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CONSULTING STRUCTURAL and CIVIL ENGINEERS

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

PROJECT:	**GLENAMUCK NORTH LRD SOUTHERN SITE – 2411**
CLIENT:	**DURKAN GLENAMUCK DEVELOPMENTS LTD.**
DATE:	**DECEMBER 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, known as "Southern Site".

1.2 We, Roger Mullarkey & Associates, were appointed by Durkan Glenamuck 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.3.3Ha and the total drained S/W area in two separate catchments is 2.62Ha. The existing lands are currently greenfield.

1.4 The proposed development will consist of a residential development of 135No. units. Please refer to Thornton O'Connor Planning Consultants for a full development description.

1.5 A table of the specific responses to the DLRCC Stage 2 Opinion generated by the water Services department – Drainage Planning in Appendix of the S2 report is included in Appendix 11.20 of this report. Please refer to that appendix for a line by line response.

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 lands are located the north of Glenamuck Road Sth, and at the junction of the recently constructed Glenamuck District Distributor Road (GDDR) and the substantially complete Glenamuck Link Distributor Road (GLDR) in Kilternan, Dublin18.

Fig. 1 – Site Location (main development site)

3.2 The existing lands are currently greenfield. The site planning application area is c.3.3Ha but it is noted that the surface water drained area is c.2.62Ha and is used for the Qbar and drainage calculations.

3.3 The topography generally has a natural split in catchment with approximately half of the site sloping down towards the Northwest and the other half sloping downwards towards the Northeast. The topography undulates between existing gradients of approximately 1/40 to 1/12, with some localised dips down towards the Glenamuck Stream at 1/6. A site survey drawing is included in the application and can be viewed as background on the drawing RMA Dwg.No.2411/100 and is summarised in Fig 2 below.

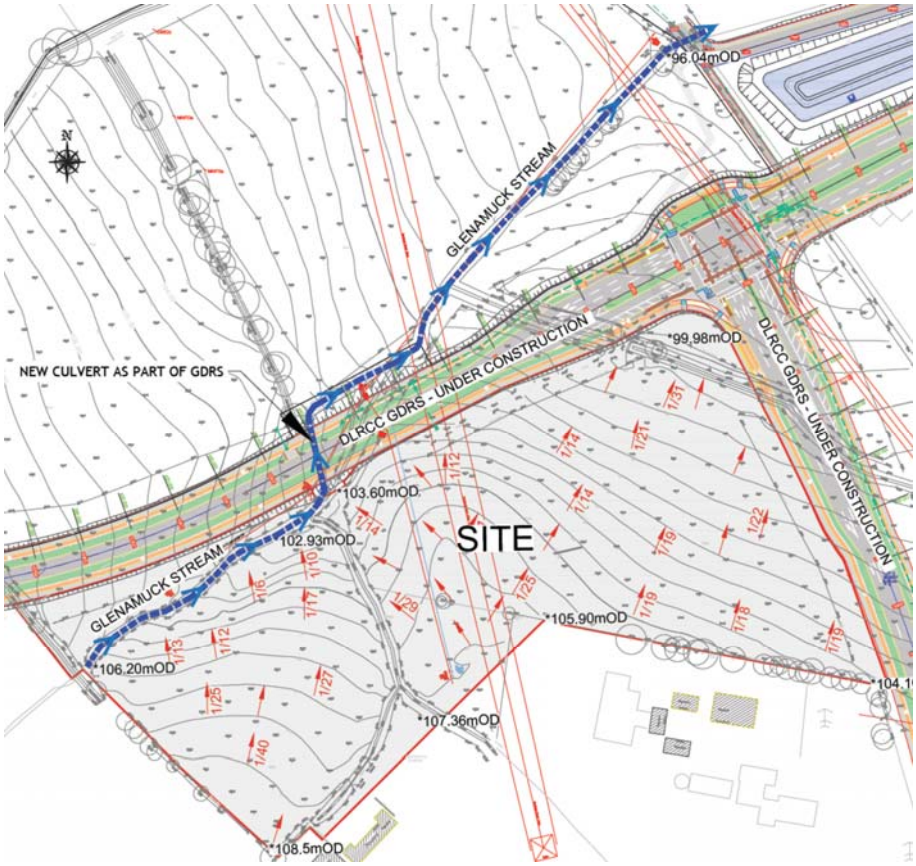


Fig.2 - Topography

3.4 The site is bounded to the north and east by the recently constructed DLRCC Glenamuck District Roads Scheme and is henceforth referred to as the GDRS in his report. To the NW of the site a watercourse bounds part of the subject lands and is known as the Glenamuck Stream 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*". An existing recently constructed residential

