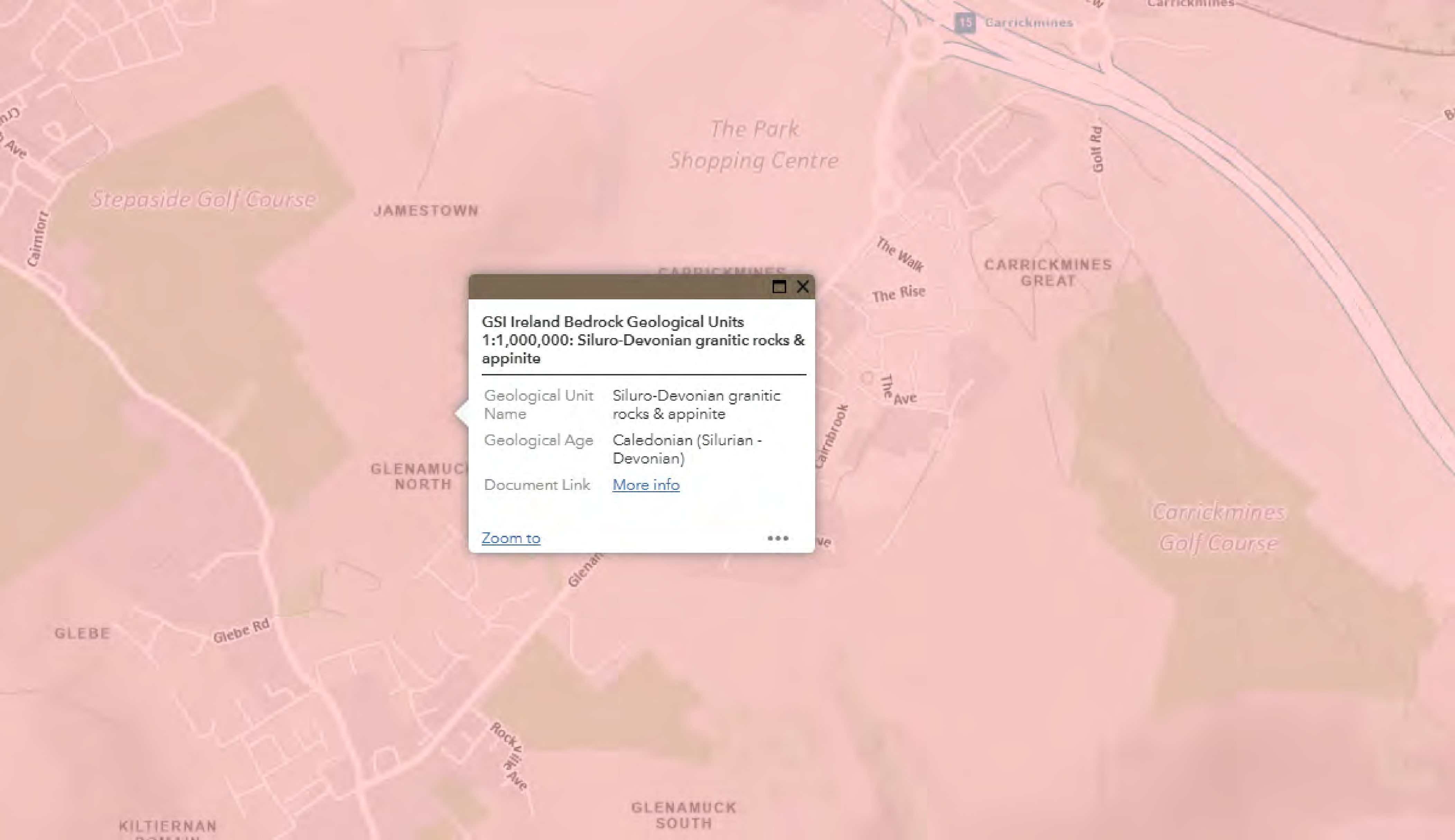
PERIMETER	1934.34462
PAR_MAT	GGr
COUNTY	DUBLIN
CATEGORY	Sand and Gravels type
DESCRIPT	Granite sands and gravels
TEXTURE	Gravelly
Class	Glaciofluvial sands and gravels
PlainEnglish	The subsoils are sands and gravels deposited by glaciers.

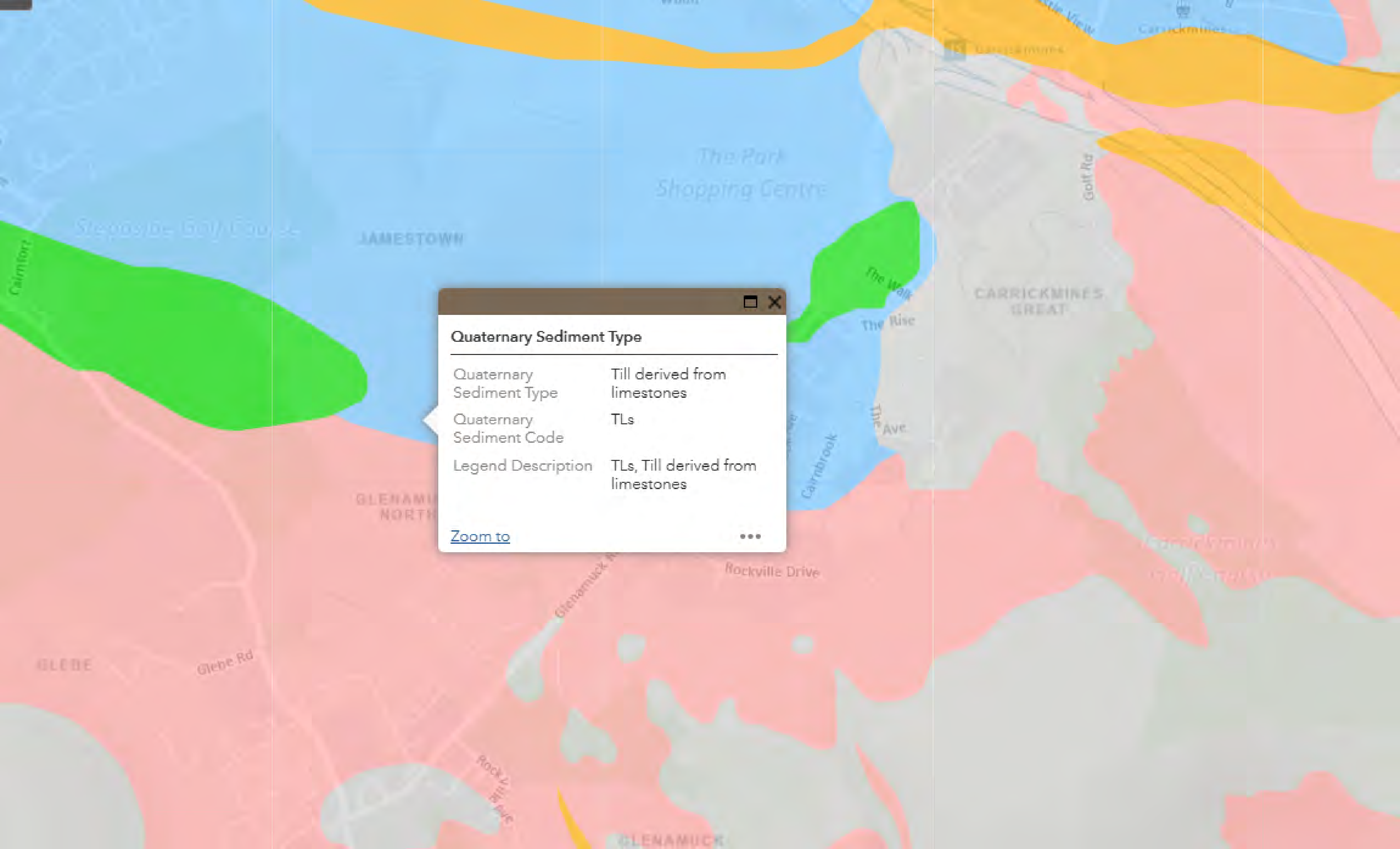
Subsoils

165475.00949

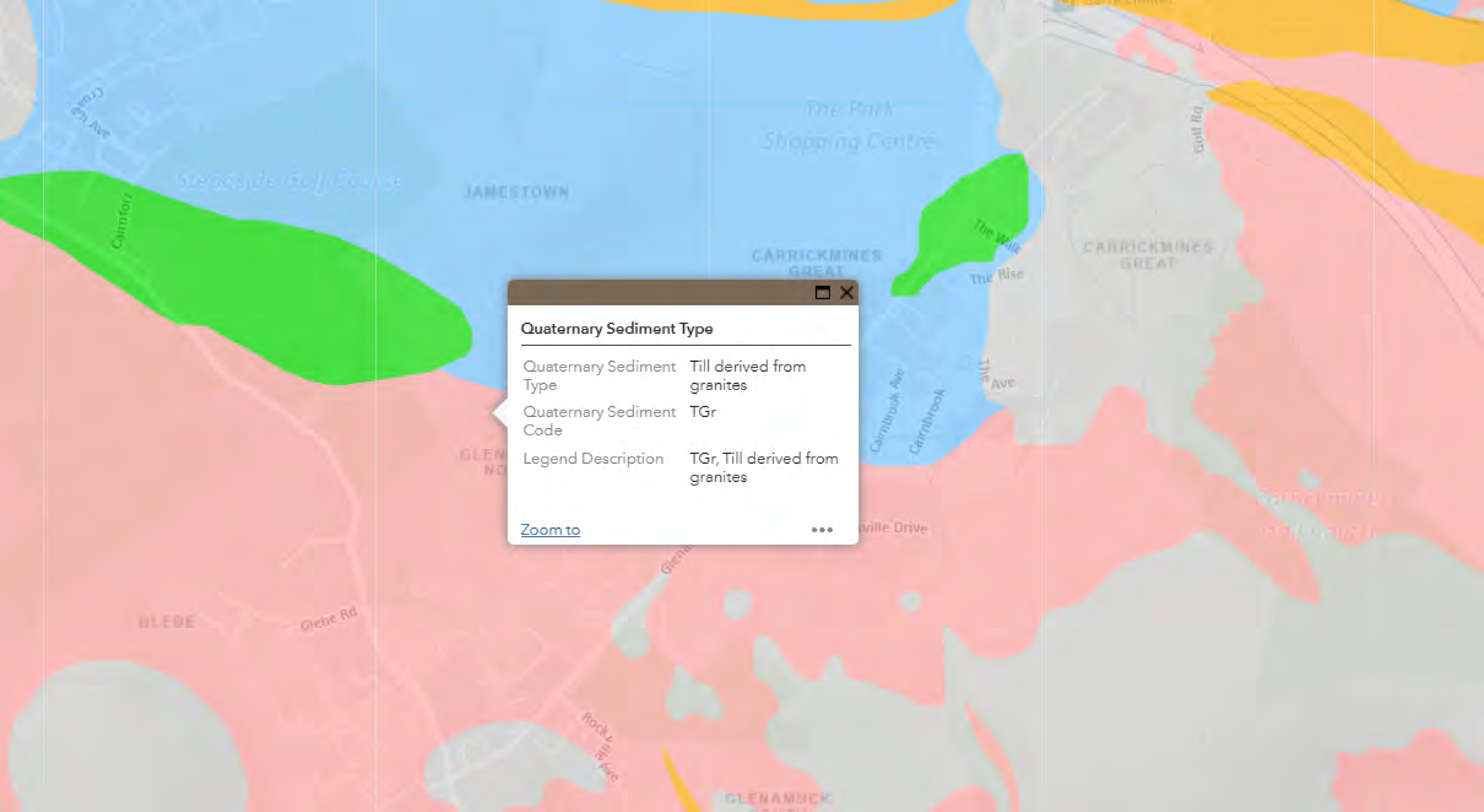
EXPORT


BedrockLithology500k: 8, Granite, granodiorite
Unit Name 8, Granite, granodiorite
Unit Description
Age Bracket Caledonian (Silurian - Devonian)
Zoom to
The Park Shopping Centre
Stepaside Golf Course
JAMESTOWN
CARRICKMINES GREAT
CARRICKMINES GREAT
Carrickmines
The Walk
The Rise
The Ave
Cairnbrook
Drive
Golf Rd
Cairnforr
Carrickmines Golf Course
GLEBE
Glebe Rd
Rockville Ave
GLENAMUCK SOUTH
KILTIERNAN DOMAIN


GSI Ireland Bedrock Geological Units 1:1,000,000: Siluro-Devonian granitic rocks & appinite
Geological Unit Name
Siluro-Devonian granitic rocks & appinite
Geological Age
Caledonian (Silurian - Devonian)
Document Link
More info
Zoom to
The Park Shopping Centre
Stepaside Golf Course
JAMESTOWN
Carrickmines
CARRICKMINES GREAT
The Walk
The Rise
The Ave
Golf Rd
Cairnbrook
GLENAMUCK NORTH
Carrickmines Golf Course
GLEBE
Glebe Rd
Rockville Ave
GLENAMUCK SOUTH
KILTIERNAN
Cairnfort



The Park
Shopping Centre
Stepaside Golf Course
JAMESTOWN
CARRICKMINES GREAT
Golf Rd
Carrickmines
The Walk
The Rise
The Ave
Carnbrook
GLENAMUCK NORTH
Rockville Drive
Glenamuck Rd
GLEBE
Glebe Rd
Rockville Drive
GLENAMUCK
Quaternary Sediment Type
Quaternary Sediment Type
Till derived from limestones
Quaternary Sediment Code
TLs
Legend Description
TLs, Till derived from limestones
Zoom to


Quaternary Sediment Type
Quaternary Sediment Type
Till derived from granites
Quaternary Sediment Code
TGr
Legend Description
TGr, Till derived from granites
Zoom to
The Park Shopping Centre
JAMESTOWN
CARRICKMINES GREAT
CARRICKMINES GREAT
The Walk
The Rise
The Ave
Carrickbrook Ave
Carrickbrook
Golf Rd
Cairnfort
GLEBE
Glebe Rd
Rockville Drive
GLENAMUCK

epa MAPS

LAND & SOIL | WASTE | ENVIRONMENT & WELLBEING | WATER | NATURE | SUSTAINABLE ECONOMY

Active Layers

GSI Vulnerability

Abstract

Groundwater Vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities

Zoom to layer

Legend

- Extreme Vulnerability
- High Vulnerability
- Moderate Vulnerability
- Low Vulnerability
- X - Rock at or near surface
- Water

Layer Symbology

Default

Layer Queryable

FILTER

Appendix 11.7

Soakaway Testing

GROUND INVESTIGATIONS IRELAND
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Ground Investigations Ireland

Cowley Lands, Kilternan

Durkan Group

Ground Investigation Report

February 2025

GROUND INVESTIGATIONS IRELAND
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DOCUMENT CONTROL SHEET

Project Title	Cowley Lands, Kilternan
Engineer	Roger Mullarkey & Associates
Client	Durkan Group
Project No	14374-12-24
Document Title	Ground Investigation Report

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
A	Final	J Cashen	B Sexton	B Sexton	Dublin	12 February 2025

Ground Investigations Ireland Ltd. present the results of the fieldworks and laboratory testing in accordance with the specification and related documents provided by or on behalf of the client The possibility of variation in the ground and/or groundwater conditions between or below exploratory locations or due to the investigation techniques employed must be taken into account when this report and the appendices inform designs or decisions where such variation may be considered relevant. Ground and/or groundwater conditions may vary due to seasonal, man-made or other activities not apparent during the fieldworks and no responsibility can be taken for such variation. The data presented and the recommendations included in this report and associated appendices are intended for the use of the client and the client's geotechnical representative only and any duty of care to others is excluded unless approved in writing.

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CONTENTS

APPENDICES

1.0 Preamble

On the instructions of Roger Mullarkey & Associates, on behalf of Durkan Group, a site investigation was carried out by Ground Investigations Ireland Ltd. (GII) in January 2025 at the site of the proposed development in Kilternan, Dublin 18.

2.0 Overview

2.1. Background

It is proposed to construct a new development with associated services, access roads and car parking at the proposed site. At the time of the site investigation the site consisted of four fields which were transected by the ongoing construction of the new Glenamuck District Distributor Road (GDDR) in Dublin 18.

2.2. Purpose and Scope

The purpose of the site investigation was to investigate subsurface conditions utilising a variety of investigative methods in accordance with the project specification. The scope of the work undertaken for this project included the following:

- Visit project site to observe existing conditions
- Carry out 4 No. Trial Pits to a maximum depth of 1.60m BGL
- Carry out 4 No. Soakaway tests to determine a soil infiltration value to BRE Digest 365
- Report with recommendations

3.0 Subsurface Exploration

3.1. General

During the ground investigation a programme of intrusive investigation specified by the Consulting Engineer was undertaken to determine the sub surface conditions at the proposed site. Regular sampling and in-situ testing were undertaken in the exploratory holes to facilitate the geotechnical descriptions and to enable laboratory testing to be carried out on the soil samples recovered during excavation and drilling.
The procedures used in this site investigation are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:2015+A1:2020.

3.2. Trial Pits

The trial pits were excavated using a JCB 3CX excavator at the locations shown in the exploratory hole location plan in Appendix 1. The locations were checked using a CAT scan to minimise the potential for encountering services during the excavation. The trial pits were sampled, logged and photographed by a

Geotechnical Engineer/Engineering Geologist prior to backfilling with arisings. Notes were made of any services, inclusions, pit stability, groundwater encountered, and the characteristics of the strata encountered and are presented on the trial pit logs which are provided in Appendix 2 of this Report.

3.3. Soakaway Testing

The soakaway testing was carried out in selected trial pits at the locations shown in the exploratory hole location plan in Appendix 1. These pits were carefully excavated and filled with water to assess the infiltration characteristics of the proposed site. The pits were allowed to drain and the drop in water level was recorded over time as required by BRE Digest 365. The pits were logged prior to completing the soakaway test and were backfilled with arising's upon completion. The soakaway test results are provided in Appendix 3 of this Report.

3.4. Surveying

The exploratory hole locations have been recorded using a KQGeo M8 GNSS System which records the coordinates and elevation of the locations to Irish Transverse Mercator (ITM) as required by the project specification. The coordinates and elevations are provided on the exploratory hole logs in the appendices of this Report.

4.0 Ground Conditions

4.1. General

The ground conditions encountered during the investigation are summarised below with reference to in-situ and laboratory test results. The full details of the strata encountered during the ground investigation are provided in the exploratory hole logs included in the appendices of this report.

The sequence of strata encountered was consistent across the site and generally comprised;

- Topsoil
- Cohesive Deposits

TOPSOIL: Topsoil was encountered in all the exploratory holes and was present to a maximum depth of 0.30m BGL.

COHESIVE DEPOSITS: Cohesive deposits were encountered beneath the topsoil and were described typically as *brown / greyish brown / brown mottled grey / grey sandy gravelly CLAY with low cobble and boulder content*. The secondary sand and gravel constituents varied across the site and with depth, with granular lenses occasionally present in the glacial till matrix. These deposits had low (<5%), medium (5%-20%) or high (20%-50%) cobble and boulder content, where noted on the exploratory hole logs.

4.2. Groundwater

Groundwater strikes are noted on the exploratory hole logs where they occurred. It should be noted that these exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime and groundwater levels would be expected to vary with the tide, time of year, rainfall, nearby construction and other factors.

5.0 Recommendations & Conclusions

5.1. General

The recommendations given and opinions expressed in this report are based on the findings as detailed in the exploratory hole records. Where an opinion is expressed on the material between exploratory hole locations, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for conditions which have not been revealed by the exploratory holes. Limited information has been provided at the ground investigation stage and any designs based on the recommendations or conclusions should be completed in accordance with the current design codes, taking into account the variation and the specific details contained within the exploratory hole logs.

5.2. Soakaway Design

At the locations of all soakaway tests, the water level dropped too slowly to allow calculation of 'f' the soil infiltration rate. These locations are therefore not recommended as suitable for soakaway design and construction.

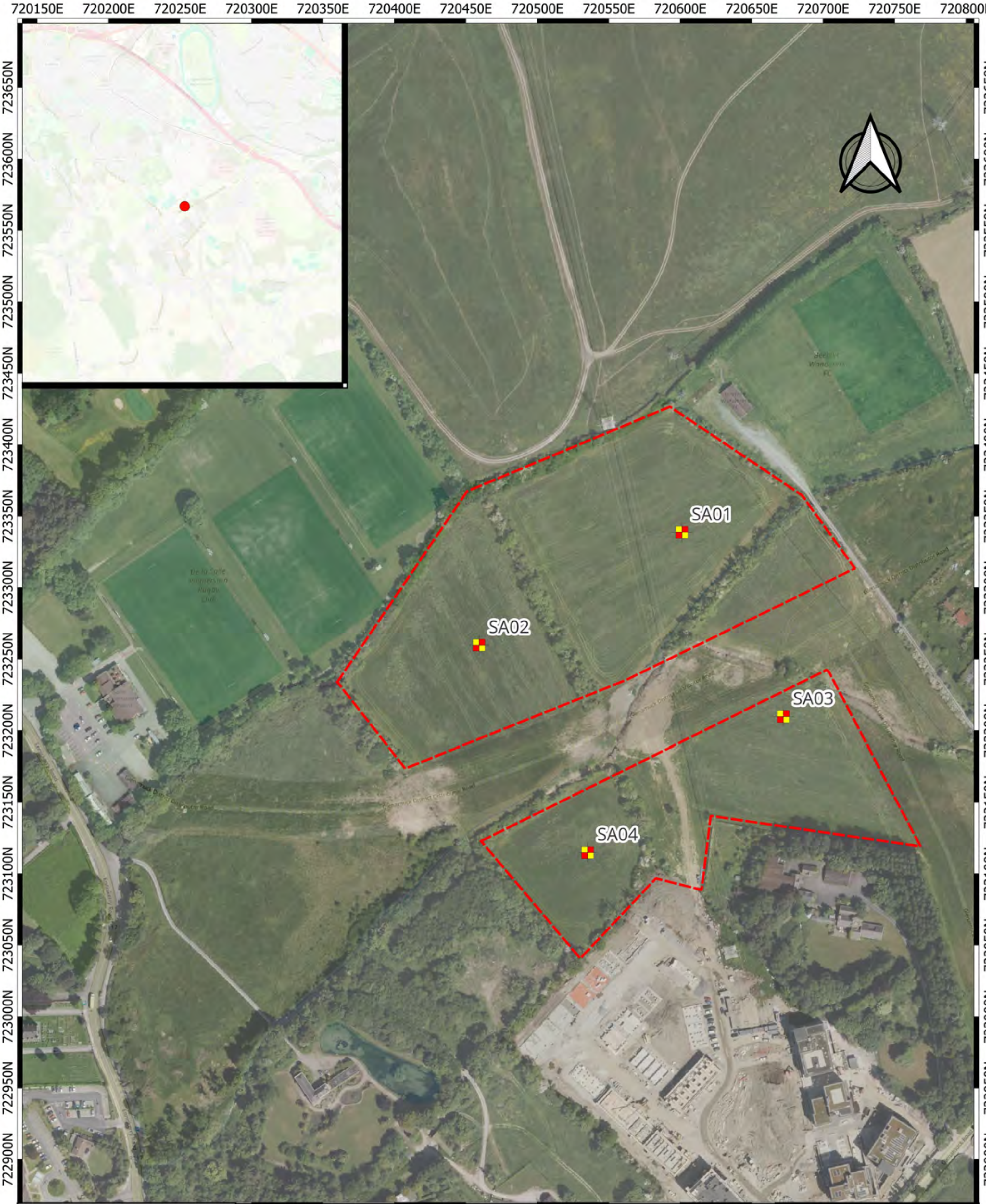
5.3. Excavations

Short term temporary excavations in the cohesive deposits will remain stable for a limited time only and will require to be appropriately battered or the sides supported if the excavation is below 1.25m BGL or is required to permit man entry. Excavations in the soft Cohesive Deposits will require to be appropriately battered or the sides supported due to the low strength of these deposits. The groundwater and stability noted on the trial pit logs should be consulted when determining the most appropriate construction methods for excavations.

The recommendations provided in this report should be verified in the design of the proposed buildings, using the full details of the loading conditions and taking into consideration the allowable tolerable settlements/movements that the building can accommodate. The founding strata should be inspected and verified by a suitably qualified engineer prior to construction of the building foundations.

APPENDIX 1 - Figures

www.gii.ie



GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

Ground Investigations Ireland Ltd.
Catherinstown House,
Hazelhatch Road,
Newcastle, Co. Dublin
www.gii.ie 01-6015175/5176

Engineer:

ROGER MULLARKEY & ASSOCIATES

0 20 40 60 80 m

Project Title:
Cowley Lands, Kilternan

Drawing Title:
Figure 1 Proposed SI

GII Project Reference:
14374-12-24

Drawn By:
JC

Date:
12/02/2025

Site Location

Indicative Site Boundary

Trial Pit - Soakaway

APPENDIX 2 – Trial Pit Records

Ground Investigations Ireland Ltd www.gii.ie	Site: Cowley Lands Glenamuck Road	Trial Pit Number: SA01

Machine : JCB 3CX Excavator Method : Trial Pit	Dimensions: 1.90m x 0.50m x 1.50m L x W x D	Ground Level (mOD)	Client: Roger Mullarkey	Job Number: 14374-12-24
	Location: 720601 E 723338 N	Dates: 22/01/2025	Engineer	Sheet: 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	TOPSOIL		
0.50	B				(0.40) 0.60	Soft light greyish brown slightly sandy silty CLAY		
					(0.40) 1.00	Soft grey sandy gravelly CLAY with low subrounded cobble content (Damp)		1
1.50	B		Water strike(1) at 1.00m.		(0.50) 1.50	Firm dark grey slightly sandy gravelly CLAY with medium subangular to subrounded cobble content		
						Complete at 1.50m		

Plan

Remarks

Groundwater encountered. Seepage at 1.00m BGL
Trial Pit Stable
Tril Pit complete at 1.50m BGL
Soakaway test carried out in accordance with BRE Digest 365

Scale (approx)	Logged By	Figure No.
1:25	JG	14374-12-24.SA01

Ground Investigations Ireland Ltd www.gii.ie		Site Cowley Lands Glenamuck Road	Trial Pit Number **SA02**
Machine : JCB 3CX Excavator **Method :** Trial Pit	**Dimensions** 1.60m x 0.50m x 1.50m L x W x D	**Ground Level (mOD)**	**Client** Roger Mullarkey	**Job Number** 14374-12-24
	Location 720459 E 723259 N	**Dates** 22/01/2025	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	TOPSOIL		
0.50	B				(0.50) 0.70	Firm brown slightly sandy slightly gravelly CLAY with low subrounded cobble content		
1.50	B				(0.80) 1.50	Firm brown mottled grey slightly sandy slightly gravelly CLAY		
						Complete at 1.50m		

Plan

Remarks

No groundwater encountered
Trial Pit Stable
Tril Pit complete at 1.50m BGL
Soakaway test carried out in accordance with BRE Digest 365

Scale (approx)	Logged By	Figure No.
1:25	JG	14374-12-24.SA02

Ground Investigations Ireland Ltd
www.gii.ie

Site	Cowley Lands Glenamuck Road		**Trial Pit Number**	SA03
Machine : JCB 3CX Excavator **Method :** Trial Pit	**Dimensions** 1.80m x 0.50m x 1.50m L x W x D	**Ground Level (mOD)**	**Client** Roger Mullarkey	**Job Number** 14374-12-24
	Location 720672 E 723209 N	**Dates** 22/01/2025	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL		
					0.30	Soft light brown slightly sandy slightly gravelly CLAY		
0.50	B				(0.40)			
					0.70	Soft to firm greyish brown sandy slightly gravelly CLAY		
			Water strike(1) at 1.10m.		(0.80)			∇1
1.50	B				1.50	Complete at 1.50m		

Plan

Remarks

Groundwater encountered, seepage at 1.10m BGL
Trial Pit unstable; spalling at 0.70m BGL
Tril Pit complete at 1.50m BGL
Soakaway test carried out in accordance with BRE Digest 365

Scale (approx)	Logged By	Figure No.
1:25	JG	14374-12-24.SA03

Ground Investigations Ireland Ltd www.gii.ie			Site: Cowley Lands Glenamuck Road	Trial Pit Number: SA04
Machine : JCB 3CX Excavator Method : Trial Pit	Dimensions: 1.80m x 0.50m x 1.50m L x W x D	Ground Level (mOD)	Client: Roger Mullarkey	Job Number: 14374-12-24
	Location: 720535 E 723114 N	Dates: 22/01/2025	Engineer	Sheet: 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL		
0.50	B				0.30 (0.40)	Soft light brown slightly sandy slightly gravelly CLAY		
					0.70 (0.80)	Soft greyish brown sandy slightly gravelly CLAY		
1.50	B		Water strike(1) at 1.50m.		1.50	Complete at 1.50m		∇1

Plan

Remarks

Groundwater encountered, seepage at 1.50m BGL
Trial Pit unstable; spalling at 0.70m BGL
Tril Pit complete at 1.50m BGL
Soakaway test carried out in accordance with BRE Digest 365

Scale (approx)	Logged By	Figure No.
1:25	JG	14374-12-24.SA03

Cowley Lands Kilternan – Trial Pit Photographs

SA01

SA01

Cowley Lands Kilternan – Trial Pit Photographs

SA01

Cowley Lands Kilternan – Trial Pit Photographs

SA02

SA02

Cowley Lands Kilternan – Trial Pit Photographs

SA02

SA02

Cowley Lands Kilternan – Trial Pit Photographs

SA03

SA03

Cowley Lands Kilternan – Trial Pit Photographs

SA03

SA03

Cowley Lands Kilternan – Trial Pit Photographs

SA04

SA04

Cowley Lands Kilternan – Trial Pit Photographs

SA04

SA04

APPENDIX 3 – Soakaway Testing Records

www.gii.ie

GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

Catherinestown House,
Hazelhatch Road,
Newcastle,
Co. Dublin.
D22 YD52

Tel: 01 601 5175 / 5176
Email: info@gii.ie
Web: www.gii.ie

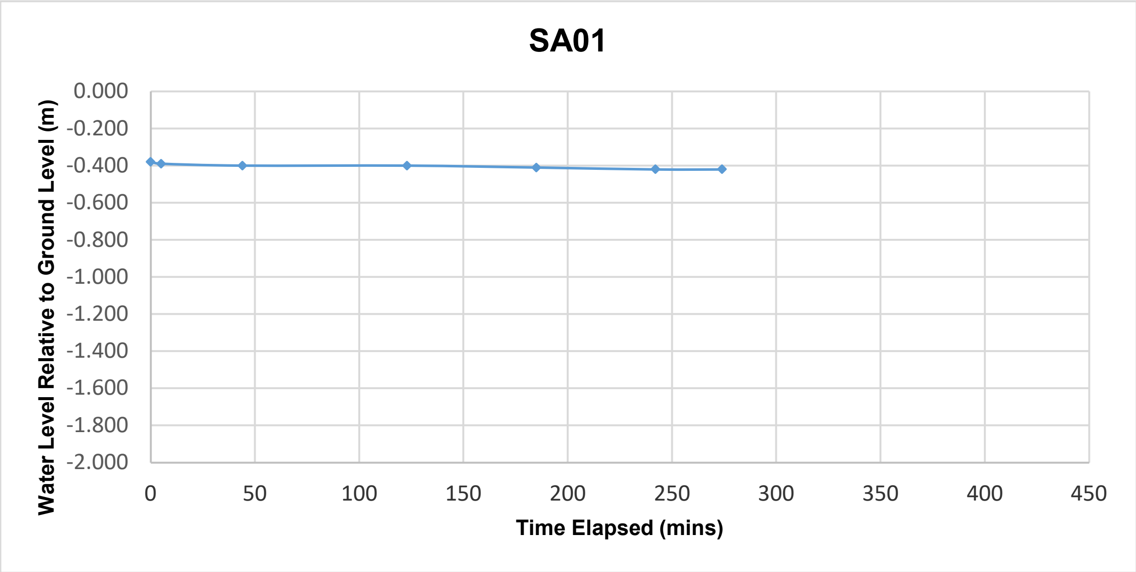
SA01

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.9m x 0.50m x 1.5m (L x W x D)

Date	Time	Water level (m bgl)
22/01/2025	0	-0.380
22/01/2025	5	-0.390
22/01/2025	44	-0.400
22/01/2025	123	-0.400
22/01/2025	185	-0.410
22/01/2025	242	-0.420
22/01/2025	274	-0.420

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.38	**1.500**	**1.120**	**0.66**	**1.22**



GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

Catherinestown House,
Hazelhatch Road,
Newcastle,
Co. Dublin.
D22 YD52

Tel: 01 601 5175 / 5176
Email: info@gii.ie
Web: www.gii.ie

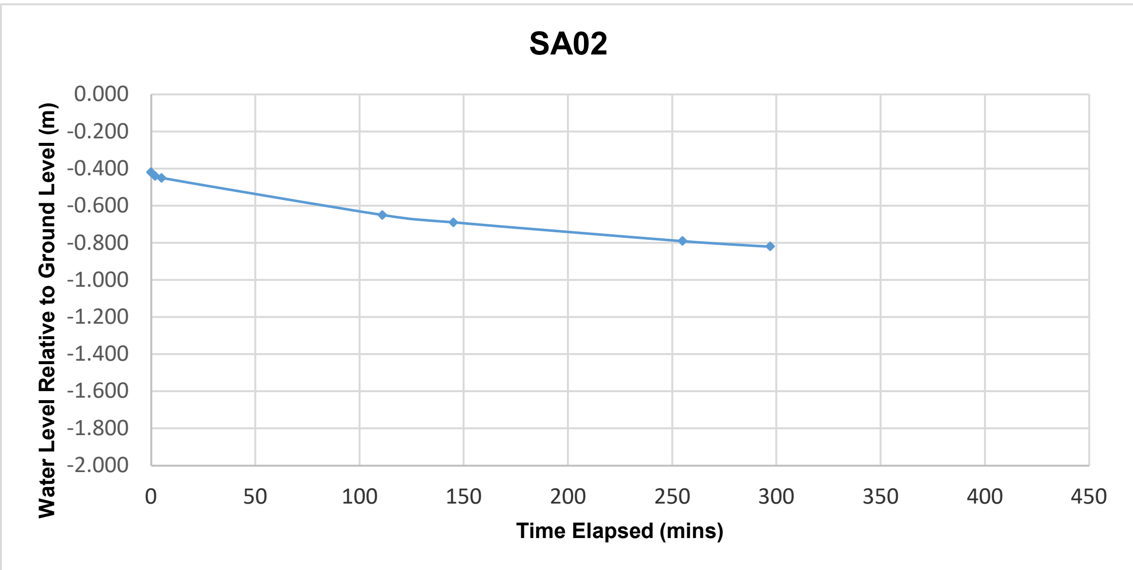
SA02

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.6m x 0.50m x 1.5m (L x W x D)

Date	Time	Water level (m bgl)
22/01/2025	0	-0.420
22/01/2025	2	-0.440
22/01/2025	5	-0.450
22/01/2025	111	-0.650
22/01/2025	145	-0.690
22/01/2025	255	-0.790
22/01/2025	297	-0.820

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.42	1.500	1.080	0.69	1.23



GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

Catherinestown House,
Hazelhatch Road,
Newcastle,
Co. Dublin.
D22 YD52

Tel: 01 601 5175 / 5176
Email: info@gii.ie
Web: www.gii.ie

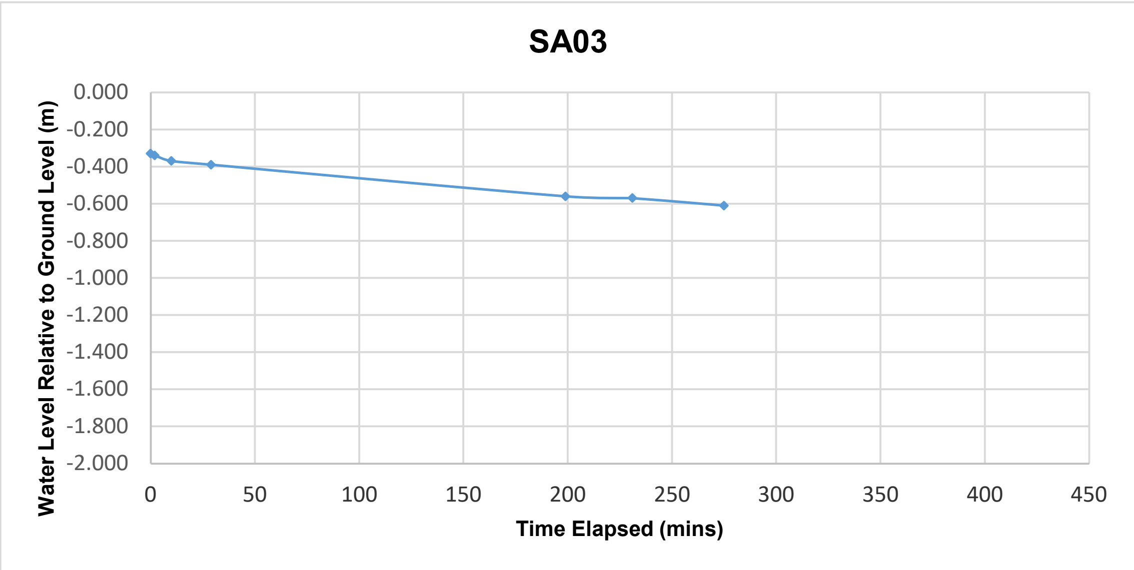
SA03

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.8m x 0.50m x 1.5m (L x W x D)

Date	Time	Water level (m bgl)
22/01/2025	0	-0.330
22/01/2025	2	-0.340
22/01/2025	10	-0.370
22/01/2025	29	-0.390
22/01/2025	199	-0.560
22/01/2025	231	-0.570
22/01/2025	275	-0.610

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.33	1.500	1.170	0.6225	1.2075



GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

Catherinestown House,
Hazelhatch Road,
Newcastle,
Co. Dublin.
D22 YD52

Tel: 01 601 5175 / 5176
Email: info@gii.ie
Web: www.gii.ie

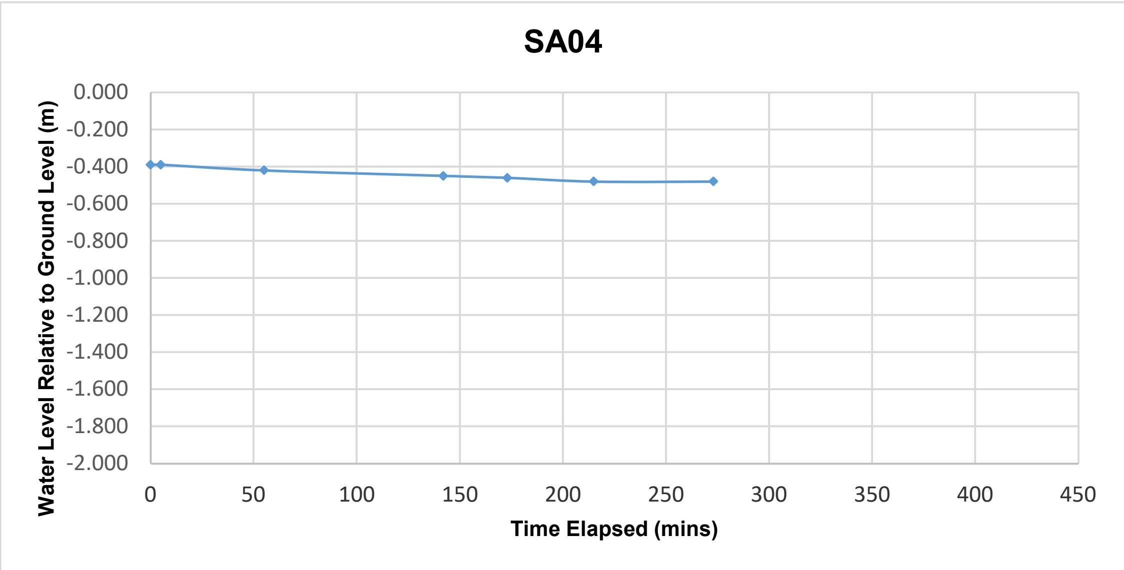
SA04

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.6m x 0.50m x 1.5m (L x W x D)

Date	Time	Water level (m bgl)
22/01/2025	0	-0.390
22/01/2025	5	-0.390
22/01/2025	55	-0.420
22/01/2025	142	-0.450
22/01/2025	173	-0.460
22/01/2025	215	-0.480
22/01/2025	273	-0.480