development (Glenamuck Manor) bounds the southwest of the site and to the west lies a thickly wooded field and the landholding of a detached residential dwelling (Shaldon Grange). The gardens of an existing detached residential dwelling (Westgate) and its greater landholding bounds the southeast of the site.

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 site 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 have been provided by the GDRS project. Connection with these provided spurs is dependant on a successful outcome to this LRD planning application. A 225mm diameter Surface Water (S/W) drainage pipe has already been installed beneath the GDRS to facilitate an interconnection between this subject site and the Glenamuck Stream which lies to the north of the GDRS.

3.8 There are existing S/W & Foul pipelines crossing this site connecting Glenamuck Manor with both the Glenamuck Stream & the recently 375mm trunk foul sewer to the north of the Glenamuck Stream and GDRS.

3.9 A Road & Block levels drawing has been prepared as part of this application and reference should be made to Dwg.No.2411/100 in this regards. 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 1/64 (1.6%) 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 The DOELG Recommendations for Site Development Works for Housing Areas document allows road gradients to 1/10 (1%) vertical alignment and as noted above, the limited use of 1/14 (7.1%) gradients on the site is therefore in accordance with DOELG document.

3.12 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.

3.13 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.

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

4.0 Existing & Proposed Drainage/Water Services Summary

4.1 There are both foul and S/W 225mm diameter sewers crossing the site from south to north interconnecting Glenamuck manor with the Glenamuck Stream and the existing 375mm trunk foul sewer to the north of the stream.

4.2 The recent construction of the GDRS project has locally diverted the route of the existing Glenamuck Stream via a new box culvert passing beneath the distributor road. Hence there was a new S/W pipe extension laid to the existing above noted 225mm S/W passing beneath the GDRS and into a new headwall outfalling into the Glenamuck stream.

4.3 Similarly, the GDRS project has diverted the existing 375mm trunk foul sewer from its previous alignment into a new pipeline laid under the new roads foot/cycle path.

4.4 There are no known watermains on the application site. 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.

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

4.6 The total drained area of the site will be 2.62Ha and the surface water drainage is to be divided into 2No.main catchment areas as shown in Table 1 below;

SURFACE WATER CATCHMENT SUMMARY		
Catchment No.	**Catchment Drained Area**	**Outfall Location**
A	1.34Ha	Outfalls into existing 225mm S/W on the subject site.
B	1.28Ha	Outfalls into to the Glenamuck Stream

Table 1 – S/W Catchment Summary

4.7 It is noted that the GDRS project is substantially complete adjacent to this site and some of the service connections are provided by that scheme. It has been stated by DLRCC that the GDRS project will be completed in c.Q1 of 2026. Therefore, the above noted connections are to be live and available by the time this development requires them, subject to a successful planning application.

4.8 The proposed foul drainage system will also have 2No.outfall connection locations summarised in table 2 below;

FOUL DRAINAGE CATCHMENT SUMMARY		
Catchment No.	**Quantity Drained**	**Outfall Location**
A	46 Residential Units	Outfalls into existing 225mm pipe crossing the site.
B	89 Residential Units	Outfalls into the new 225mm pipe connection provided by the GDRS project.

Table 2 – Foul Drainage Catchment Summary

4.9 The Glenamuck Stream bounds the northwest of the application 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.

4.10 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 topography generally has a natural split in catchment with approximately half of the site sloping down towards the Northwest and the other half sloping downwards towards the Northeast. The topography undulates between existing gradients of approximately 1/40 to 1/12, with some localised dips down towards the Glenamuck Stream at 1/6. A site survey drawing is included in the application and can be viewed as background on the drawing RMA Dwg.No.2411/100 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
- Permeable paving to all parking spaces
- Silt-trap/catchpit manholes
- Rainwater butts
- 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 2No.S/W drainage catchments with 2No.outfall points. Catchment A (c.1.34Ha drained area), downstream of the full SuDS treatment train, will outfall the attenuated flow into the existing 225mm S/W sewer crossing the site. Catchment B (c.1.28Ha drained area), downstream of the full SuDS treatment train, will outfall the attenuated flow into the Glenamuck Stream north of the GDRS. Refer to Dwg.No.2411/101 for detailed information of same.