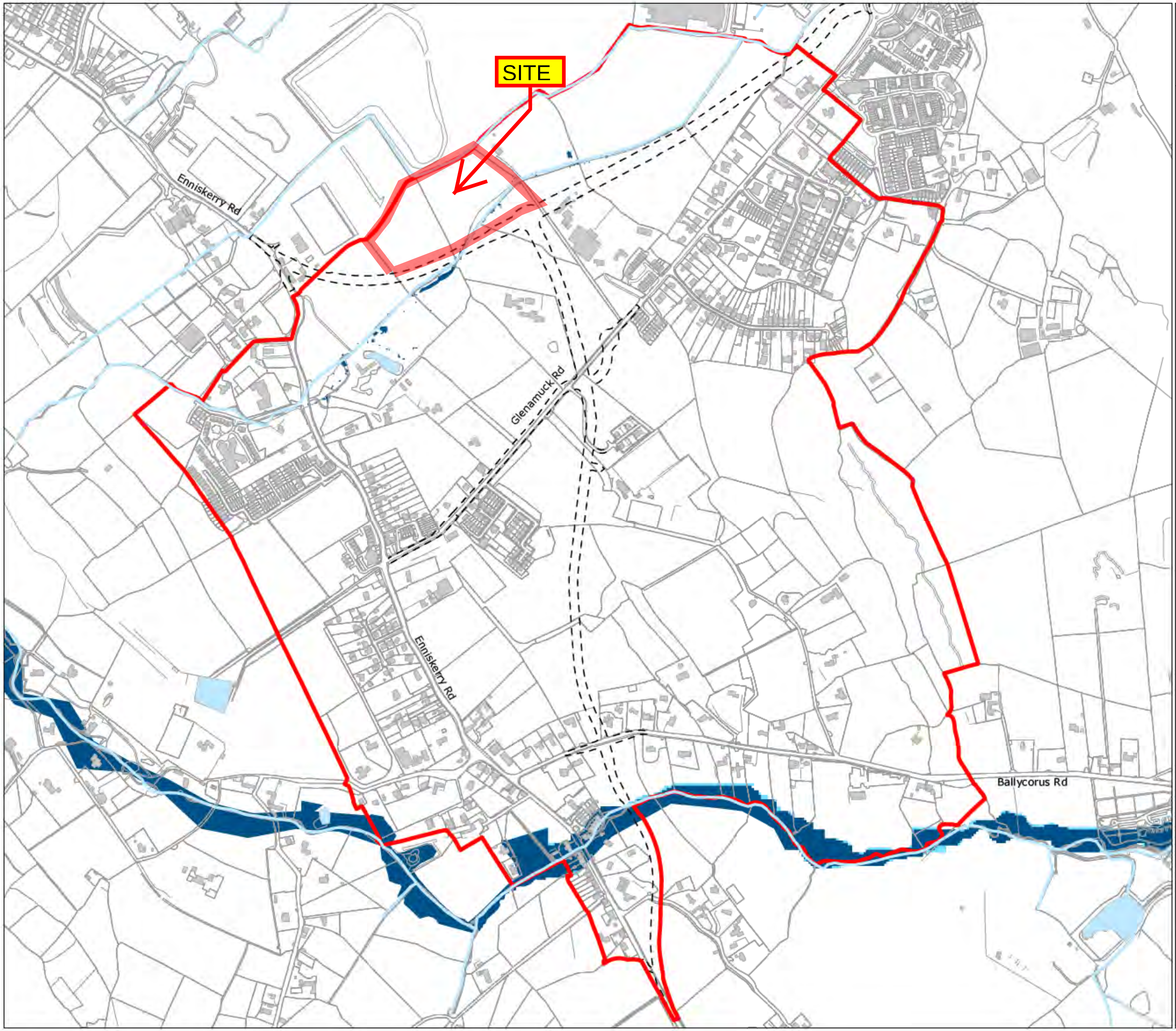
***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.39	1.500	1.110	0.6675	1.2225



Appendix 11.8

Kilternan Glenamuck LAP MapNo.PL25010



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

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Planning and Economic Development
A. Blighe
Director of Services

dlr Comhairle Contae 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 11.9

DLRCC CDP - Flood 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

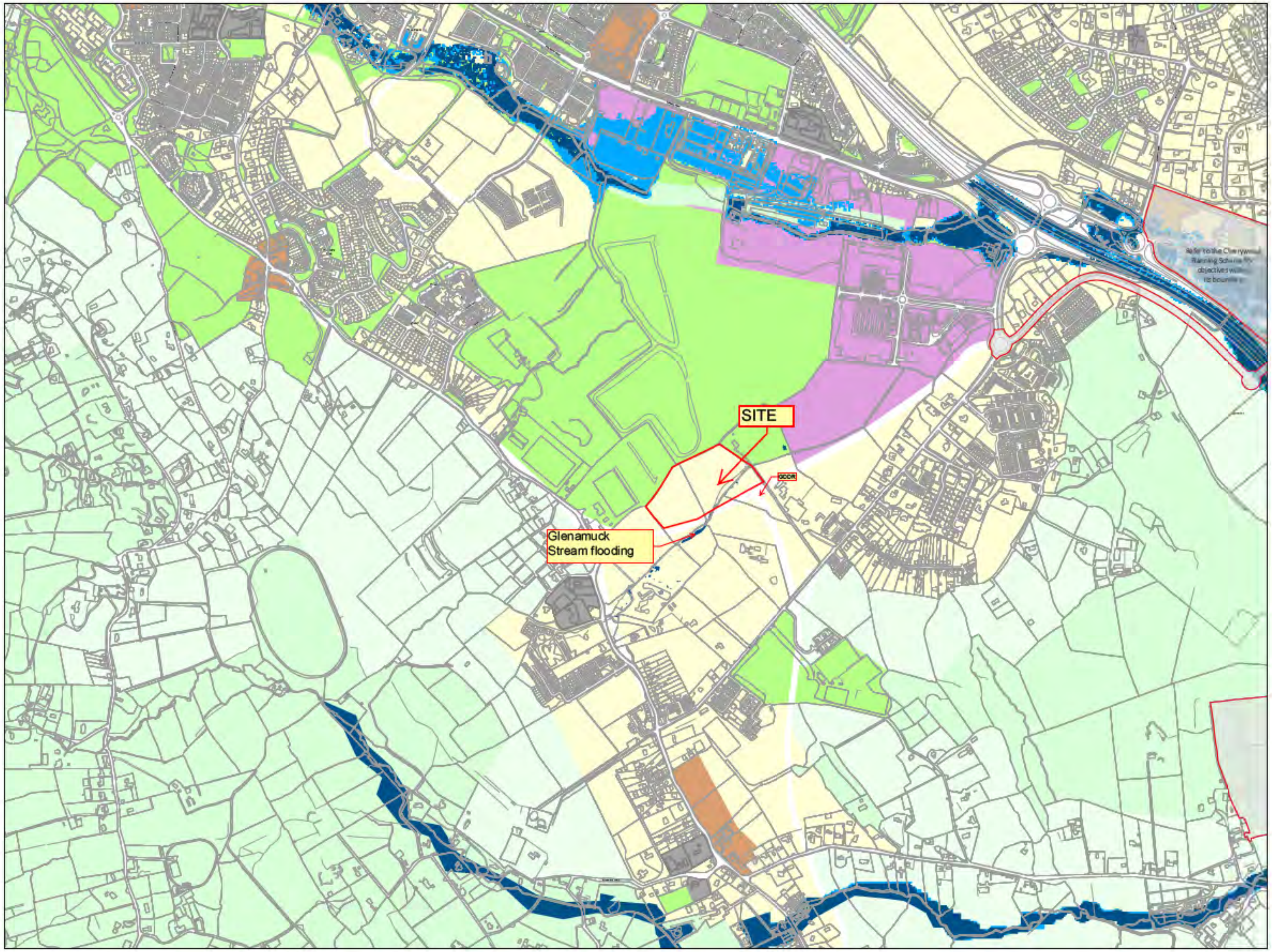
COMHAIRLE CHONTAE DHÚN LAOGHAIRE-RÁTH AN DÚIN

DÚN LAOGHAIRE-RATHDOWN COUNTY COUNCIL

COUNTY DEVELOPMENT PLAN 2022-2028

Adopted March 2022

INDEX



Land Use Zonings

Areas of Flood Risk Concern

Flood Zone A

Flood Zone B

Wave Overtopping

County Boundary

Appendix 11.10

OPW Summary Report

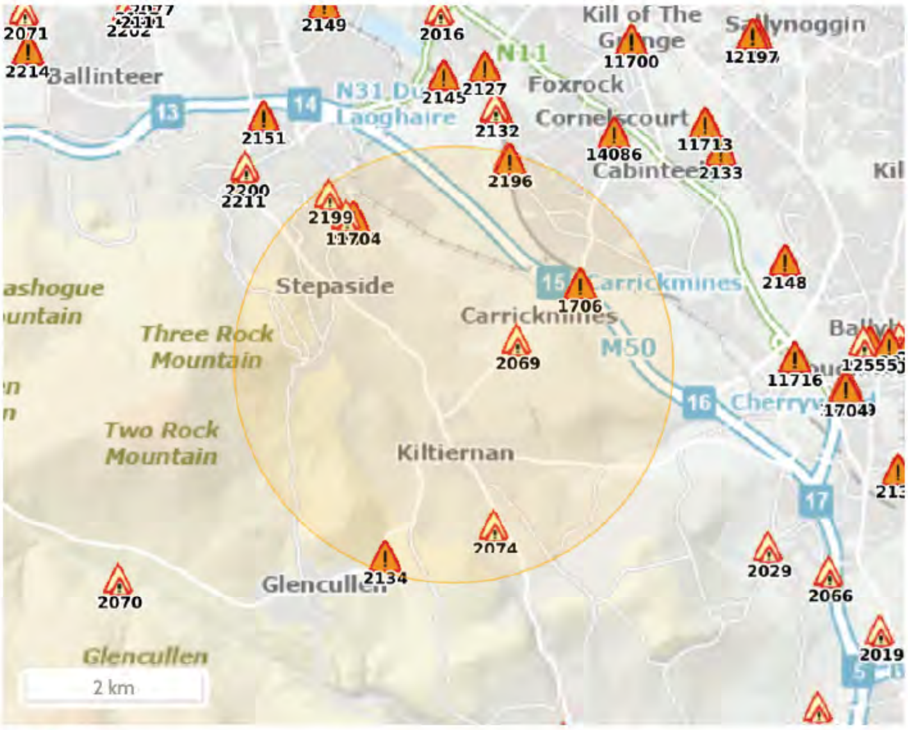

The Park
Shopping Centre
Carrickmines
Stepaside Golf Course
JAMESTOWN
Aprox. Site
location
R842
NORTH
GLEBE
R842

Past Flood Event Local Area Summary Report

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.

This report has been downloaded from www.floodinfo.ie (the "**Website**"). The users should take account of the restrictions and limitations relating to the content and use of the Website that are explained in the Terms and Conditions. It is a condition of use of the Website that you agree to be bound by the disclaimer and other terms and conditions set out on the Website and to the privacy policy on the Website.



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)		

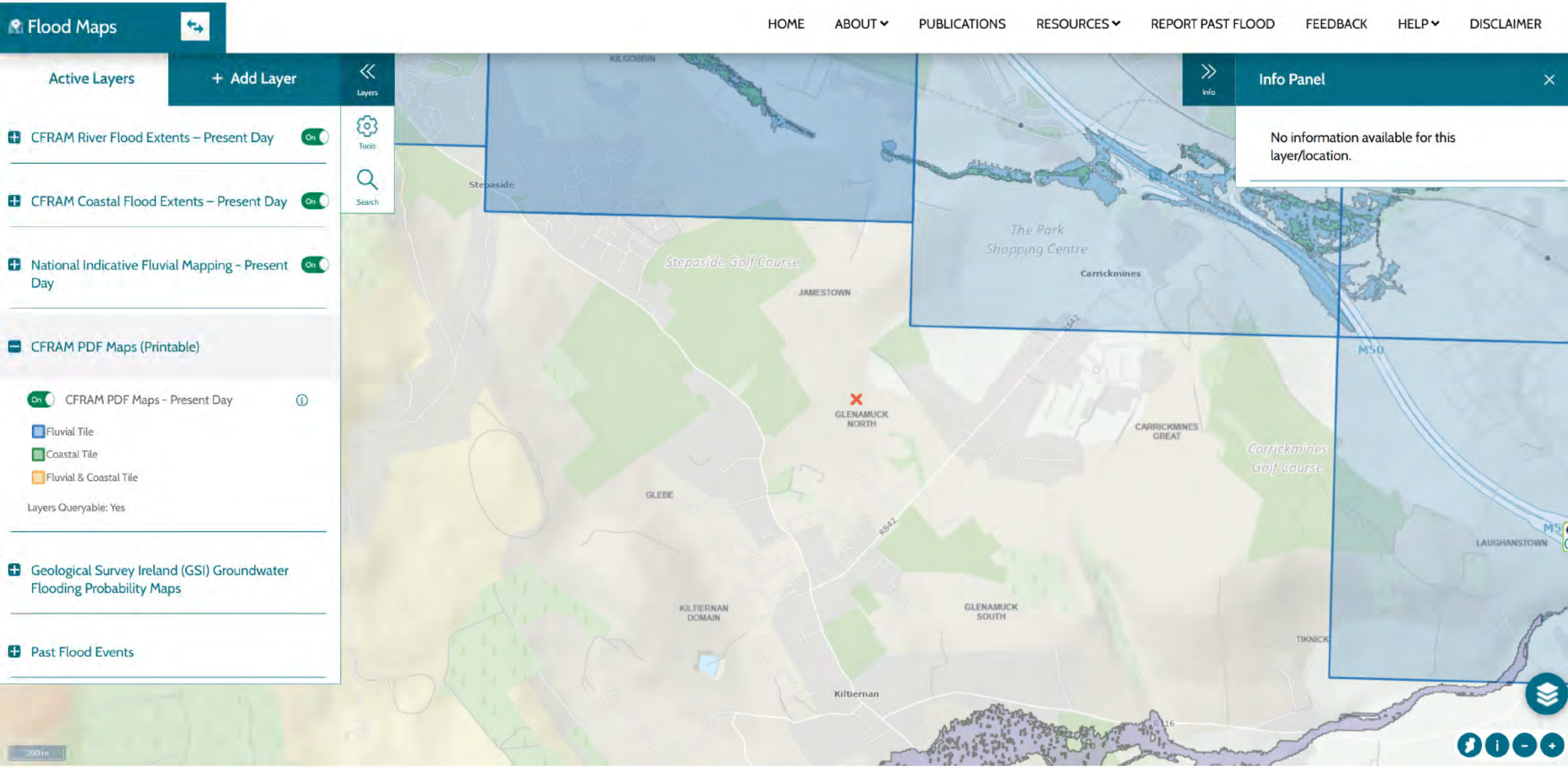
Water | WATER, LAND & SOIL | PROTECTED AREAS | MONITORING & FLOW | STATUS & RISK | PRESSURES & ACTIVITIES | TAKING ACTION | HELP

Results

Keep Previous Results

River Waterbodies
IE_EA_10C040350

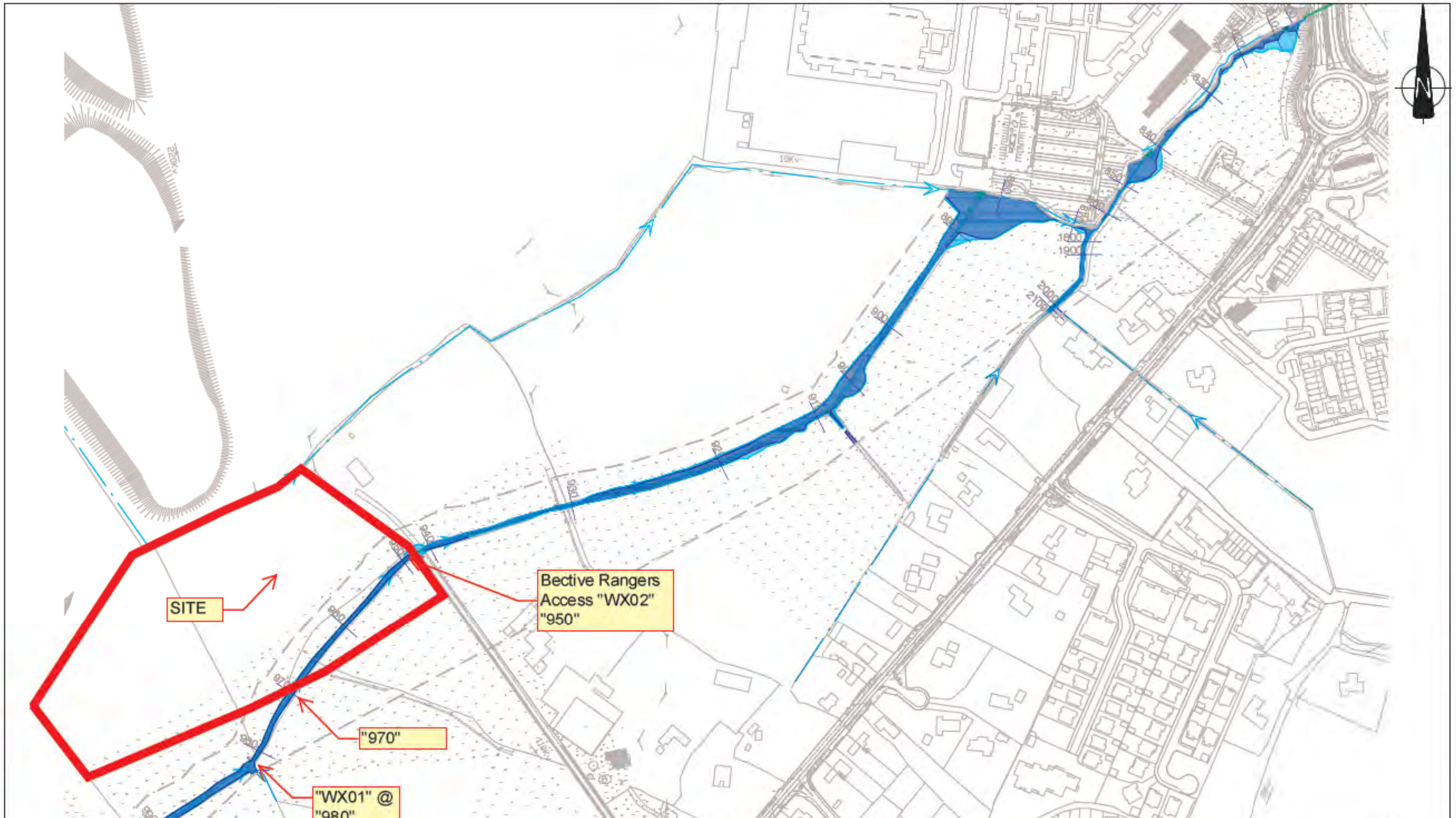
EU_CD	IE_EA_10C040350
NAME	CARRICKMINES STREAM_010
URL	View the Data Page
MS_CD	EA_10C040350
REGION_CD	17
INS_WHEN	2014-11-14T00:00:00Z
BASIN_CD	x1_10 Coastal
LAT	53.2583712
LON	-6.18506205
LENGTHKM	27.11683814
SUB_CD	10_5
DateChanged	2019-11-20T00:00:00Z
Change	Rivers updated
GEOLOGY	L
CatchmentAreaKm2	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



Flood Maps
HOME
ABOUT
PUBLICATIONS
RESOURCES
REPORT PAST FLOOD
FEEDBACK
HELP
DISCLAIMER
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.
KILGOBBIN
Stepaside
Stepaside Golf Course
JAMESTOWN
The Park Shopping Centre
Carrickmines
GLENAMUCK NORTH
CARRICKMINES GREAT
Carrickmines Golf Course
M50
GLEBE
R842
KILTIERNAN DOMAIN
GLENAMUCK SOUTH
LAUGHANSTOWN
TIKNICK
Kiltiernan
R116
200 m

Appendix 11.11

GDRS EIAR Hydrological Maps 14-2 & 14-2



GLENAMUCK STREAM & TRIBS - PLAN

1:5000

LOUGHLINSTOWN RIVER - PLAN

1:5000

Legend

- WATERCOURSE (EPA MAPPED)
- WATERCOURSE (LOCAL DRAINAGE)
- EXTENT OF FLOOD MAPPING
- Q100 FLOOD EXTENTS
- Q1000 FLOOD EXTENTS
- XX CROSS SECTION LOCATION
- EXISTING CULVERT
- PROPOSED CULVERT

Notes

1. DRAWINGS ARE PRELIMINARY DESIGNS FOR PLANNING ONLY AND ARE SUBJECT TO DETAILED DESIGN
2. ALL WATERCOURSE CROSSING WORKS SUBJECT TO OPW SECTION 50 APPROVAL AND APPROVAL BY INLAND FISHERIES IRELAND

Client

dlr Comhairle Contae County Council

Project

Key Plan

Drawing Title

EXISTING FLOOD EXTENTS

Scale at A3

AS SHOWN

Discipline

HYDROLOGY

Drawing Status

PLANNING

Drawing No

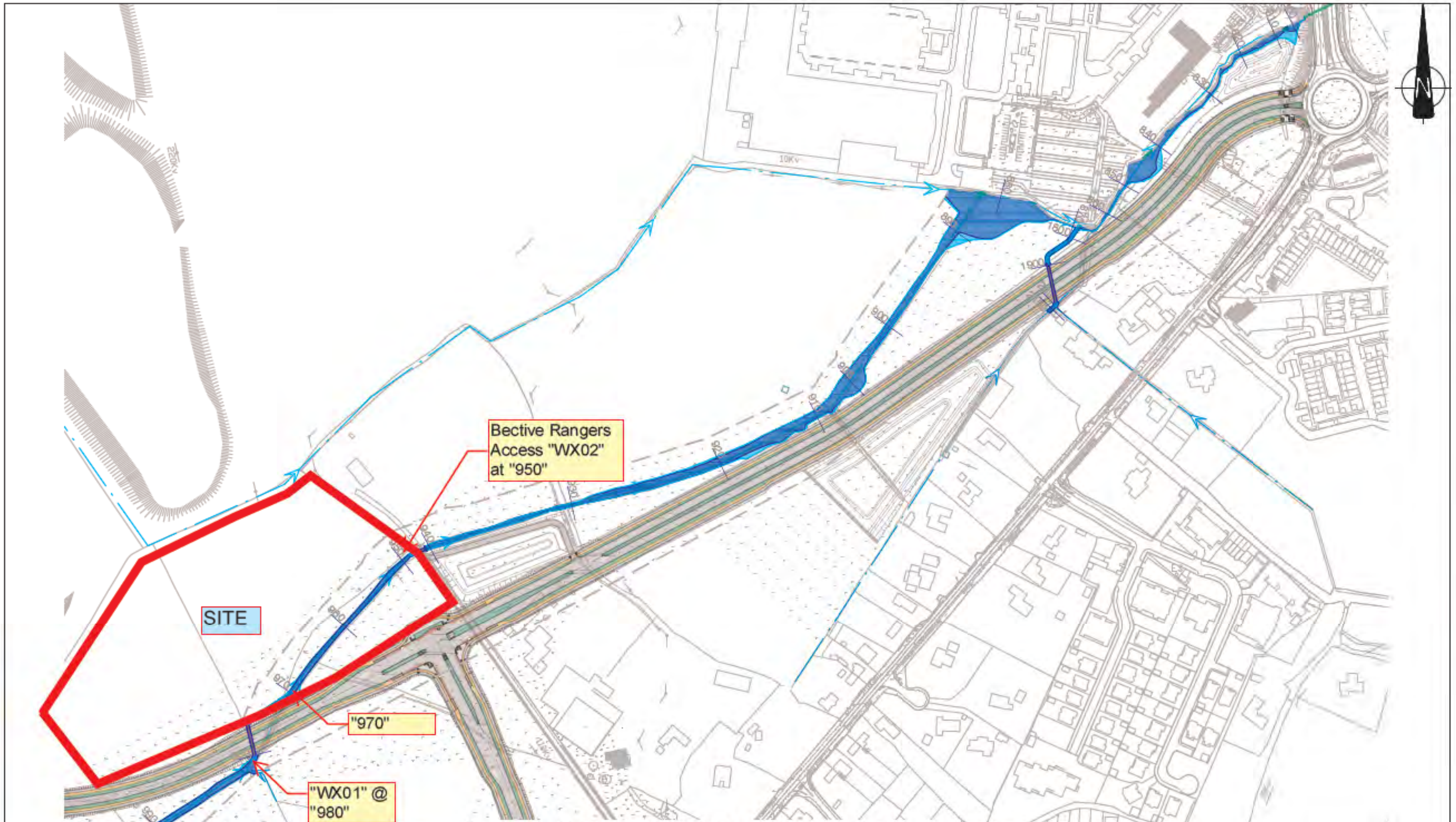
APPENDIX 14-1 FIGURE 1

Issue

-

Prepared By

DBFL Consulting Engineers
DUBLIN OFFICE Ormond House, Upper Ormond Quay, Dublin 7, Ireland. PHONE +353 1 400 4000
WATERFORD OFFICE Unit 2, The Chandlery, 1-2 O' Connell Street, Waterford, Ireland. PHONE +353 51 309 500
EMAIL info@dbfl.ie SITE www.dbfl.ie



GLENAMUCK STREAM & TRIBS - PLAN
1:5000

LOUGHLINSTOWN RIVER - PLAN
1:5000

Legend

- WATERCOURSE (EPA MAPPED)
- WATERCOURSE (LOCAL DRAINAGE)
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Client

dlr
Comhairle Contae County Council

Project

Key Plan

Drawing Title
PROPOSED FLOOD EXTENTS

Scale at A3
AS SHOWN

Discipline
HYDROLOGY

Drawing Status
PLANNING

Drawing No
APPENDIX 14-1 FIGURE 2

Issue
-

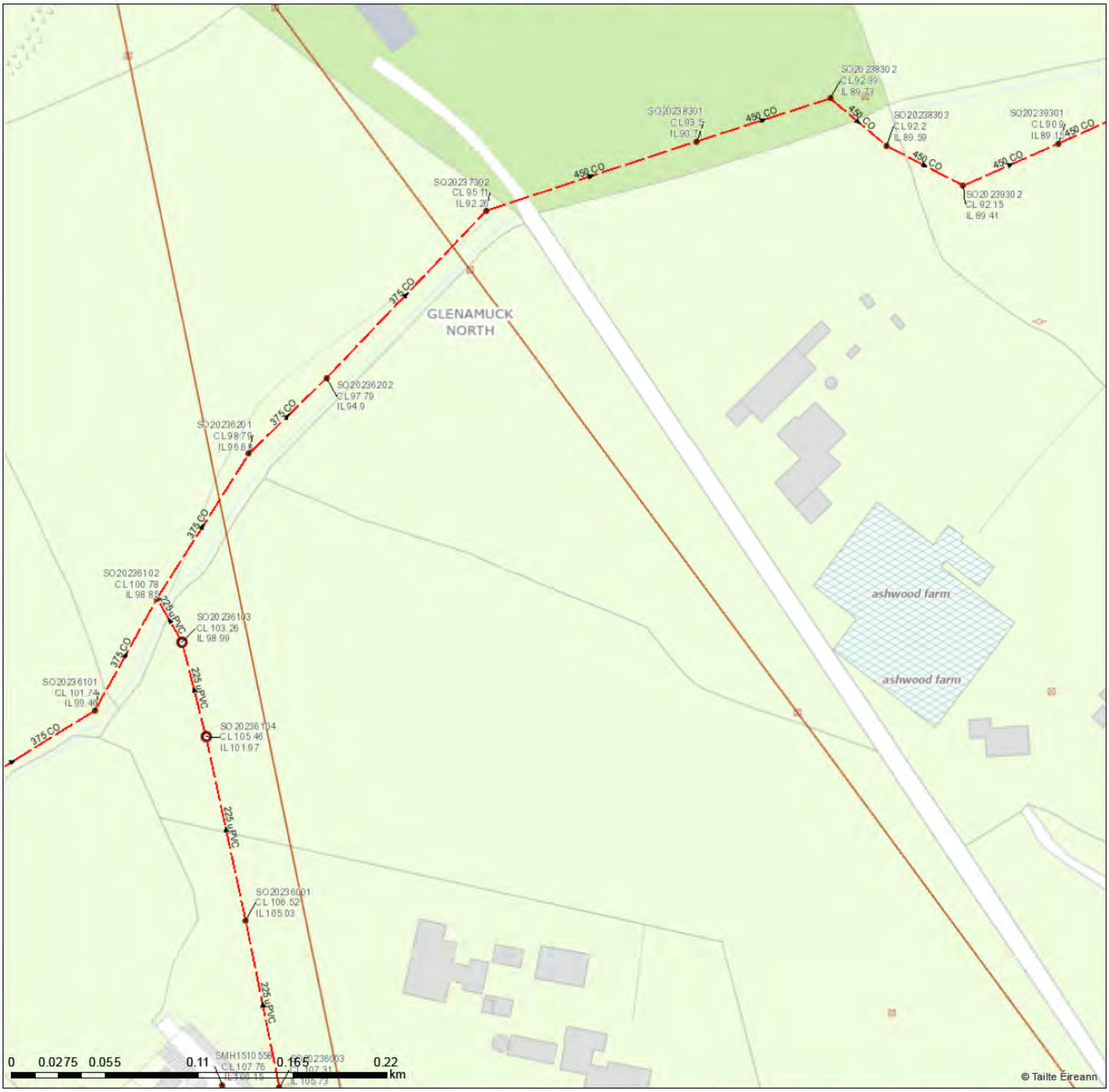
Prepared By

DBFL Consulting Engineers
DUBLIN OFFICE Ormond House, Upper Ormond Quay, Dublin 7, Ireland. PHONE +353 1 400 4000
WATERFORD OFFICE Unit 2, The Chandlery, 1-2 O' Connell Street, Waterford, Ireland. PHONE +353 51 309 500
EMAIL info@dbfl.ie SITE www.dbfl.ie

Appendix 11.12

Uisce Éireann Records Maps

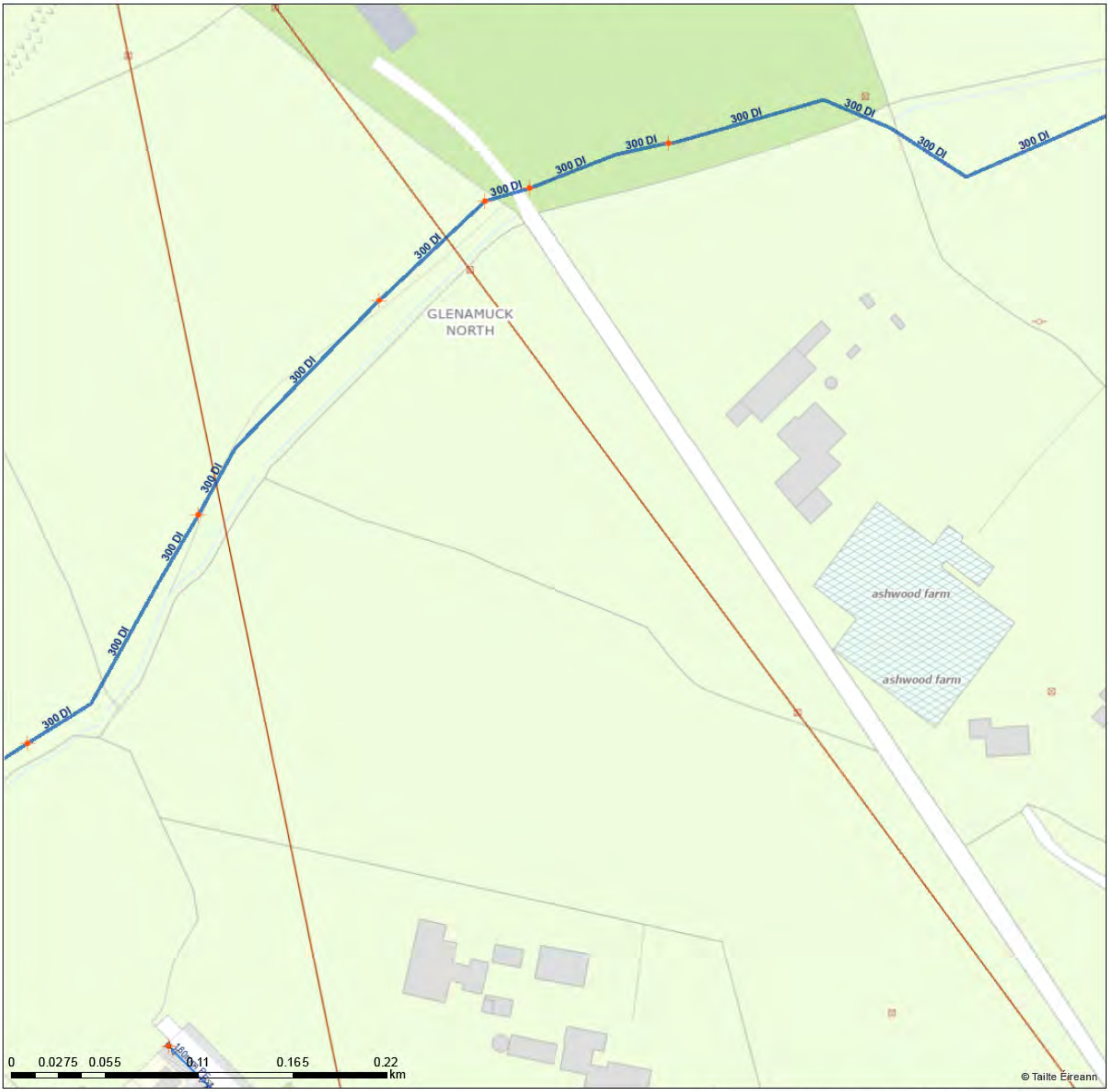
Glenamuck Foul Drainage

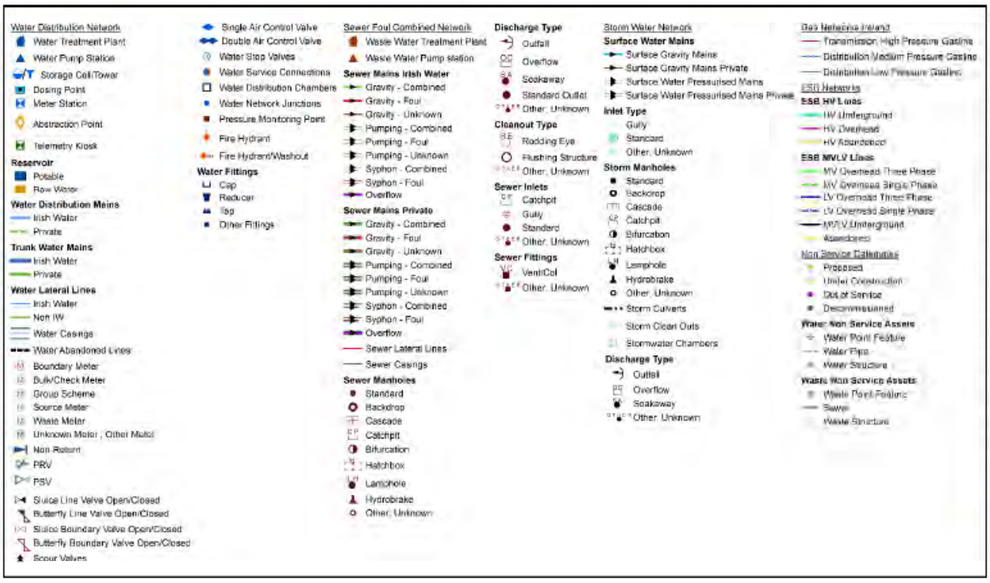


Print Date: 07/03/2025

Printed by: Uisce Éireann

Glenamuck Watermains





Uisce Éireann Irish Water

Print Date: 07/03/2025

Printed by:Uisce Éireann

Appendix 11.13

Met Éireann Rainfall Data

Met Eireann

Return Period Rainfall Depths for sliding Durations

Irish Grid: Easting: 320661, Northing: 223188,

DURATION	Interval 6months,	1year,	Years 2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	120,
5 mins	2.4,	3.4,	4.0,	4.9,	5.5,	6.0,	7.6,	9.4,	10.6,	12.3,	13.8,	15.0,	15.8,
10 mins	3.3,	4.8,	5.6,	6.8,	7.7,	8.3,	10.5,	13.0,	14.7,	17.1,	19.2,	20.9,	22.0,
15 mins	3.9,	5.6,	6.6,	8.0,	9.0,	9.8,	12.4,	15.3,	17.3,	20.1,	22.6,	24.6,	25.9,
30 mins	5.2,	7.4,	8.6,	10.4,	11.6,	12.5,	15.7,	19.3,	21.7,	25.0,	28.1,	30.4,	32.0,
1 hours	6.8,	9.6,	11.1,	13.3,	14.9,	16.0,	19.9,	24.3,	27.1,	31.2,	34.8,	37.6,	39.5,
2 hours	9.0,	12.5,	14.4,	17.2,	19.0,	20.5,	25.2,	30.5,	34.0,	38.9,	43.2,	46.5,	48.7,
3 hours	10.6,	14.6,	16.8,	19.9,	22.0,	23.7,	29.0,	34.9,	38.8,	44.2,	48.9,	52.6,	55.1,
4 hours	11.9,	16.3,	18.7,	22.1,	24.4,	26.2,	32.0,	38.4,	42.6,	48.4,	53.5,	57.5,	60.1,
6 hours	14.0,	19.1,	21.7,	25.6,	28.2,	30.2,	36.7,	43.9,	48.5,	55.0,	60.7,	65.1,	68.0,
9 hours	16.5,	22.3,	25.3,	29.7,	32.7,	34.9,	42.2,	50.2,	55.4,	62.5,	68.8,	73.7,	76.9,
12 hours	18.5,	24.9,	28.2,	33.0,	36.2,	38.7,	46.5,	55.2,	60.8,	68.5,	75.3,	80.4,	83.9,
18 hours	21.8,	29.1,	32.8,	38.3,	41.9,	44.6,	53.5,	63.1,	69.3,	77.9,	85.4,	91.1,	94.9,
24 hours	24.5,	32.4,	36.5,	42.5,	46.4,	49.4,	59.0,	69.4,	76.1,	85.3,	93.3,	99.5,	103.5,
2 days	30.5,	39.4,	44.0,	50.5,	54.7,	58.0,	68.1,	79.1,	86.0,	95.5,	103.7,	109.9,	114.0,
3 days	35.6,	45.3,	50.3,	57.3,	61.8,	65.3,	76.1,	87.6,	94.8,	104.7,	113.2,	119.5,	123.8,
4 days	40.1,	50.7,	55.9,	63.4,	68.2,	71.8,	83.2,	95.2,	102.8,	113.0,	121.8,	128.4,	132.7,
6 days	48.3,	60.2,	66.0,	74.3,	79.6,	83.6,	95.9,	108.9,	117.1,	128.0,	137.3,	144.3,	148.8,
8 days	55.8,	68.8,	75.2,	84.1,	89.8,	94.1,	107.4,	121.2,	129.9,	141.4,	151.2,	158.5,	163.3,
10 days	62.8,	76.8,	83.6,	93.2,	99.3,	103.9,	118.0,	132.6,	141.7,	153.8,	164.0,	171.7,	176.7,
12 days	69.4,	84.4,	91.7,	101.9,	108.3,	113.1,	127.9,	143.3,	152.8,	165.4,	176.1,	184.0,	189.2,
16 days	82.0,	98.8,	106.8,	118.0,	125.1,	130.4,	146.5,	163.2,	173.4,	187.0,	198.5,	207.0,	212.5,
20 days	94.0,	112.3,	121.0,	133.2,	140.8,	146.6,	163.9,	181.7,	192.6,	207.1,	219.2,	228.2,	234.1,
25 days	108.3,	128.4,	137.9,	151.2,	159.5,	165.7,	184.4,	203.5,	215.2,	230.6,	243.5,	253.0,	259.3,

NOTES:
These values are derived from a Depth Duration Frequency (DDF) Model update 2023
For details refer to:
'Mateus C., and Coonan, B. 2023. Estimation of point rainfall frequencies in Ireland. Technical Note No. 68. Met Eireann',
Available for download at:
http://hdl.handle.net/2262/102417

Glenamuck North -Site B Dec 2025
320661E,223188N
M5/60 = 16.0mm
r=0.276
SAAR = 994

Appendix 11.14

Uisce Éireann Confirmation of Feasibility

CONFIRMATION OF FEASIBILITY

Uisce Éireann
Bosca OP 448
Oifig Sheachadta na Cathrach Theas
Cathair Chorcaí

Uisce Éireann
PO Box 448
South City
Delivery Office
Cork City

www.water.ie

Phillip Assaf

1st Floor Maple House
Lower Kilmacud Road
Stillorgan
Dublin
A94E3F2

19 November 2025

Our Ref: CDS24006778 Pre-Connection Enquiry
Site B, Glenamuck North, Kilternan, Dublin

Dear Applicant/Agent,

We have completed the review of the Pre-Connection Enquiry.

Uisce Éireann has reviewed the pre-connection enquiry in relation to a Water & Wastewater connection for a Housing Development of 250 unit(s) at Site B, Glenamuck North, Kilternan, Dublin, (the **Development)**.

Based upon the details provided we can advise the following regarding connecting to the networks;

- **Water Connection**
  - Feasible without infrastructure upgrade by Uisce Éireann
  - A new 200mm diameter spur has been constructed from the new 355mm diameter water main to service the development as part of the Glenamuck District Roads Scheme

- **Wastewater Connection**
  - Feasible without infrastructure upgrade by Uisce Éireann
  - A new 225mm diameter spur has been constructed from the new 450mm diameter foul sewer to service the development as part of the Glenamuck District Roads Scheme

This letter does not constitute an offer, in whole or in part, to provide a connection to any Uisce Éireann infrastructure. Before the Development can be connected to our network(s) you must submit a connection application and be granted and sign a connection agreement with Uisce Éireann.

As the network capacity changes constantly, this review is only valid at the time of its completion. As soon as planning permission has been granted for the Development, a completed connection application should be submitted. The connection application is available at www.water.ie/connections/get-connected/

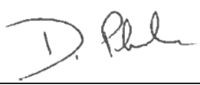
Where can you find more information?

- **Section A -** What is important to know?
- **Section B -** Details of Uisce Éireann's Network(s)

This letter is issued to provide information about the current feasibility of the proposed connection(s) to Uisce Éireann's network(s). This is not a connection offer and capacity in Uisce Éireann's network(s) may only be secured by entering into a connection agreement with Uisce Éireann.

For any further information, visit **www.water.ie/connections**, **email newconnections@water.ie** or contact 1800 278 278**.**

Yours sincerely,



Dermot Phelan
Connections Delivery Manager

Section A - What is important to know?