6.5 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.

6.6 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 the Qbar of 19.1l/s and divided as between the two catchments as 9.4 l/s for Catchment A and 9.7 l/s for Catchment B. It is relevant to note that S/W outfall rate for proposed development have been calculated using the drained site area and not the application "*redline*".

6.7 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.

6.8 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, filter drains, intensive green roofs, tree pits, bio retention areas, permeable paving, below ground infrastructure, silt-traps and will direct the flows via void arched attenuation systems vortex flow restricting devices, Hydrobrake or similar.

6.9 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.

6.10 Downstream of the SuDS elements, the retained storm water flows will be stored in a 2No. below ground storage areas, such as the void arched system.

6.11 The MicroDrainage software was used to generate drainage simulation models for storm events for 2 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. The parameters used for the calculations are summarised in Table 3 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	19.1l/s split between catchments A & B of 9.4l/s and 9.7l/s respectively 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 3 – S/W Design Parameters

6.12 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.2411/104. Dropped kerbs and profiling of the local landscape will be constructed to direct the overland flows to low lying landscaped areas.

6.13 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 in the model by increasing the calculated attenuation volume by 10%.

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 4 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 4 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 A	9.4	277	378	**38**	**416**	**432**	102.44
Catchment B	9.7	262	362	**36**	**398**	**407**	99.03
TotalMax.Storage Required		539m^3	740m^3	74m^3	**814m^3**	**839m^3**	
The total storage provided > required							

Table 4 – 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 5 below;

FREEBOARD SUMMARY				
Storage	**TWL (mOD)**	**FFL (mOD)**	**Freeboard (m)**	**Pass/Fail**
1	102.44	104.30	1.86	PASS
2	99.03	101.05	2.02	PASS

Table 5 - 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, 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. As per the parameters laid out in the GDSDS the interception volume was calculated and is summarised in the following table 6. Refer to Appendix 11.2 for detailed calculations.

INTERCEPTION - Glenamuck Nth Site A - CATCHMENT A								
Paved Surfaces connected to the drainage system (Ha) =	0.935	Volume of Interception Required (m^3)			37.4	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 (mm)**	**Void Ratio**	**Volume (m^3)**
Voids of stone below Permeable Paving overflow			1,250			0.2	0.3	75.0
Voids of stone below Filter Drains	287	0.75		1		0.15	0.4	12.9
Voids of stone below Swale overflow	119	0.75				0.15	0.4	5.4
Tree Pits	2	5		3		0.1	1	3.0
Green Roof (Intensive)			0	1		0.2	0.35	0.0
Bio Retention			217	1		0.1	1	21.7
Voids of stone below Storage areas			510			0.3	0.4	61.2
						Volume of Interception Provided (m^3) =		**179.2**
						Volume of Interception Required (m^3) =		**37.4**
						Interception provided > Required		**OK**

INTERCEPTION - Glenamuck Nth Site A - CATCHMENT B								
Paved Surfaces connected to the drainage system (Ha) =	0.954	Volume of Interception Required (m^3)			38.2	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 (mm)**	**Void Ratio**	**Volume (m^3)**
Voids of stone below Permeable Paving overflow			1,255			0.2	0.3	75.3
Voids of stone below Filter Drains	109	0.75		1		0.15	0.4	4.9
Voids of stone below Swale overflow	116	0.45				0.15	0.4	3.1
Tree Pits	0.6	5	29	7		0.1	1	5.0
Green Roof (Intensive)			1,007	1		0.2	0.35	70.5
Bio Retention			154	1		0.1	1	15.4
Voids of stone below Storage areas			448			0.3	0.4	53.8
						Volume of Interception Provided (m^3) =		**228.0**
						Volume of Interception Required (m^3) =		**38.2**
						Interception provided > Required		**OK**

Table 6 – Catchment A & B Interception

INTERCEPTION SUMMARY		
FULL CATCHMENT	REQUIRED	PROVIDED
TOTAL	76	407

Table 7 – 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 achieve that goal. A sample calculation narrative is shown in Fig.3 below and included on Dwg.2411/106.