What is important to know?	Why is this important?
Do you need a contract to connect?	• Yes, a contract is required to connect. This letter does not constitute a contract or an offer in whole or in part to provide a connection to Uisce Éireann's network(s). • Before the Development can connect to Uisce Éireann's network(s), you must submit a connection application and be granted and sign a connection agreement with Uisce Éireann.
When should I submit a Connection Application?	• A connection application should only be submitted after planning permission has been granted.
Where can I find information on connection charges?	• Uisce Éireann connection charges can be found at: https://www.water.ie/connections/information/charges/
Who will carry out the connection work?	• All works to Uisce Éireann's network(s), including works in the public space, must be carried out by Uisce Éireann*. *Where a Developer has been granted specific permission and has been issued a connection offer for Self-Lay in the Public Road/Area, they may complete the relevant connection works
Fire flow Requirements	• The Confirmation of Feasibility does not extend to fire flow requirements for the Development. Fire flow requirements are a matter for the Developer to determine. • **What to do?** - Contact the relevant Local Fire Authority
Plan for disposal of storm water	• The Confirmation of Feasibility does not extend to the management or disposal of storm water or ground waters. • **What to do?** - Contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges.
Where do I find details of Uisce Éireann's network(s)?	• Requests for maps showing Uisce Éireann's network(s) can be submitted to: datarequests@water.ie

What are the design requirements for the connection(s)?	• The design and construction of the Water & Wastewater pipes and related infrastructure to be installed in this Development shall comply with ***the Uisce Éireann Connections and Developer Services Standard Details and Codes of Practice,*** available at www.water.ie/connections
Trade Effluent Licensing	• Any person discharging trade effluent** to a sewer, must have a Trade Effluent Licence issued pursuant to section 16 of the Local Government (Water Pollution) Act, 1977 (as amended). • More information and an application form for a Trade Effluent License can be found at the following link: https://www.water.ie/business/trade-effluent/about/ **trade effluent is defined in the Local Government (Water Pollution) Act, 1977 (as amended)

Section B – Details of Uisce Éireann's Network(s)

The map included below outlines the current Uisce Éireann infrastructure adjacent the Development: To access Uisce Éireann Maps email datarequests@water.ie

Reproduced from the Ordnance Survey of Ireland by Permission of the Government. License No. 3-3-34

Note: The information provided on the included maps as to the position of Uisce Éireann's underground network(s) is provided as a general guide only. The information is based on the best available information provided by each Local Authority in Ireland to Uisce Éireann.

Whilst every care has been taken in respect of the information on Uisce Éireann's network(s), Uisce Éireann assumes no responsibility for and gives no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided, nor does it accept any liability whatsoever arising from or out of any errors or omissions. This information should not be solely relied upon in the event of excavations or any other works being carried out in the vicinity of Uisce Éireann's underground network(s). The onus is on the parties carrying out excavations or any other works to ensure the exact location of Uisce Éireann's underground network(s) is identified prior to excavations or any other works being carried out. Service connection pipes are not generally shown but their presence should be anticipated.

Appendix 11.15

Foul and Water Demand Calculations

Foul/Wastewater Calculations

New Network - DOMESTIC Wastewater Flows -						
Usage	**Quantity**	**Occupancy (h)**	**Population (P)**	**Consumption (G) (l/h/day)**	**Loading (PxG)(l/day)**	
Residential	219 Units	2.7No./Unit	591	150	88,695	
				Total =	**88,695 l/day**	
				Flowrate per day (l/s)		**1.0l/s**
				Growth Rate	1	1
				Infiltration (I)	10%	0.01
				Dry Weather Flow	**PG + I**	**1.01 l/s**
				Peaking Factor (Pf_{Dom})	6	
				Design Foul Flow (l/s)	**Pf_{Dom} x PG**	**6.06 l/s**
				Misconnection Allowance (SW)	1.5%	0.01l/s
				Design Flow (l/s)		**6.07 l/s**

Based on Irish Water Code of Practice Wastewater Infrastructure

New Network – COMMERCIAL Wastewater Flows -						
Usage	**Quantity**	**Occupancy (h)**	**Population (P)**	**Consumption (G) (l/h/day)**	**Loading (PxG)(l/day)**	
Creche	572m^2	1child/5m^2 + Staff (20%) + support accommodation	135	50	6,750	
				Total =	**6,750 l/day**	
				Flowrate per day (l/s)		**0.16l/s**
				Growth Rate	1	1
				Infiltration (I)	10%	0.02
				Dry Weather Flow	**PG + I**	**0.18 l/s**
				Peaking Factor (Pf_{Dom})	6	
				Design Foul Flow (l/s)	**Pf_{Dom} x PG**	**1.08 l/s**
				Misconnection Allowance (SW)	1.5%	0.01l/s
				Design Flow (l/s)		**1.09 l/s**

Based on Irish Water Code of Practice Wastewater Infrastructure

Water Demand Calculations

New Network – DOMESTIC Water Demand								
Usage	**Quantity**	**Occupancy**	**Population**	**Consumption (l/l/h/day)**	**Ave. Daily Domestic Demand (l/day)**	**Ave. Daily Domestic Demand (l/s)**	**Ave. Day/Peak Week (l/s)**	**Peak Hour Water Demand (l/s)**
Resi'	219 Units	2.7 No./Unit	591	150	88,695	1.0	1.25	**6.25 l/s**
Peak Hour Water Demand (Domestic)								**6.3 /s**

Based on Irish Water Code of Practice for Water Infrastructure

New Network – COMMERCIAL Water Demand								
Usage	**Quantity**	**Occupancy**	**Population**	**Consumption (l/l/h/day)**	**Ave. Daily Domestic Demand (l/day)**	**Ave. Daily Domestic Demand (l/s)**	**Ave. Day/Peak Week (l/s)**	**Peak Hour Water Demand (l/s)**
Creche	$572m^2$	1child/$5m^2$ + Staff (20%) + support accommodation	135	50	6,750	0.16	0.2	**1.0 l/s**
Peak Hour Water Demand (Domestic)								**1.0 /s**

Based on Irish Water Code of Practice for Water Infrastructure

Appendix 11.16

Hydrobrake Calculations

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	0.730	20.100
Flush-Flo™	0.309	20.030
Kick-Flo®	0.564	17.768
Mean Flow		16.205

hydro-int.com/patents

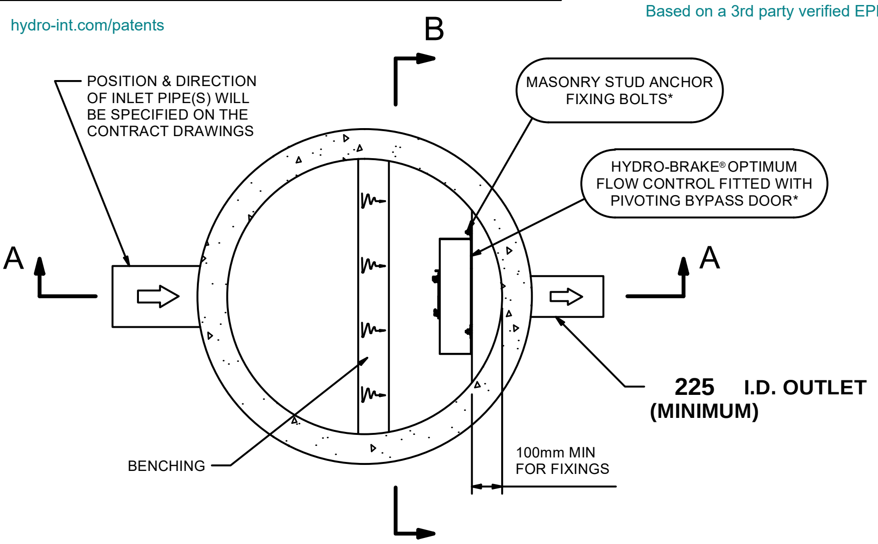
This Hydro-Brake® Optimum includes:

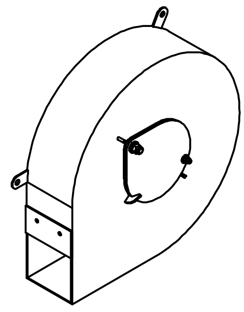
- All in 3 mm Grade 304L stainless steel
- Integral pivoting by-pass door allowing clear line of sight through to outlet, c/w operating rope
- Media blasted for corrosion resistance
- Variable flow rate post installation via adjustable inlet (if necessary)
- Indicative Weight: 25 kg
- Product Carbon Footprint: 100 kgCO2e

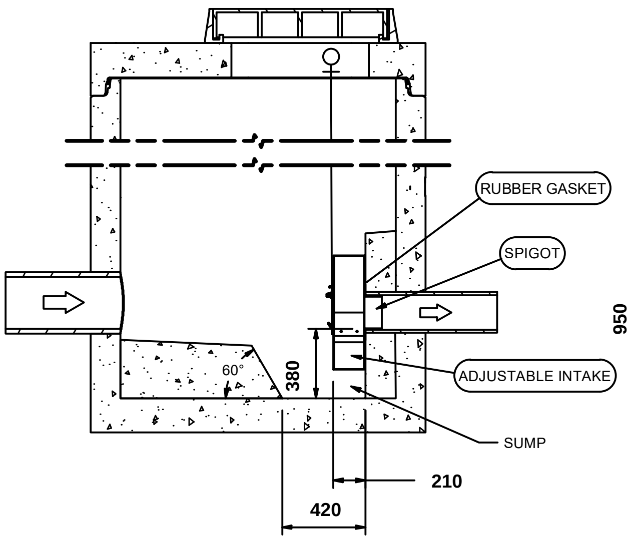
Based on a 3rd party verified EPD: hydro-int.com/epd

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

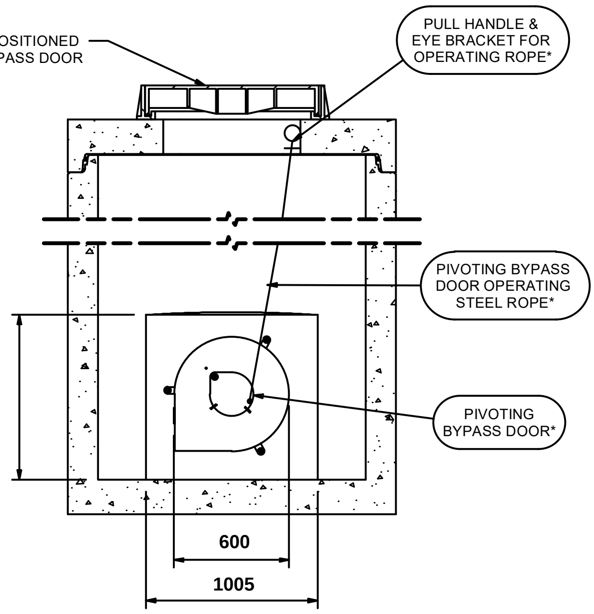
wrc approved PT/503/0422







SECTION A-A



SECTION B-B

IMPORTANT: LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS
* WHERE SUPPLIED
HYDRO-BRAKE® IS A REGISTERED TRADEMARK FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE !

The head/flow characteristics of this SHE-0202-2010-0730-2010 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International A CRH COMPANY

DATE	21/01/2026 16:19
SITE	Glenamuck Nth Site B1
DESIGNER	Roger Mullarkey
REF	2411

SHE-0202-2010-0730-2010
Hydro-Brake® Optimum

info@rmullarkey.ie

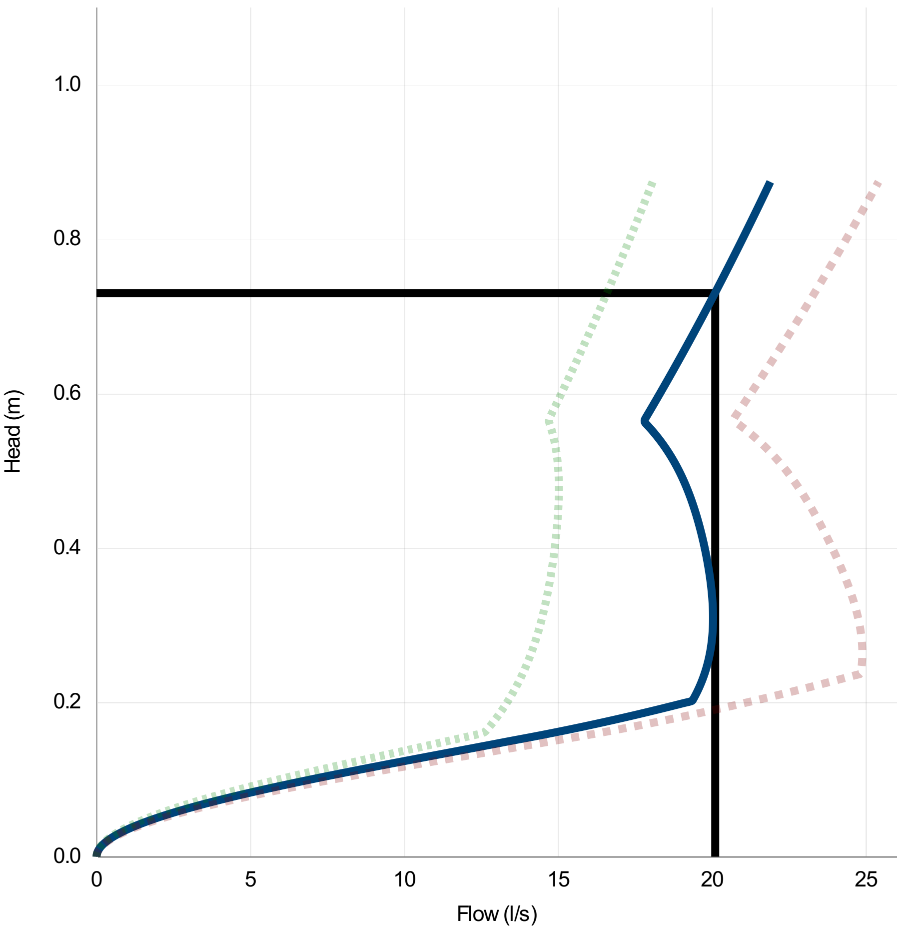
Technical Specification

Control Point	Original Setting		Minimum Setting		Maximum Setting	
	Head (m)	Flow (l/s)	Head (m)	Flow (l/s)	Head (m)	Flow (l/s)
Primary Design	0.730	20.100	0.730	16.578	0.730	23.320
Flush-Flo™	0.309	20.030	0.477	15.020	0.264	24.879
Kick-Flo®	0.564	17.768	0.565	14.673	0.565	20.663
Mean Flow		16.205		12.605		19.144

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE No 08/4596

wrc approved PT/503/0422

hydro-int.com/patents



Head (m)	Flow (l/s)
0.000	0.000
0.025	0.513
0.050	1.964
0.076	4.196
0.101	7.030
0.126	10.249
0.151	13.581
0.176	16.683
0.201	19.335
0.227	19.656
0.252	19.861
0.277	19.980
0.302	20.027
0.327	20.017
0.352	19.960
0.378	19.867
0.403	19.743
0.428	19.590
0.453	19.402
0.478	19.170
0.503	18.877
0.529	18.501
0.554	18.012
0.579	17.996
0.604	18.363
0.629	18.722
0.654	19.074
0.680	19.418
0.705	19.757
0.730	20.089

DESIGN ADVICE

!

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Hydro International A CRH COMPANY

DATE	21/01/2026 16:19
Site	Glenamuck Nth Site B1
DESIGNER	Roger Mullarkey
Ref	2411

SHE-0202-2010-0730-2010

Hydro-Brake® Optimum

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	0.770	10.000
Flush-Flo™	0.256	9.997
Kick-Flo®	0.553	8.560
Mean Flow		8.412

hydro-int.com/patents

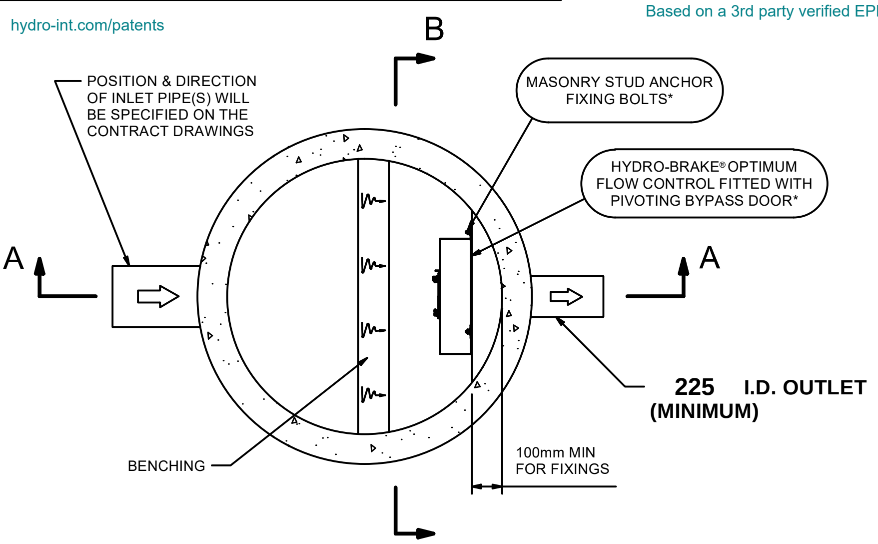
This Hydro-Brake® Optimum includes:

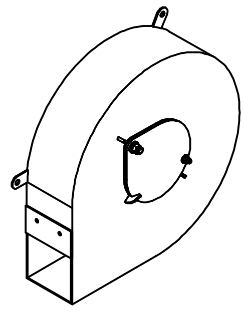
- All in 3 mm Grade 304L stainless steel
- Integral pivoting by-pass door allowing clear line of sight through to outlet, c/w operating rope
- Media blasted for corrosion resistance
- Variable flow rate post installation via adjustable inlet (if necessary)
- Indicative Weight: 20 kg
- Product Carbon Footprint: 73.27 kgCO2e

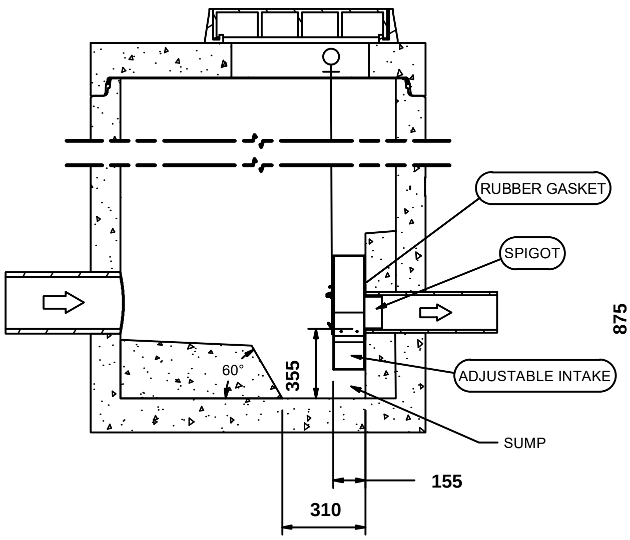
Based on a 3rd party verified EPD: hydro-int.com/epd

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

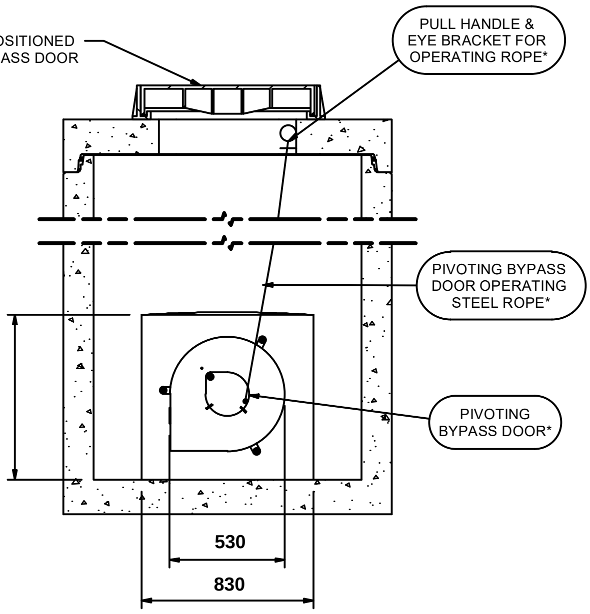
wrc approved PT/503/0422







SECTION A-A



SECTION B-B

IMPORTANT: ⬭ LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
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* WHERE SUPPLIED
HYDRO-BRAKE® IS A REGISTERED TRADEMARK FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

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DESIGN ADVICE !

The head/flow characteristics of this SHE-0149-1000-0770-1000 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International A CRH COMPANY

DATE	21/01/2026 14:01
SITE	Glenamuck Nth Site B2
DESIGNER	Roger Mullarkey
REF	2411

SHE-0149-1000-0770-1000

Hydro-Brake® Optimum

info@rmullarkey.ie

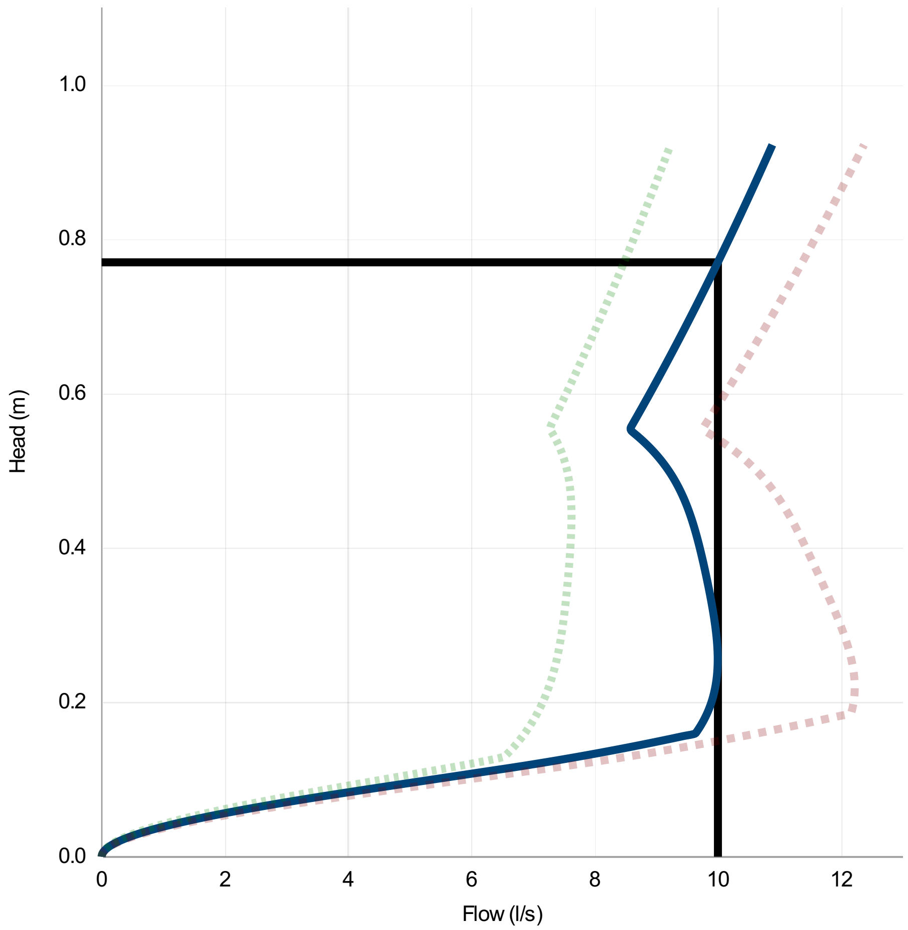
Technical Specification

	Original Setting		Minimum Setting		Maximum Setting	
Control Point	Head (m)	Flow (l/s)	Head (m)	Flow (l/s)	Head (m)	Flow (l/s)
Primary Design	0.770	10.000	0.770	8.477	0.770	11.367
Flush-Flo™	0.256	9.997	0.442	7.624	0.219	12.220
Kick-Flo®	0.553	8.560	0.554	7.260	0.553	9.740
Mean Flow		8.412		6.727		9.783

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE No 08/4596

wrc approved PT/503/0422

hydro-int.com/patents



Head (m)	Flow (l/s)
0.000	0.000
0.027	0.479
0.053	1.787
0.080	3.690
0.106	5.884
0.133	7.952
0.159	9.633
0.186	9.825
0.212	9.938
0.239	9.989
0.266	9.994
0.292	9.967
0.319	9.919
0.345	9.858
0.372	9.788
0.398	9.711
0.425	9.622
0.451	9.511
0.478	9.365
0.504	9.162
0.531	8.881
0.558	8.595
0.584	8.784
0.611	8.969
0.637	9.149
0.664	9.326
0.690	9.499
0.717	9.668
0.743	9.835
0.770	9.998

DESIGN ADVICE

!

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The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International A CRH COMPANY

DATE	21/01/2026 14:01
Site	Glenamuck Nth Site B2
DESIGNER	Roger Mullarkey
Ref	2411

SHE-0149-1000-0770-1000

Hydro-Brake® Optimum

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	0.710	2.200
Flush-Flo™	0.213	2.195
Kick-Flo®	0.461	1.808
Mean Flow		1.911

hydro-int.com/patents

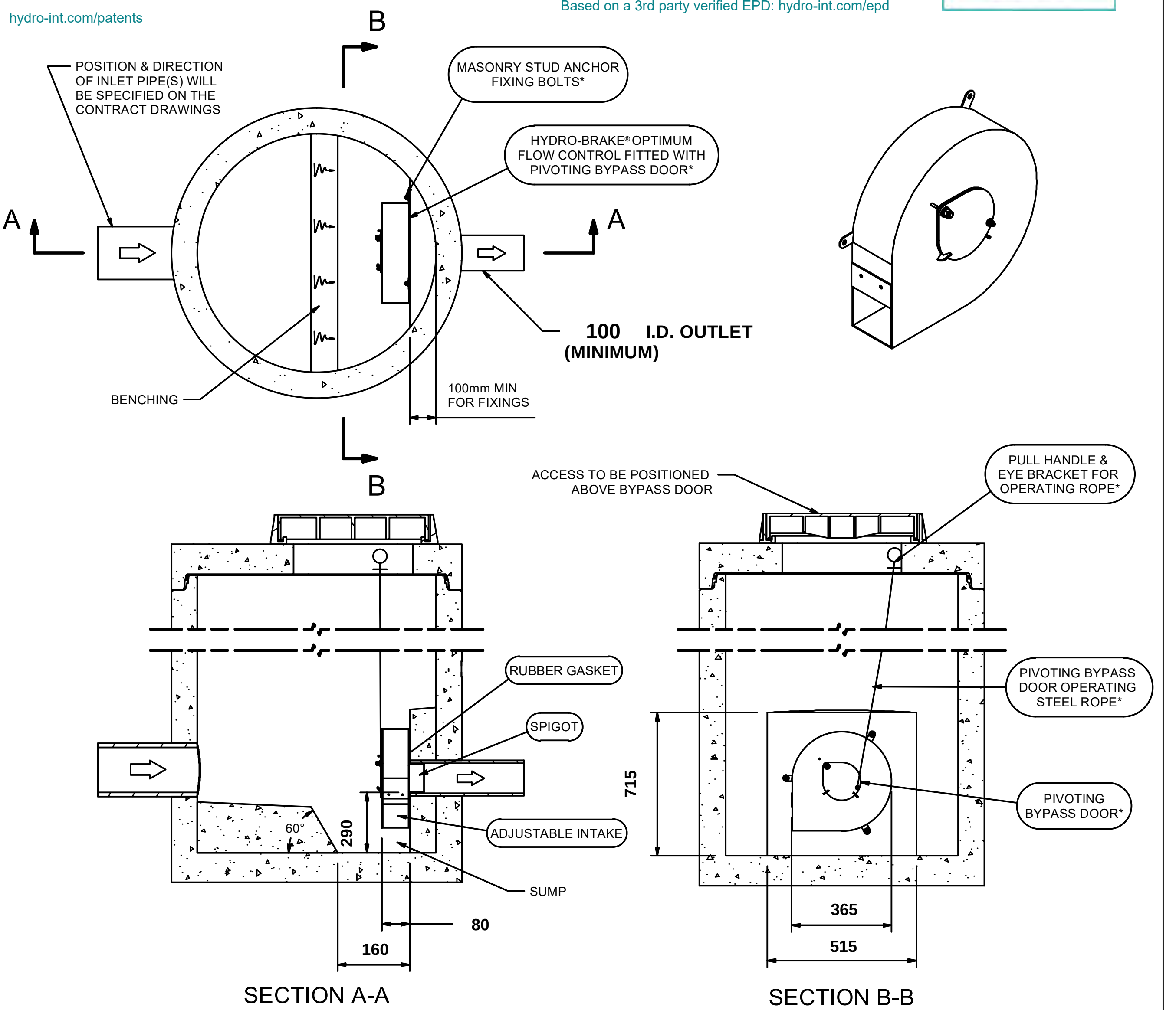
This Hydro-Brake® Optimum includes:

- All in 3 mm Grade 304L stainless steel
- Integral pivoting by-pass door allowing clear line of sight through to outlet, c/w operating rope
- Media blasted for corrosion resistance
- Variable flow rate post installation via adjustable inlet (if necessary)
- Indicative Weight: 10 kg
- Product Carbon Footprint: 31.73 kgCO2e

Based on a 3rd party verified EPD: hydro-int.com/epd

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

wrc approved PT/503/0422



IMPORTANT: LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS
* WHERE SUPPLIED
HYDRO-BRAKE® IS A REGISTERED TRADEMARK FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE !

The head/flow characteristics of this SHE-0075-2200-0710-2200 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International A CRH COMPANY

DATE	21/01/2026 14:05
SITE	Glenamuck Nth Site B3
DESIGNER	Roger Mullarkey
REF	2411

SHE-0075-2200-0710-2200
Hydro-Brake® Optimum

info@rmullarkey.ie

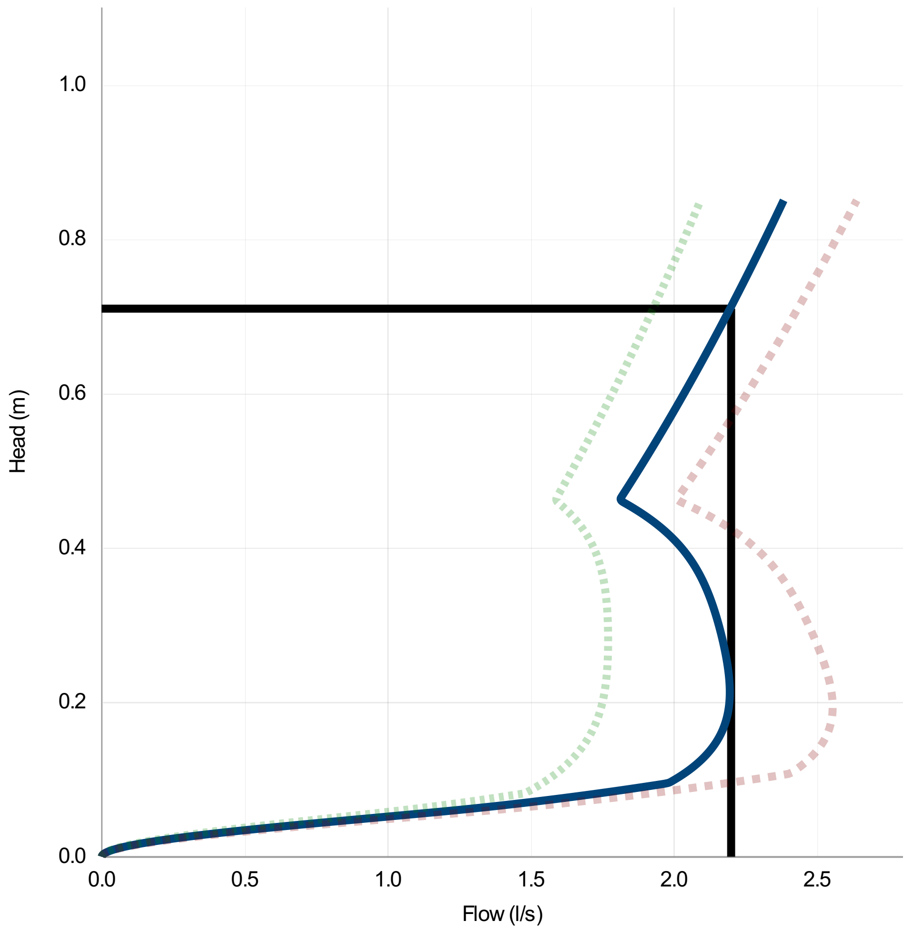
Technical Specification

Control Point	Original Setting		Minimum Setting		Maximum Setting	
	Head (m)	Flow (l/s)	Head (m)	Flow (l/s)	Head (m)	Flow (l/s)
Primary Design	0.710	2.200	0.710	1.927	0.710	2.433
Flush-Flo™	0.213	2.195	0.280	1.770	0.195	2.555
Kick-Flo®	0.461	1.808	0.461	1.584	0.462	2.006
Mean Flow		1.911		1.607		2.162

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE No 08/4596

wrc approved PT/503/0422

hydro-int.com/patents



Head (m)	Flow (l/s)
0.000	0.000
0.024	0.269
0.049	0.909
0.073	1.558
0.098	1.993
0.122	2.087
0.147	2.145
0.171	2.178
0.196	2.193
0.220	2.195
0.245	2.189
0.269	2.177
0.294	2.161
0.318	2.142
0.343	2.118
0.367	2.087
0.392	2.045
0.416	1.986
0.441	1.904
0.465	1.815
0.490	1.857
0.514	1.898
0.539	1.939
0.563	1.978
0.588	2.016
0.612	2.054
0.637	2.090
0.661	2.126
0.686	2.162
0.710	2.196

DESIGN ADVICE

!

The head/flow characteristics of this SHE-0075-2200-0710-2200 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.

The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International A CRH COMPANY

DATE	21/01/2026 14:05
Site	Glenamuck Nth Site B3
DESIGNER	Roger Mullarkey
Ref	2411

SHE-0075-2200-0710-2200

Hydro-Brake® Optimum

Appendix 11.17

Green Roofs

Bauder Green Roof Solutions

Systems for new build construction and existing buildings

For all green roofs, an integrated approach is crucial for the design and specification of both the waterproofing and landscaping components to achieve the best results.

Creating a green roof requires key decisions about access and what the roof is to be used for before the design can begin. We will work with you from the earliest design stage to ensure that your green roof project comes to fruition beautifully.

Intensive green roofs

Garden planting schemes require greater depths of substrate and the overall weight of the solution dictates the construction of the supporting structure and the green roof components required to sustain the vegetation.
See pages 6-7.

Biodiverse green roofs

The aim is to replicate, as far as is practical, the ecological requirements for the local area. The habitats are designed to support a variety of native plants, birds, animals, and invertebrates. The careful design and construction of these habitats is key to conforming to the local Biodiversity Action Plan (BAP) or the site's Urban Greening Factor (UGF) commitment. See pages 8-9.

~~**Extensive green roofs**~~

Extensive green roofs are constructed using shallow depths of growing mediums and access limited to only allow for maintenance.

A substrate-based green roof will often incorporate a mixed vegetation scheme of low maintenance plants chosen to suit the project and location.

Our BauderGREEN Sedum System is installed with the BauderGREEN XF 301 sedum blanket direct on to our root resistant waterproofing.
See pages 10-13.

Marischal Square
New Aberdeen

Richard Knightly House

Brookfield Primary School

Enhancing the Roof

Bringing net zero and climate change into focus through further rooftop facilities

Generating renewable energy through adding a PV array and attenuating stormwater with a rooftop SuDS to reduce localised flooding.

Using the roof to generate energy

A flat roof is the ideal place for a solar photovoltaic (PV) installation to generate site-sourced electricity. Our BauderSOLAR G LIGHT is an integrated biosolar solution for mounting photovoltaic renewable energy on a green roof or blue roof where the substrate and vegetation provide the ballasted installation mechanism to secure the array.

A biosolar PV system allows for the entire roof to qualify as a green roof, and if a biodiversity finish is specified this can further enhance the BREEAM credit rating for the roof element. See pages 14-15.

Clapham Park
Lambeth, London

Attenuating rainfall to reduce run-off

A blue roof offers a sustainable drainage method designed to attenuate and slow the discharge of stormwater from a flat roof for up to a 48 hour period via a restrictive flow outlet. Ideal for urban areas where options for ground-based attenuation systems are limited or where construction is being carried out within flood sensitive areas. See pages 16-17.

Permeable paving on pedestals finish

Bauder Intensive Green Roofs

Outdoor spaces for people to enjoy soft vegetated recreational areas and hard landscaped access zones

Replicating a traditional landscape at roof level with lightweight components and substrates for a shallower build up than conventional landscaping.

Creating an intensive green roof on a building provides additional facilities and maximises the potential of the building.

The desired planting finish will dictate the assembly of the green roof components and the construction of the supporting structure.

Depths of substrate will vary to accommodate trees, shrubs, herbaceous planting, and turfed areas with bedding options for hard landscaping. Maintenance of the roof is required throughout the year to upkeep the landscape and allow the vegetation to flourish.

Plus points

- Assists in maximising the building's potential and overall value of the property.
- Provides valuable recreational space.
- Bauder technical support service gives integrated approach for design and specification of waterproofing and landscaping components.
- Comprehensive range of guarantee packages to fulfil cover requirements for the project (dependent on system/product selection). For more information contact our technical dept for a sample guarantee outlining cover level, terms and conditions.


Marischal Square
Aberdeen, Scotland

Bauder Intensive Green Roofs

Holyrood Student Accommodation
Edinburgh

BUILDING BOARD

Roof Size:	4,000m^2
Roofing Systems:	Bauder Hot Melt System and intensive green roof
Client:	University of Edinburgh
Main Contractor:	Balfour Beatty
Specifier:	Oberlanders Architects & JM Architects
Approved Contractor:	Procladd

All England Lawn Tennis Club Museum
Wimbledon

Bauder Biodiverse Green Roofs

Creating a habitat to encourage a wider spread of birds, insects, and plant species

Substrate based non publicly accessed green roofs meeting the requirement for biodiversity at roof level and primarily specified for ecological benefits.

Biodiverse green roofs are generally designed with British native vegetation and additional elements, such as log piles and dew ponds, to create the desired habitat. The different plants are normally established through plugs, seeds, or wildflower blanket on a range of substrate depths, typically 80-150+mm.

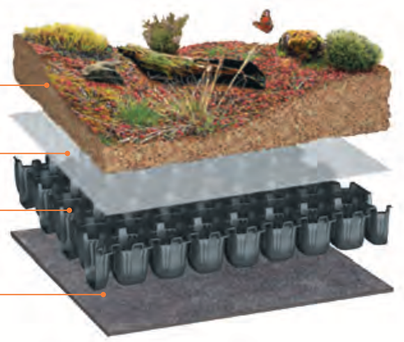
Biodiverse green roofs can also be created on a pitch of up to 25 degrees. This configuration requires the BauderGREEN WSP reservoir board to enhance water retention for the plants, hold the substrate in place, and be sufficiently rigid to manage the imposed shear load.

Plus points

- British native vegetation options comprising seed mixes, plug plants, and wildflower blanket.
- Specification embraces all elements of waterproofing, the green roof components and planting scheme.
- Meet Biodiversity Action Plans, Urban Greening Factor, or planning requirements for the location.
- Contributes to BREEAM assessment ratings.
- Single source for design of Bauder waterproofing and green roof with clear accountability.
- Comprehensive range of guarantee packages to fulfil cover requirements for the project (dependent on system/product selection). For more information contact our technical dept for a sample guarantee outlining cover level, terms and conditions.

Biodiverse roof plans

An ecological report will normally define the requirements for the biodiverse finish and our technical team will provide detailed layouts of the roof showing mounding of substrate and location of planting ensuring the loading of the roof is compatible with the structure.



Bauder Biodiverse Green Roofs

Our vegetation options

BauderGREEN WB wildflower blanket for instant coverage at installation

BauderGREEN WB native species wildflower blanket

The UK grown vegetation blanket contains a broad mix of 38 British wildflowers, herbs, and grasses that are included on most BAP lists. The vegetation is grown in lightweight substrate on a coir carrier that is 100% biodegradable. The natural fibres of the coir carrier promote the rapid rooting of the blanket into the BauderGREEN SUB-BM UK biodiverse substrate.

The blanket meets GRO recommendations and the vegetation is specifically selected to flourish in the challenging conditions found at roof top level.

BauderGREEN Plug Plants immediately after planting

BauderGREEN Plug Plants native species wildflowers

The use of small seedling plants allows the specifier to select the individual species to be planted by hand, their position on the roof, and density of planting. The more plugs per square metre, the faster the vegetation will establish to cover the roof entirely.

We supply a large variety of British provenance plug plants to suit the specification and desired finish.

BauderGREEN Flora seed mix established over two years

BauderGREEN Flora Seed Mixes

Our range uses with different blends of seed with British and Scottish provenance to suit different roof environments for costal, urban, and chalk grassland. They balance the requirement to have grasses and low ground cover, to prevent erosion, with wildflowers to offer a nectar source to many insects visiting the green roof.