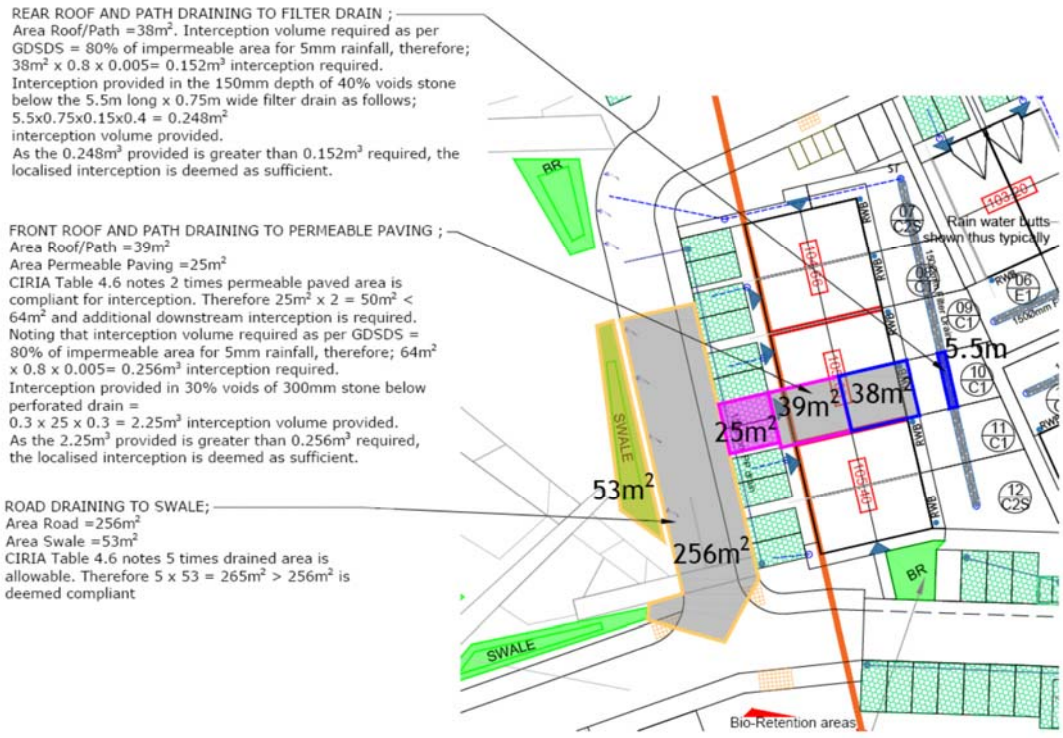


Fig – 3 Localised Interception

6.21 **Criterion 2** is complied with in applying the total allowable Qbar outfall rate of 19.1 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 8 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 8 – Sub-criterion

6.23 **Criterion 4** River flood protection is satisfied under sub-criterion 4.3 in accordance with the application of Qbar (19.1 l/s) and therefore long-term storage is not required.

6.24 An exceedance flow routing plan can be viewed on Dwg.No.2411/104 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 2411/101 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.

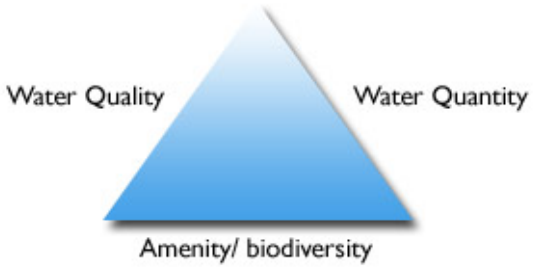


Fig.4 – The SuDS Triangle

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
- Intensive Green Roofs
- Swales adjacent to roads where practically feasible
- Tree pits where practically feasible
- Permeable paving to all parking spaces
- Silt-trap/catchpit manholes
- Rainwater butts to rear of private housing
- 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.5 below