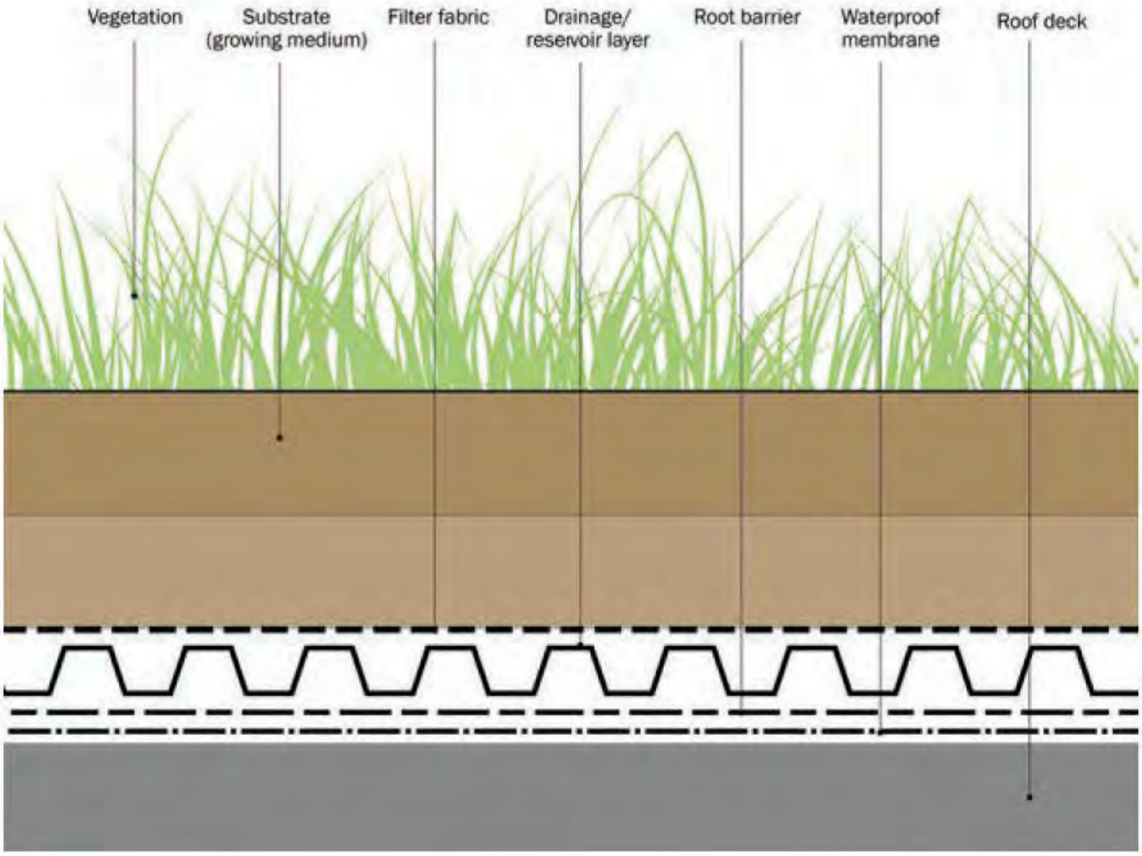


Figure 12.1 Section showing typical extensive green roof components

As mentioned earlier, there are two main types of green roof:

Extensive green roofs – These systems cover the entire roof area with hardy, slow growing, drought tolerant, low maintenance plants (eg mosses, succulents, herbs, grasses) often enhanced with wildflowers. Planting often establishes more slowly, but the long-term biodiversity can be of high value. They are only accessed for maintenance and can be flat or sloping. Extensive green roofs typically comprise a 20–150 mm thick growing medium and can be further divided into "single-layer" systems (which consist of a single medium designed to be free-draining and support plant growth), and "multi-layer" systems that include both a growing medium layer and a separate underlying drainage layer. They are lightweight and low cost to maintain, and can be used in a wide variety of locations with minimal intervention. They are often suitable for retrofit on existing structures due to their light weight. Biodiverse extensive green roofs are often planted with a mix of species supported by a range of soil depths.

Intensive green roofs (or roof gardens) – These are designed to sustain more complex landscaped environments that can provide high amenity or biodiversity benefits. They are planted with a range of plants including grasses, shrubs and/or trees, either as ground cover or within planters, and may also include water features and storage of rainwater for irrigation (ie blue roof elements). They are usually easily accessible, as they normally require a fairly high level of regular maintenance, and in some cases they are made accessible to the public. Intensive roofs have a deeper substrate, with >150 mm growing medium, and therefore impose greater loads on the roof structure.

Green roofs with substrate depths of 100–200 mm tend to be semi-intensive roofs, and can include characteristics of both extensive and intensive roofs, with plants that include shrubs and woody plants. Irrigation and maintenance requirements of this type of roof will be dependent upon the plant species chosen for the roof. There are also various combinations of green roof that combine both types in a single roof system.

A comparison of the main differences between extensive and intensive green roof systems is given in **Table 12.1**.

Appendix 11.18

Surface Cover Type

Surface Cover Type	Area (m^2)
Wetland or open water (semi-natural; not chlorinated) maintained or established on site.	3645
Semi-natural vegetation (e.g. hedgerows, trees, woodland, species-rich grassland) maintained or established on site.	2687
Reuse of existing soils and seed source to develop vegetation cover	0
Standard trees planted in connected tree pits with a minimum soil volume equivalent to at least two thirds of the projected canopy area of the mature tree.	0
Standard trees planted in pits with soil volumes less than two thirds of the projected canopy area of the mature tree.	17*
Intensive green roof or vegetation over structure. Substrate minimum settled depth of 150mm.	2690
Non intensive Brown Roof (Biodiversity Roof). Substrate minimum settled depth of 150mm. Design will be site specific and developed by a suitably qualified ecologist.	0
Extensive green roof with substrate of minimum settled depth of 80mm (or 60mm beneath vegetation blanket)	0
Extensive green roof of sedum mat or other lightweight systems	0
Green wall -modular system or climbers rooted in soil.	0
Rain gardens and other vegetated sustainable drainage elements.	1128
Flower-rich perennial planting.	5815
Hedges (line of mature shrubs one or two shrubs wide).	2000
Hedgerows or double hedgerow of native species (may have an associated ditch and bank)	2687
Groundcover planting.	0
Amenity grassland entire area or sections managed for lesser mowing frequencies for pollinators (e.g. six week meadow)	3526
Amenity grassland (species-poor, regularly mown lawn).	5465
Water features (chlorinated) or unplanted detention basins.	0
Permeable paving.	3975
Sealed surfaces (e.g. concrete, asphalt, waterproofing, stone)	16,085
Blue roof	0

Appendix 11.19

Stage 2 Opinion Response Table

	LRD Notice of Response Ref PAC/LRD2/005/25	
No	**DLR Water Services Department – Drainage Planning Opinion – Appendix C Internal Reports**	**Response**
1	*The applicant has indicated that the open channel running through the site is to be maintained. As noted in the SSFRA this channel carries run off from a catchment that includes the Jamestown Golf Course. This channel appears to be located within the detention basin area and will be controlled via the flow control device at SMh235HB. It is not clear from the information provided if an allowance has been made for storage volume associated with this channel in the calculations of storage requirements and provision. The applicant is requested to provide details of the catchment area for this channel, including a catchment map, and estimate a volume associated with the channel that will be added to the volume of the storage structure for the site. If this is not possible, the open channel should be removed from the detention basin area and permitted to discharge directly to the stream as per the status quo.*	To clarify, the Glenamuck Stream is independent of any proposed new drainage infrastructure and is not attenuated by any flow control device. Therefore, there is no associated attenuation volume to be assessed.
2	*The applicant has indicated the total flat roof area of the buildings with green roof proposed. The applicant is requested to clarify if this is the total roof area of the buildings. The green roof policy is based on the total roof area rather than the flat roof area.*	The green roof areas noted in the report are net areas and are in compliance with the green roof policy. See paragraphs 7.1.9 & 7.1.10 for more detail.
3	*The applicant has provided a S/W Drained Area drawing which sets out the various catchment areas. The applicant is requested to clarify what the red hatched area refers to, as it has not been included in the legend. It appears that this does not drain to a SuDS feature and has not been included in the area calculations. In addition, the applicant is requested to clarify the area of the site that has not been included in the analysis, as the site has been reduced from 5.2ha to 4.1ha, presumably it is largely the riparian corridor, which has not been coloured in the drained area map. However, this non-coloured area is also present to the rear of the houses, but there is a drain provided which connects to the main drainage network. This area should be included in the area calculations if positively drained. A review of the road network should be carried out to ensure areas of the network that drain*	Refer to Dwg.Dwg.2411206 that shows all paved areas, including rear gardens, that account for the total net catchment areas used. All relevant applicable paved area factors have been applied and highlighted as such in coloured shaded areas on Dwg.2411/206.

	directly to the attenuation tank, without going through a soft SuDS measure should be removed from the "Road to SuDS" areas.	
4	*The applicant has proposed to use a detention basin in Catchment B1 for all flood events, including the smaller events. While the site has been provided with a large number of soft SuDS measures, the utilisation of the green space could be compromised on a number of occasions due to the wet ground conditions. In addition, the storage depth for the AEP 1% is almost 1m in depth. This is a significant depth of water to be stored on site, and in particular on the only significant public open space. The applicant is requested to consider the use of a tank for events up to and including the 1 in 30-year event.*	Noted and the Stage 3 design CATCHMENT B1 has been revised to allow for a below ground storage system.
5	*It should be noted that MicroDrainage uses a default Cv value of 1.0, as stated in Section 6.12 of the engineering report. However, inconsistencies have been identified in the application of Cv values throughout the MicroDrainage model. The applicant is requested to ensure consistency by applying a Cv value of 1.0 uniformly across the report and updating all associated calculations.*	The Cv values have been set to 1.0 and calculations adjusted accordingly in the Stage 3 submission.
6	*In Section 6.17 of the Engineering Report, Table 4 outlines the flow control limits for each catchment area. However, these values do not align with the QBAR calculations presented in Table 2 of Section 6.12, as well as the allowable outflow reference on the "Attenuation Storage Detail" drawing. The applicant is required to ensure consistency between the flow control limits and the QBAR values throughout the report, and to revise the relevant sections.*	The QBar of the site and corresponding flow control limits are aligned and summarised in paragraph 6.7.
7	*The applicant has stated that a Section 50 will be submitted to the OPW in line with the requirements for structures over watercourses in relation to the vehicular bridge proposed. A pedestrian bridge is also proposed which should also get Section 50 approval from the OPW.*	Noted.
8	*As standard, the applicant is requested to ensure that all surface water design proposals are in accordance with the requirements of Appendix 7: Sustainable Drainage System Measures of the County Development Plan 2022-2028.*	The SuDS elements are provided in accordance with Appendix 7 of the DLRCC CDP.
9	*As standard, the applicant is requested to ensure that the proposed surface water design is in accordance with County Development Plan 2022-2028 Section 10.2.2.6*	Appropriate SuDS measures have been utilised in the Stage 3 submission including green roofs, permeable paving,

	Policy Objective EI4: Sustainable Drainage Systems, such that the proposal meets the requirements of the Greater Dublin Strategic Drainage Study (GDSDS) policies in relation to Sustainable Drainage Systems (SuDS). The design must incorporate SuDS measures appropriate to the scale of the proposed development such as green roofs, bioretention areas, permeable paving, rainwater harvesting, swales, etc. that minimise flows to the public drainage system and maximises local infiltration potential.	bio-retention areas, swales, filter drains and rain water butts
10	*Any changes to parking and hardstanding areas shall be constructed in accordance with the recommendations of the Greater Dublin Strategic Drainage Study for sustainable urban drainage systems (SuDS) i.e. permeable surfacing, and in accordance with Section 12.4.8.3 Driveways/Hardstanding Areas of the County Development Plan 2022-2028. Appropriate measures shall be included to prevent runoff from driveways entering onto the public realm as required.*	All parking areas are permeable paved.
11	*The applicant shall ensure that trees shall not be planted in the area over the attenuation tank. Trees shall be placed at a minimum distance of 2m from the edge of attenuation tanks. Tree protection barriers may be required, depending on the tree species and the expected extent of root spread, to be advised by the landscape architect. The applicant is requested to comment on the provision of any furniture in the detention basin area and detail if there is any impact on capacity.*	The landscape architect (NMP) is aware of DLRCC position on locating trees and their designs can be viewed in the submission. The detention basin is removed from the Stage 3 submission and therefore the comment is superseded.
12	*The applicant is requested to confirm that a utilities clash check has been carried out ensuring all utilities' vertical and horizontal separation distances can be provided throughout the scheme. The applicant should demonstrate this with cross- sections at critical locations such as junctions, site thresholds and connection points to public utilities. Minimum separation distances shall be in accordance with applicable Codes of Practice.*	Clash checks have been carried out and verified on the longitudinal sections drawings submitted. Greater than minimum separation distances have been achieved.
13	*As standard, and as noted within the application, the applicant is requested to ensure that a Stage 1 Stormwater Audit is carried out for the development. In accordance with the Stormwater Audit policy, the audit shall be forwarded to DLRCC*	A Stormwater Audit has been completed and the results submitted to DLRCC prior to lodgement of the Stage 3 submission. Refer to the Appendix 11.17 of the Report.

	prior to lodging the planning application. All recommendations shall be complied with, unless agreed in writing otherwise with DLRCC.	
14	*As standard, the applicant is requested to submit long-sections of the surface water drainage system, clearly labelling cover levels, invert levels, pipe gradients and pipe diameters.*	S/W Longitudinal sections have been provided in the Stage 3 submission.
15	*As standard, the applicant is requested to provide a penstock in the flow control device chamber and ensure that the flow control device provided does not have a bypass door. The applicant shall also clarify whether a silt trap is being provided in the flow control device chamber and if not to make provision for same.*	Penstock and removal of the bypass operation is noted and details of same are shown on Dwg.2411/208 & 215.
16	*As standard, the applicant is requested to provide fully dimensioned plans and sections of the attenuation storage system and detention basin. All relevant inlet and outlet levels, dimensioned clearances between other utilities, and actual depths of cover to the tank shall be provided. The applicant shall include confirmation from the chosen manufacturer of the storage system that the specific model chosen, with the depth of cover being provided, has the required load bearing capacity to support the loading that may imposed upon it.*	Attenuation storage plans and details can be viewed on Dwg.2411/208. Information relating to a prospective system is included in the application. Noting that developer's commercial decision on products is carried out post-planning stage and can be confirmed with DLRCC at compliance stage subject to a positive Stage 3 decision.
17	*As standard, the applicant is requested to show the options being proposed for interception and treatment with contributing areas on a drawing together with an accompanying text and tabular submission showing the calculations, to demonstrate that the entire site is in compliance with GDSDS requirements. The applicant should note that over-provision in one location does not compensate for under provision elsewhere.*	Refer to Dwg.2411/206 for catchment measurements and interception tablature (also included in Section 6.19 and Appendix 11.2 of this report)
	Flood Risk Assessment	
	Based on the information contained in the Site-Specific Flood Risk Assessment (SSFRA) submitted by the applicant, the conclusions therein are accepted.	Noted

	Foul Water and Water Supply	
	As the foul water and water supply networks are Uisce Eireann owned assets, the proposer should contact Uisce Eireann to discuss any issues regarding the impact of the proposed development on their assets. The preconnection enquiry response (ie. Confirmation of Feasibility) should be dated within 6 months of the application date.	An Uisce Éireann CoF letter dated within 6 months of the application is included in Appendix 11.14 of the report.
	The applicant shall ensure a minimum wayleave distance of 6.0m (3.0m either side from the external face of the pipe to any building/foundation) shall be provided for all foul water sewers located within the site.	Noted

Appendix 11.20

SWA Report Summary

Large Residential Development "Site B" at Glenamuck North, Kilternan, Dublin 18

Stage 1 Stormwater Audit

254215-PUNCH-XX-XX-RP-C-0001

January 2026

Document Control

Document Number: **254215-PUNCH-XX-XX-RP-C-0001**

Status	Rev	Description	Date	Prepared	Checked	Approved
S3	P01	DRAFT Issue	27/01/2026	A. McCarthy	D. Trkulja	N. Cronin
S3	P02	Final Issue	30/01/2026	A. McCarthy	D. Trkulja	N. Cronin

Report by: Andrew McCarthy ______________________ Date: 30th January 2026

Andrew Mc Carthy

Project Engineer, BE, ME, MIEI

PUNCH Consulting Engineers

Checked by: Drazen Trkulja ______________________ Date: 30th January 2026

Drazen Trkulja

Project Engineer, BEng (Hons) MIEI

PUNCH Consulting Engineers

Checked by: Niamh Cronin ______________________ Date: 30th January 2026

Niamh Cronin

Director, BE PGradDip CEng FIEI

PUNCH Consulting Engineers

Table of Contents

1 Introduction

1.1 Purpose of Report

This report presents a Stage 1 Stormwater Audit carried out for a proposed LRD (Site B) including 219 no. residential units, a creche, and associated infrastructure at Glenamuck North, Kilternan, Co. Dublin, ref. PAC/LRD2/005/25.

Roger Mullarkey & Associates were appointed to provide Engineering Services, which includes design of the surface water network and associated sustainable drainage systems (SuDS) proposed.

PUNCH Consulting Engineers have been appointed by Durkan Glenamuck Developments Ltd to carry out an independent Stage 1 Stormwater Audit in line with Dún Laoghaire Rathdown County Council requirements.

1.2 Site Details

The site is located at Glenamuck North, Kilternan, Dublin 18, within lands zoned under Zoning Objective A in the Dún Laoghaire-Rathdown County Development Plan 2022–2028. The planning application area comprises approximately 5.2 hectares, with a total drained surface water area of 4.44 hectares. The site is bounded to the south by the recently constructed Glenamuck District Distributor Road (GDDR) in Kilternan, Dublin 18. This road is part of the DLRCC Glenamuck District Roads Scheme (GDRS) project.

The proposed development consists of a Large Residential Development (LRD) comprising 219 no. residential units, a creche (572m²), and associated infrastructure. 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.

1.3 Report Details

The audit was carried out by Andrew McCarthy, checked by Drazen Trkulja, and approved by Niamh Cronin between the dates of January 23rd and January 30th 2026.

The Stage 1 Audit has been carried out in accordance with the Dún Laoghaire-Rathdown County Council (DLRCC) procedures outlined in the Dun Laoghaire Rathdown Development Plan 2022-2028, Appendix 7 "Stormwater Management Policy - Including Stormwater Audit Procedure". The auditor has examined only those issues within the design relating to surface water drainage and Sustainable Drainage Systems (SuDS) implications of the scheme and has therefore not examined or verified the compliance of the design to any other criteria. Design responsibility for the stormwater drainage and SuDS remains solely with the Design Engineer.

Appendix A contains the copies of current drawings and documents examined by the auditor. Appendix B contains the Stage 1 Surface Water Audit Feedback form.

All findings outlined in Section 2 of this report are considered by the auditor to require action to improve the stormwater credentials of the scheme.

1.4 Drawings & Documents Reviewed

Initial documents received 22-01-2026:

1. Stage 2 Opinion Response
2. ~~RMA 2411 Cowley Site B SSFRA Stage 3~~
3. ~~RMA 2411 Glenamuck Nth - Site B Infrastructure and SIA Report LRD Stage 3~~
4. ~~RMA 2411-200 Road and Block Levels Site B~~
5. ~~RMA 2411-201 SW and SuDS Site B~~
6. ~~RMA 2411-202 Foul Drainage GA Site B~~
7. ~~RMA 2411-205 SuDS Details~~
8. ~~RMA 2411-206 Catchment and Exceedence Flow~~
9. ~~RMA 2411-208 Attenuation Storage Details~~
10. ~~RMA 2411-209 SW Longitudinal Sections - Sheet 1~~
11. ~~RMA 2411-210 SW Longitudinal Sections - Sheet 2~~
12. ~~RMA 2411-211 SW Longitudinal Sections - Sheet 3~~
13. ~~RMA 2411-212 Foul Longitudinal Sections - Sheet 1~~
14. ~~RMA 2411-213 Foul Longitudinal Sections - Sheet 2~~
15. ~~RMA 2411-214 Foul Longitudinal Sections - Sheet 3~~
16. ~~RMA 2411-215 Manhole Details~~
17. ~~RMA 2411-216 Road Details - Sheet 1~~
18. ~~RMA 2411-217 Road Details - Sheet 2~~

Response documents received 28-01-2026:

1. RMA 2411 Cowley Site B SSFRA Stage 3
2. RMA 2411 Glenamuck Nth - Site B Infrastructure and SIA Report LRD Stage 3
3. RMA 2411-200 Road and Block Levels Site B
4. RMA 2411-201 SW and SuDS Site B
5. RMA 2411-202 Foul Drainage GA Site B
6. RMA 2411-205 SuDS Details
7. RMA 2411-206 Catchment and Exceedence Flow
8. RMA 2411-208 Attenuation Storage Details
9. RMA 2411-209 SW Longitudinal Sections - Sheet 1
10. RMA 2411-210 SW Longitudinal Sections - Sheet 2
11. RMA 2411-211 SW Longitudinal Sections - Sheet 3
12. RMA 2411-212 Foul Longitudinal Sections - Sheet 1
13. RMA 2411-213 Foul Longitudinal Sections - Sheet 2
14. RMA 2411-214 Foul Longitudinal Sections - Sheet 3
15. RMA 2411-215 Manhole Details
16. RMA 2411-216 Road Details - Sheet 1
17. RMA 2411-217 Road Details - Sheet 2

Note: Strikethrough text indicates documents that were superseded during the audit. These superseded documents are not included in the final audit report.

2 Stage 1 Audit Findings

2.1 General Requirements as per DLRCC County Development Plan 2022-2028

Table 2-1 below outlines the result of a review of the scheme designer's proposals against the general requirements outlined in the DLRCC County Development Plan 2022-2028, Appendix 7, section 7.1.1.