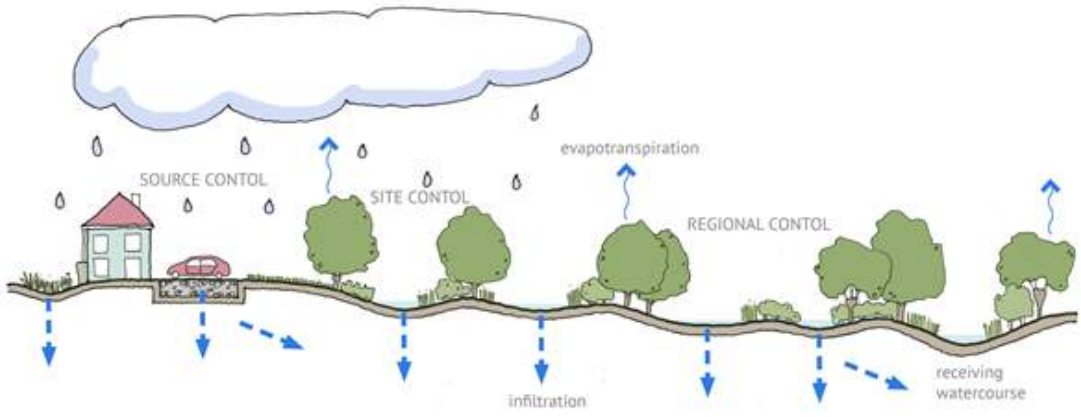


Fig.5 – Treatment Train

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** and **bio-retention** areas 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 2411/100 and further illustrated on Dwg.No.2411/105.

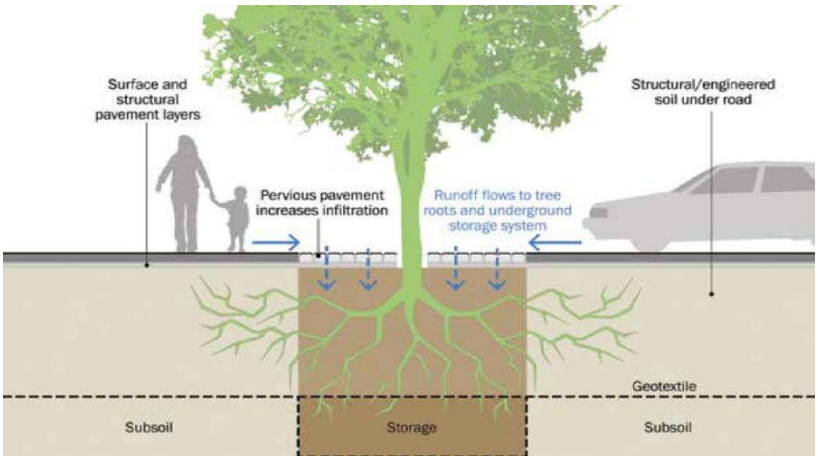


Fig.6 – Tree Pit (ex. SuDS Manual fig.19.3)

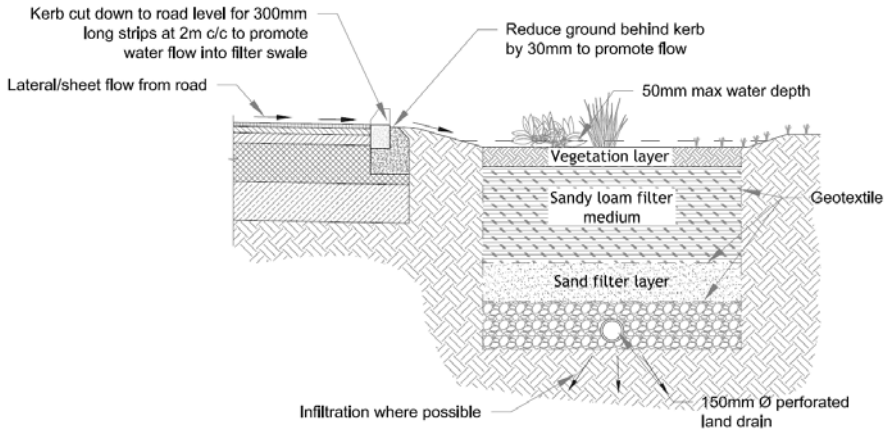


Fig.7 Bio-Retention (ex.Dwg.2411/105)

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 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.

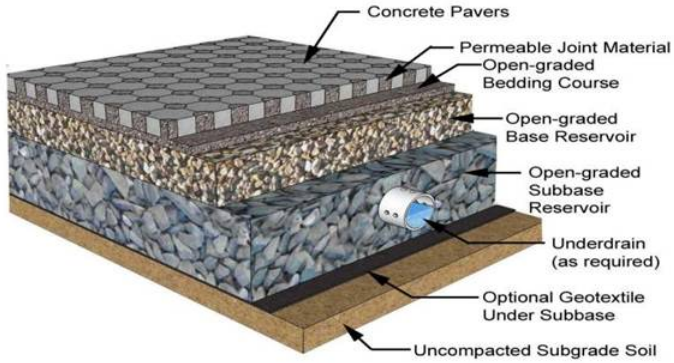
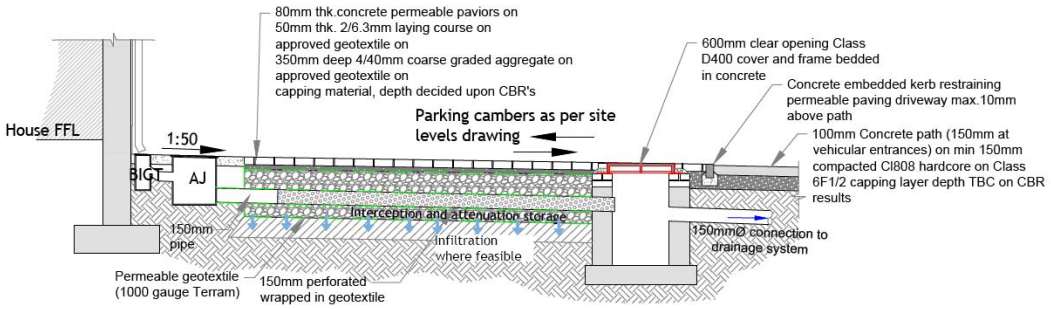


Fig.8 – Permeable Paving



Typical Private Parking Bay

Fig.9 – 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 0.83 (83%) will apply to the intensive green roofs provided. A 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 2411/101 & 105 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.

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 > 300m^2

- Notwithstanding that there are no roof flat roof areas exceeding 300m^2 in this application, Green Roofs are provided to all areas of

flat roof where practically feasible. 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 3No.proposed blocks. PV panels are not proposed to be used for the apartment blocks. .
- Refer to Table 10 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 Green Roof**	**Min.% Reqd.**	**Pass/Fail DLRCC Min. %**
Block A	424	535	79%	50%	**PASS**
Block B	99	127	78%	50%	**PASS**
Block D	366	453	81%	50%	**PASS**
Bin/Bike Store	118	120	98%	50%	**PASS**

Table 9 – Green Roof Coverage Summary

GR3- Hydraulic requirements & overflow

- The proposed 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 are provided as part of the overall green roof system proposed and is typically detailed in Appendix 12.13 of this report. It is proposed that inclusion of the above therefore complies with GR3.

GR4- Best practice

- The green roof system proposed is in accordance with industry best practice details of which are shown on Dwg.No.2411/105 and in Appendix 11.19. 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.