Table 2-1 General Requirements for all developments greater than a single house

	Requirements as per DLRCC 2022-2028 Development Plan	Addressed by Scheme Designer?
2.1.1	**Climate Change** All developments must apply a minimum factor of 1.2 to their drainage design and attenuation volumes to accommodate climate change.	Y
2.1.2	**Urban Creep** All developments must apply a factor of 1.1 to their drainage design and attenuation volumes to accommodate urban creep.	Highlighted as part of this audit
2.1.3	**Blockage Analysis** Scheme Designers must submit details of the proposed surface water drainage system in the event of blockage or partial blockage of the system, commenting on any surcharging or flood risk that may be identified, particularly in relation to freeboard used in the simulation analysis. The proposal must include a drawing confirming that safe overland flow routes do not negatively impact properties both within and without the site. The overland flow route plan should identify drop kerbs or ramps required for channelling the flow and address low point areas in the site and detail how properties, both within the development and on adjacent lands, will be protected in the event of excessive overland flows.	Highlighted as part of this audit
2.1.4	**Utility Clash Check** The Scheme Designer must undertake a utilities clash check to ensure all utilities' vertical and horizontal separation distances can be provided throughout the scheme. The Scheme Designer should demonstrate this with cross-sections at critical locations such as junctions, site thresholds and connection points to public utilities. Minimum separation distances must be in accordance with applicable Codes of Practice.	Highlighted as part of this audit
2.1.5	**Private Drains** Where an applicant's land is crossed by a private drain, the applicant is responsible for acquiring any rights or permissions necessary to connect to, or to increase the discharge into, or to build over, or divert, or to ensure the adequate capacity is not exceeded, or otherwise alter any private drains not in their exclusive ownership or control, and for ensuring their adequacy.	Highlighted as part of this audit
2.1.6	**Pumping of Surface Water**	N/A
2.1.7	**Sustainable Drainage Systems (SuDS):** The proposal must demonstrate that they meet the requirements of the Greater Dublin Strategic Drainage Study (GDSDS) policies in relation to Sustainable Drainage Systems (SuDS). The design must incorporate SuDS measures appropriate to the scale of the proposed development such as green roofs, bioretention areas, permeable	Highlighted as part of this audit

	paving, rainwater harvesting, swales, etc. that minimise flows to the public drainage system and maximises local infiltration potential. The Scheme Designer should provide cross-sections and long-sections, and commentary that demonstrates all proposed SuDS measures have been designed in accordance with the relevant industry standards and the recommendations of The SuDS Manual (CIRIA C753)	
2.1.8	**Infiltration:** The Scheme Designer should submit Site Investigation Report and results, including infiltration tests, and a plan showing the trial pits/soakaway test locations across the site. The report should address instances where groundwater, if any, was encountered during testing and its impact.	Y
2.1.9	**Hardstanding/Parking Areas:** All proposed parking and hardstanding areas should maximise local infiltration before discharge to the surface water drainage system, via a specifically designed permeable paving/porous asphalt system, in accordance with the requirements of Section 12.4.8 of the County Development Plan 2022-2028.	Highlighted as part of this audit
2.1.10	**Basement:** If basement carparking is provided, then all incidental run-off from the basement should be shown to drain to the foul system and not the surface water system	N/A
2.1.11	**Run-off Factors:** Where Scheme Designers propose to use reduced run-off factors (or reduced impermeable contributing areas) for areas of their site that drain to SuDS measures these factors must be agreed with Municipal Services, preferable during the pre-planning process. It should be noted that standard surface water simulation software uses default Cv values of 0.84 for Winter and 0.75 for Summer. If the Scheme Designer proposes to use their own reduced run-off rates, then the default Cv values should be amended to a value of 1.0. Maintaining the default Cv values in conjunction with the Scheme Designers proposed rates reduces the run-off in simulations of rainfall events, giving inaccurate simulation results which may lead to under sizing of the drainage system and attenuation storage required.	Highlighted as part of this audit
2.1.12	**Hydrological Parameters** Scheme Designers must use site specific or local data in their Qbar, attenuation volume and surface water system design such as: • SAAR • Soil Type • Rainfall Return Period Table (available from MET Eireann) • Rainfall intensity • Other hydrological parameters	Y
2.1.13	**Discharge Rate:** Surface Water discharge from a development must be restricted to 2 l/s/ha or the calculated Qbar, whichever is greater. The Qbar should be calculated using the net area drained and not the gross area of the site (i.e. red line boundary). This discharge rate should be marked on the drainage drawing on the manhole in which the flow restricting device if located. The manhole in which the flow restricting device is located should not have a bypass pipe and, a penstock and silt trap should be provided. Flow restricting devices with an orifice of less than 50mm in diameter should be avoided. Where this is not possible then the Scheme Designer must submit a robust maintenance regime to ensure blockages are avoided, to the satisfaction of dlr. Scheme Designers are recommended to use the HR Wallingford UK SuDS Greenfield runoff rate estimation tool to estimate Qbar for their site: https://www.uksuds.com/drainage-calculation-tools/greenfield-runoff-rate-estimation	Y

2.1.14	**Attenuation:** If an attenuation system is proposed it should, where possible, not be located under the internal roads but in/under open space or parking areas. Attenuation systems must be inline. The preference is for attenuation systems that allow for infiltration and/or treatment within the site. The Scheme Designer should note that certain landscaping items, such as trees, may not be compatible with attenuation systems. The Scheme Designer must provide fully dimensioned plans and sections of the attenuation storage system. All relevant inlet and outlet levels, dimensioned clearances between other utilities, and actual depths of cover to the system should be provided. Details of the proposed inlet and outlet manholes and arrangements to facilitate draw down and maintenance should also be provided. Scheme Designers are recommended to use the HR Wallingford UK SuDS Surface water storage volume estimation tool to estimate the attenuation storage required for their site: https://www.uksuds.com/drainage-calculation-tools/surface-water-storage.	Y
2.1.15	**Green Roof:** The proposal must meet the requirements of Appendix 7.2: Green Roof Policy of the County Development Plan 2022-2028.	Highlighted as part of this audit
2.1.16	**Interception and Treatment:** The Scheme Designer must demonstrate that required interception and/or treatment of surface water run-off is achieved in accordance with GDSDS policy. To be in compliance with GDSDS Volume 2 Section 6.3.3 Table 6.3 Criterion 1, interception of the first 5-10mm is required. If interception of first 5-10mm can't be achieved, then treatment of first 15mm is required.	Highlighted as part of this audit
2.1.17	**Maintenance:** Scheme Designers must submit a post-construction maintenance specification and schedule for the drainage system, including SuDS measures and attenuation system to DLRCC for approval. This maintenance specification and schedule must be included in the Safety File.	Highlighted as part of this audit
2.1.18	**New Connections:** Prior to submission of the planning application, the Scheme Designer must obtain the sewer network records from DLRCC and assess if a new connection to the public sewer is technically feasible.	Highlighted as part of this audit

2.2 DLRCC 2022 Development Plan - Stormwater Audit Procedure Table

Table 2-2 Stormwater Audit Procedure Table - Completed by Scheme Designer

Surface Cover Type	Area (m^2)
Wetland or open water (semi-natural; not chlorinated) maintained or established on site.	3,645
Semi-natural vegetation (e.g. hedgerows, trees, woodland, species-rich grassland) maintained or established on site.	2,687
Reuse of existing soils and seed source to develop vegetation cover	0
Standard trees planted in connected tree pits with a minimum soil volume equivalent to at least two thirds of the projected canopy area of the mature tree.	0
Standard trees planted in pits with soil volumes less than two thirds of the projected canopy area of the mature tree.	17*
Intensive green roof or vegetation over structure. Substrate minimum settled depth of 150mm.	2,690
Non intensive Brown Roof (Biodiversity Roof). Substrate minimum settled depth of 150mm. Design will be site specific and developed by a suitably qualified ecologist.	0
Extensive green roof with substrate of minimum settled depth of 80mm (or 60mm beneath vegetation blanket)	0
Extensive green roof of sedum mat or other lightweight systems	0
Green wall –modular system or climbers rooted in soil.	0
Rain gardens and other vegetated sustainable drainage elements.	1,128
Flower-rich perennial planting.	5,815
Hedges (line of mature shrubs one or two shrubs wide).	2,000
Hedgerows or double hedgerow of native species (may have an associated ditch and bank)	2,687
Groundcover planting.	0
Amenity grassland entire area or sections managed for lesser mowing frequencies for pollinators (e.g. six week meadow)	3,526
Amenity grassland (species-poor, regularly mown lawn).	5,465
Water features (chlorinated) or unplanted detention basins.	0
Permeable paving.	3,975
Sealed surfaces (e.g. concrete, asphalt, waterproofing, stone)	16,085
Blue roof	0

2.3 Urban Creep

Problem: Report states that a 10% factor for urban creep has applied in the calculations; however, this is not clearly reflected in the MicroDrainage analysis within Appendix 11.1. Urban creep of 10% is required for drainage design and attenuation volume calculations as per Section 7.1.1 of the DLRCC Development Plan 2022–2028. The report states an increase in the drained paved area to the rear of all houses by more than 17% of the roof/path area draining to the back of each house to accommodate the overall 10%.

Recommendation: The designer to confirm that the 17% expansion of back gardens equates to minimum 10% of all impervious surfaces as per DLRCC Development Plan.

2.4 Blockage Analysis

Problem: There is a potential risk of blockage within the drainage infrastructure, particularly at the outfall hydrobrake manholes.

Recommendation: It is recommended that the designer considers the impact of a localised blockage at the outfall hydrobrake manhole, such as a scenario where inflow to the drainage network is temporarily restricted, and provides a brief commentary on how exceedance flows would be managed in such an event.

2.5 Overland Flow Routes

Problem: Drawing reference 2411/206 does not show the location of ramps or dropped kerbs to safely channel overland flow routes.

Recommendation: It is recommended that the designer consider adding the locations of ramps or dropped kerbs to drawing reference 2411/206.

2.6 Utility Clash Checks

Problem: The provided long sections show separation between the surface water and foul systems, but these do not confirm a comprehensive utility clash check among all proposed and existing utilities on the site.

Recommendation: Scheme designer to confirm a utility clash check has been carried out and adequate separation distances are achieved between the surface water network and SuDS features, and all other utilities, all in accordance with relevant Uisce Éireann Code of Practice, other utilities providers Codes of Practice, and Council requirements.

2.7 Geological & Hydrogeological Parameters

Problem: The soil on site, currently classified as Class 4 for calculation purposes could be interpreted as Class 2 to Class 4 based on the background information provided.

Recommendation: The scheme designer to provide justification for the use of Soil Class 4.

2.8 Run-off coefficients

Problem: Reduced run-off coefficients are proposed for different types of finishes and SuDS features, however it is not clear if these have been agreed with DLRCC. It should be noted that the Cv of 1.0 has been correctly applied in this scenario.

Recommendation: Designer to confirm reduced run-off coefficients have been discussed and/or agreed with DLRCC.

2.9 Drainage Catchments

Problem: Drawing reference 2411/206 shows an unhatched area adjacent to the Glenamuck Stream which has not been assigned to any catchment area.

Recommendation: Designer to clarify if the unhatched area adjacent to the Glenamuck Stream is for all intents and purposes an area not developed in such a way that it would be positively drained through the proposed surface water drainage system.

2.10 Drainage Layouts & Details

Problem: Drawing reference 2411/201 legend refers to a new land drain, however it is not clear where on the layout this is proposed. Additionally, drawing reference 2411/205 makes reference to 'Typical Rear Garden Filter Trench' detail, however it is not clear if this is proposed.

Recommendation: Designer to clarify if the unhatched area adjacent to the Glenamuck Stream is for all intents and purposes an area not developed in such a way that it would be positively drained through the proposed surface water drainage system.

2.11 Green Roof Item No. 1

Problem: There are inconsistencies within the body of the report and drawings regards type of green roof proposed.

Recommendation: Scheme designer to show type of green roof on the proposed layout drawings and ensure consistency in the report.

2.12 Green Roof Item No. 2

Problem: Table 8 – Green/Blue Roof Coverage Summary in the Infrastructure and SuDS Report calculates the green roof provision as a percentage of the 'Total Flat Roof Area'. However, Appendix 7.2 of the Dún Laoghaire-Rathdown County Development Plan 2022-2028 (Green Roof Policy) requires the minimum coverage percentage to be applied to the total roof area being developed for all applicable buildings, rather than only the flat roof area.

Recommendation: The scheme designer should revise the report and associated calculations to demonstrate compliance with the DLRCC Green Roof Policy (Appendix 7.2, CDP 2022-2028), specifically by assessing green roof coverage against the total roof area being developed (not against flat roof area). This may require updating Table 8 and any related green/blue roof quantification in the Infrastructure and SIA Report.

2.13 Interception

Problem: The interception calculations present total provided volumes that substantially exceed the site requirement, derived by summing the individual contributions from various SuDS components. It is not clear whether the contributory impermeable areas assigned to each component (particularly green roofs, swales, bioretention areas, filter drains and permeable pavements) comply with the maximum permissible ratios set out in Table 24.6 of CIRIA C753 (SuDS Manual). Green roofs, for example, can only provide interception for the roof area they cover. For swales, permeable paving, bioretention areas and filter drains, Table 24.6 of CIRIA C753 limits the contributory impermeable area that can be treated for interception.

Recommendation: Please provide clarification, demonstrating that the proposed interception provision complies with the contributory-area limits in Table 24.6 of CIRIA C753. Addionally, designer to clarify if the longitudinal gradient of the vegetated area in swales is less than 1:100. Revised calculations should be submitted if necessary.

2.14 Maintenance Schedule

Problem: Scheme Designers must submit a post-construction maintenance specification and schedule for the drainage system, including SuDS measures and attenuation system to DLRCC for approval. This maintenance specification and schedule must be included in the Safety File.

Recommendation: Scheme designer to consider including a maintenance schedule for the drainage system, including SuDS measures, for review.

2.15 Water Table

Problem: It is stated that the groundwater strikes were noted on the exploratory hole logs between 1m BGL and 1.5m BGL, and the samples did not remain open for sufficiently long periods of time to establish the regime and groundwater is expected to vary.

Recommendation: Designer to ensure design of SuDS features as well as surface water drainage infrastructure is reflective of site specific groundwater table conditions.

2.16 CBR Values – Permeable Paving

Problem: Californian bearing ration (CBR) varies inversely with moisture content (as the latter increases the CBR value decreases). The equilibrium CBR value is the long-term value that occurs once the pavement is constructed, and the moisture content of the subgrade soil comes in to equilibrium with the suction forces within the subgrade air spaces. Carrying out CBR tests will allow for appropriate permeable paving design including capping material if and where required. This capping is typically quite impermeable when compacted.

Recommendation: Consider undertaking CBR tests on site to allow for appropriate permeable paving design. These CBR tests are to be carried out in accordance with BS 1377-4:1990.

2.17 Gradients and ground modelling

Problem: As per Chapter 29.2, Section E of The SuDS Manual, **s**uccessfully integrating SuDS measures including swales, infiltration trenches and infiltration blankets require areas of ground modelling to ensure proposed SuDS measures are located in appropriate areas to ensure adequate drainage of the site.

Recommendation: It is recommended that the integration of each SuDS component be considered, and its contouring adjusted to allow the levels to flow towards to SuDS measure, in a naturalistic manner that is visually attractive, and accords with the local surrounding landscape. Ensuring that contouring of swales does not conflict with proposed or existing utilities.

2.18 Bypass Petrol Interceptors

Problem: Petrol Interceptor has not been included in the design of the stormwater drainage system.

Recommendation: Designer to provide a justification for not including petrol interceptors prior to discharge to the watercourse.

2.19 Minimum Velocity

Problem: Table 6.4 of the GDSDS requires a minimum velocity (pipe full) of 1.0m/s.

Recommendation: Designer to confirm if minimum velocity in the surface water pipework is achieved.

Scheme Title: **Residential Development at "Site B", Glenamuck North, Kilternan, Dublin 18**

Audit Stage: 1 **Audit Completed:** 30/01/2026 **Project Ref:** 254215

Paragraph No. in Audit Report	Issue Accepted (Yes/No)	Recommended Measure Accepted (Yes/No)	Alternative Measures (described) [or reason problem not accepted]	Alternative Measures Accepted by Auditors (Yes/No)
2.3	Y	N	To achieve the 10% Urban Creep requirement, the Q100 + 20% CC calculated attenuation volumes have been increased by 10% as outlined in paragraph 6.12 & Table 3. Furthermore, additional impermeable surfacing to the rear of the houses has been allowed for in the model but is not relied upon as the method of calculation of Urban Creep in this application. It is proposed that this is a more conservative and safer approach to drainage design.	Y
2.4	Y	Y	A blockage analysis simulation has been carried out in accordance with the DLRCC Drainage Dept. requirements in that the model was run with a 2 hour restriction on the outflow on all vortex devices. There is capacity in the S/W network to contain the resulting backed-up water below ground as outlined in Section 6.13 and Appendix 11.1. Notwithstanding the above, an exceedance flow route is shown on Dwg.2411/206.	
2.5	Y	Y	Text has been added to highlight the locations of the drop kerbs shown on Dwg.2411/206.	
2.6	Y	Y	Clash checks have been carried out and the designer is satisfied the current proposals meet the required standards and are sufficient to enable the development proceed to planning stage. In advance of construction, at compliance stage and connection application stage to Uisce Éireann, further reviews will take place and any adjustments necessary will be facilitated.	
2.7	Y	Y	The choice of SOIL Type has been reviewed and determined by the designer that Type 4 is appropriate choice for this site based on the WRAP Map (Class 5), the FSR (Type 4) and the SI results.	

Paragraph No. in Audit Report	Issue Accepted (Yes/No)	Recommended Measure Accepted (Yes/No)	Alternative Measures (described) [or reason problem not accepted]	Alternative Measures Accepted by Auditors (Yes/No)
2.8	Y	Y	The run-off coefficients have been discussed and agreed in principle with DLRCC Water Services Department.	
2.9	Y	Y	The unhatched area is not to be developed and is maintained as a riparian corridor in accordance with DLRCC policy.	
2.10	Y	Y	There is no land drain proposed and the legend has been adjusted accordingly. The rear garden filter trench is included on the legend now and shown on the S/W drawing No.2411/202.	
2.11	Y	Y	Intensive green roof are proposed and noted in the report & drawings.	
2.12	Y	N	The green roof areas provided in Table 8 reflect the roof areas available for installation of green roofs and account for edge strips and PV panels and roof over shots. The designer is satisfied this is compliant with the DLRCC policy on green roofs.	Y
2.13	Y	Y	Contributary areas cannot always be achieved in higher density residential projects but are substantially achieved in this application. Interception of a typical road to swale, house roof to permeable paving and house roof to filter drain pictorial narrative has been included on drawing No.2411/206. Where there are proportional area limitations exceeded, on a catchment wide basis, in the designers opinion there is more than sufficient interception provided at the downstream lowest elements of the drainage network below the 3No.storage systems. A minimum longitudinal gradients of 1/100 are achieved and the calculations adjusted accordingly.	
2.14	Y	Y	A series of maintenance actions are outlined in section 7.1.13 of the report. A maintenance scheduling regime is to be established with an appropriate specialist contractor at construction/commissioning stage. This is deemed to be in compliance with GR5.	

Paragraph No. in Audit Report	Issue Accepted (Yes/No)	Recommended Measure Accepted (Yes/No)	Alternative Measures (described) [or reason problem not accepted]	Alternative Measures Accepted by Auditors (Yes/No)
2.15	Y	Y	The SuDS features proposed are shallow in nature and generally above the noted ground water. At pre-commencement stage additional consideration will be given to any local ground water high points and possible effects on the SuDS features. This application proposes a considerable number of SuDS elements at surface level or raised above ground in the case of green roofs which is reflective of the design approach taken to achieve a nature based design solution.	
2.16	Y	Y	Subject to a successful planning outcome, additional SI work will be undertaken including CBR testing in advance of construction commencing on the site.	
2.17	Y	Y	The location of the SuDS components are generally at the low points along each catchment and surface levels are directed towards those elements. Cambering of the road surfaces towards the SuDS elements is shown on Dwg.2411/200 and further indicated by flow arrows on Dwg.2411/201.	
2.18	Y	Y	It is considered that due to the extensive implementation of SuDS measures on the site and more than sufficient downstream interception provided PI's have not been included in the application. If DLRCC require PI's, they can condition same as part of the planning process.	
2.19	Y	Y	Minimum velocities are achieved as reasonably possible. Some pipelines in the drainage model are representing flow through the attenuation systems which explains why the velocities are <1m/s. The pipelines are laid at a gradient of no flatter than 1/150 which is deemed acceptable.	

Paragraph No. in Audit Report	Issue Accepted (Yes/No)	Recommended Measure Accepted (Yes/No)	Alternative Measures (described) [or reason problem not accepted]	Alternative Measures Accepted by Auditors (Yes/No)

Signed:

Design Team Project Manager **Date:** 28/01/26

Please complete and return to the auditor

Auditor Signed Off: .... *Auditor* **Date:** 30/01/2026