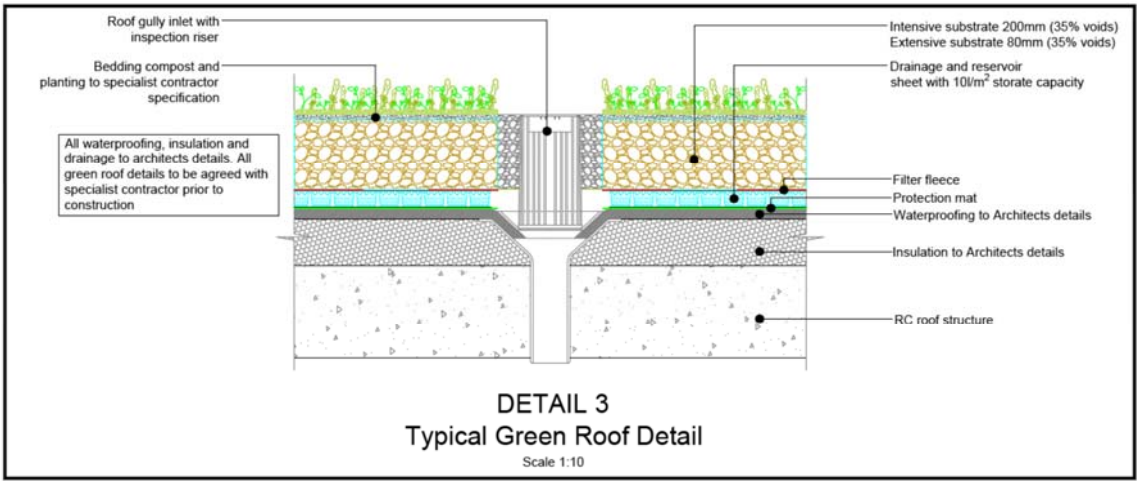


Fig.10 –Green Roof (ex.Dwg.2411/105)

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.2411/105 included in the submission. PV panels to these roofs do not form part of this application. 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 In providing the intensive green roof system, a run-off rate of 83% (0.83 paved area factor applied) has been applied in the surface water calculations for the Intensive Green Roof area in accordance with appendix 7.2 Green Roof Policy of the DLRCC County Development Plan 2022-2028.

7.1.12 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 11 – Rainwater Butt

7.1.13 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.2411/105 for further detail.

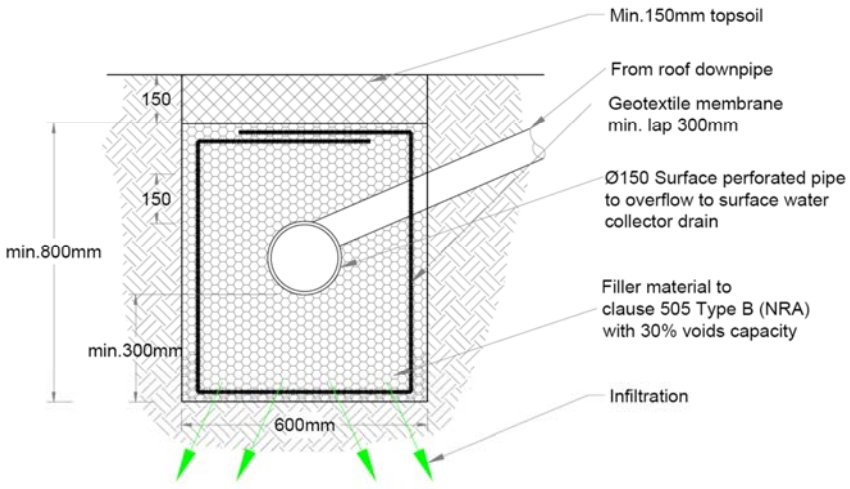


Fig.12 – Filter Drain

7.1.14 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;

- Green roof maintenance by specialist contractor
- 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.13 below from the CIRIA SuDS Manual illustrates the principle.

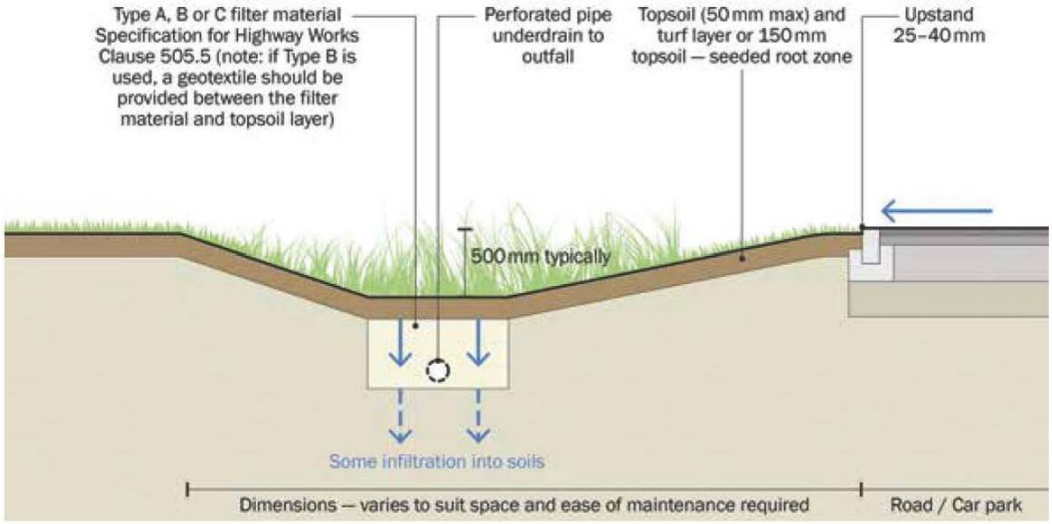


Fig.13 – Filter Swale

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 2411/101 & 105 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. 2411/100.

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.2411/105 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 2No.void arched **attenuation systems**, such as illustrated in Fig.14 below.

Fig.14 –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 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 roadside grassed swales, tree pits, bio-retention areas and use of rainwater butts.

7.4.3 The overall site surface water runoff rate has been restricted to the greenfield runoff rate, Qbar (19.1 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 2411/101 & 105 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.CDS25008771) 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 10 – 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 crossing the site, from south to north, serving the Glenamuck Manor residential development. This foul pipe is laid at a gradient of c.1/21 yielding a flowrate capacity of c.114 l/s. The peak discharge flowrate emanating from the Glenamuck Manor project was noted to be c.6.5 l/s. Based on the published flowrate figures it is apparent that the existing foul pipe crossing the site has a capacity in excess of 17 times that of the peak rate foul flows coming through from Glenamuck Manor. Refer to dwg.No.2411/102 for location/detail of this existing sewer.

9.6 There is also an existing 375mm diameter public trunk foul sewer flowing from west to east, located partly within the site boundary area but 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. The GDRS project works have provided a 225mm spur connection from the newly diverted sewer back into the subject site in the NE corner. As part of the pre-planning process, discussions have taken place with the DLRCC Roads Project Office and the spur connection and invert level have been agreed. Subject to a successful planning outcome to this LRD application and completion of a connection agreement with Uisce Éireann, this 225mm spur will be used to drain c.75No.units. UÉ have provided a CoF in agreement with this principle, refer to Appendix 11.14.

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, subject to a successful planning application, to be live and available by the time this development requires them.

9.8 The proposed foul drainage system will have 2No.outfall connection locations summarised in table 9 below;

FOUL DRAINAGE CATCHMENT SUMMARY		
Catchment No.	**Quantity Drained**	**Outfall Location**
A	46 Residential Units	Outfalls into existing 225mm pipe crossing the site.
B	89 Residential Units	Outfalls into the new 225mm pipe connection provided by the GDRS project.

Table 11 – Foul Drainage Catchment Summary

9.9 Refer to Dwg.No.2411/102 for the alignment and levels of the proposed foul drainage network.

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

Foul Wastewater Calculations

New Network - DOMESTIC Wastewater Flows – TOTAL SITE						
Usage	**Quantity**	**Occupancy (h)**	**Population (P)**	**Consumption (G) (l/h/day)**	**Loading (PxG)(l/day)**	
Residential	135Units	2.7No./Unit	365	150	54,675	
				Total =	**54,675 l/day**	
				Flowrate per day (l/s)		**0.63/s**
				Growth Rate	1	1
				Infiltration (I)	10%	0.06
				Dry Weather Flow	**PG + I**	**0.64 l/s**
				Peaking Factor (Pf_{Dom})	6	
				Design Foul Flow (l/s)	**Pf_{Dom} x PG**	**3.81l/s**
				Misconnection Allowance (SW)	1.5%	0.01l/s
				Design Flow (l/s)		**3.82 l/s**

Based on Irish Water Code of Practice Wastewater Infrastructure (Aug'25)

Table 12 – Residential 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 was "*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 partly within the site boundary area but on the north 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.2411/103 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 11 below;

Water Demand Calculations

New Network – DOMESTIC Water Demand – Total Site								
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'	135 Units	2.7 No./Unit	365	150	54,750	0.63	0.79	**3.95 l/s**
Peak Hour Water Demand (Domestic)								**3.95 /s**

Based on Irish Water Code of Practice for Water Infrastructure (Aug'25)

Table 13- Residential Water Demand Calculations