INFRASTRUCTURE

Project

Proposed Development at Glenamuck Road, Dublin 18

Report Title

Infrastructure Design Report

Client

Bowbeck DAC

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1.0 INTRODUCTION

1.1 Background

DBFL have been instructed to prepare an Infrastructure Design Report to accompany a pre-planning application for the proposed mixed-use development at Glenamuck Road, Carrickmines, Dublin 18.

1.2 Location & Topography

The subject site is located to the south of junction 15 of the M50 Motorway, as shown in Figure 1-1. The site is approximately 1.78Ha and is currently occupied by scrubland and demolished buildings.

The site is bounded by Glenamuck Road to the west, Golf Lane to the south east and the M50 slip lane to the north.

The site is located just to the north of Carrickmines and in Dun Laoghaire-Rathdown County Councils Development plan is designated as Zone A, which is to protect and improve residential amenity.

Figure 1-1: Site Location (Site Boundary Indicative Only)

Site Boundary

The nearest Environmental Protection Agency (EPA) designated watercourse is the Carrickmines River which enters and exits the north west corner of the site. Golf Stream runs within the site parallel to the Glenamuck Road and the two watercourses converge in the north west corner of the site.

The topography of the site generally falls from south to north into the River valley, ranging from approximately 80m AOD in the south to 75m AOD at the top of the river embankment with the valley being at 70m AOD at its lowest.

1.3 Existing Ground Conditions

An existing ground investigation was undertaken to accompany a previous planning application for the site, which has been used for the purposes of this report.

The report revealed that the strata encountered consisted mainly of Topsoil or Surfacing on made ground or peaty clay (sandy slightly gravelly CLAY with frequent cobbles and boulders containing occasional fragments of building material) to approximately 0.2m-0.4m on Cohesive deposits of sandy gravelly CLAY with boulders of granite.

Weathered rock and Boulders were encountered in all the trial pits, depths of weathered rock extended up to 2m in places. Although, typically depth to refusal varied across the site from 1.0m BGL to 1.6m BGL. Groundwater was noted at depths between 1.4m and 1.7m BGL.

Trial Pits to the west of the site near the stream, indicated sands which could have potential infiltration properties. Although due to the presence of Groundwater and the proximity to watercourses it is likely infiltration techniques will not be suitable.

1.4 Proposals

The proposed development comprises a residential development of 482 no. units (all apartments), along with ancillary residential amenities, and provision of a childcare facility, gym, and local shop. The proposed residential units comprise 31 no. studio units, 183 no. 1-bedroom units, 229 no. 2-bedroom units, and 39 no. 3-bedroom units (including 2 no. duplex type units).

The proposed development is set out in 7 no. blocks which comprise the following:

- Block A1 comprises 62. no, apartments within a part four, part six storey building, including 10 no. studio units, 7 no. 1-bedroom units, 41 no. 2 bedroom units, and 4 no. 3-bedroom units. An ESB substation is provided at ground floor level.
- Block A2 comprises 85 no. apartments within a part four, part eight storey building, including 25 no. 1-bedroom units, 45 no. 2-bedroom units, and 15 no. 3-bedroom units.
- Block A3 comprises 79 no. apartments within a part four, part twelve storey building, including 21 no. studio units, 19 no. 1-bedroom units, 28 no. 2-bedroom units, and 11 no. 3-bedroom units.
- Block B0 comprises 150 no. apartments and resident's amenities within a part four, part eighteen, part twenty-one and part twenty-two storey building. The apartments include 76 no. 1-bedroom units, 68 no. 2-bedroom units, and 6 no. 3-bedroom units (including 2 no. duplex type units). An ESB substation, resident's concierge area and

amenity space (171 sq.m sq.m) are provided at ground floor level. A further resident's amenity / event space is provided at the twentieth and twenty-first floor levels (83 sq.m).

- Block B1 comprises 8 no. apartments and is four storeys in height, directly abutting Block B. The apartments include 4 no. 1-bedroom units, and 4 no. 2-bedroom units.
- Block C comprises 42 no. apartments and a local shop within a part five, part seven storey building. The apartments include 30 no. 1-bedroom units, 9 no. 2-bedroom units, and 3 no. 3-bedroom units. A local shop (154 sq.m) and an ESB substation are provided at ground floor level.
- Block D comprises 56 no. apartments, a commercial gym, resident's concierge area, resident's lounge, and a childcare facility in a part four, part seven storey building. The apartments include 22 no. 1-bedroom units, and 34 no. 2-bedroom units. The resident's concierge area (99 sq.m), commercial gym (340 sq.m), and childcare facility (300 sq.m) units are located at ground floor level. The resident's lounge (292 sq.m) is located at first floor level.

Two basement levels are proposed, providing car parking spaces (299 no.), bin stores, plant rooms, bicycle parking (1,000 no. spaces), and circulation areas. A further 240 no. bicycle parking spaces and 4 no. car parking spaces are provided at ground level. The proposed development includes landscaping, boundary treatments, public, private and communal open space (including roof terraces), two cycle / pedestrian crossings over the stream at the western side of the site, along with a new pedestrian and cycle crossing of Glenamuck Road South at the west of the site, cycle and pedestrian facilities, play facilities, and lighting. The proposed buildings include the provision of private open space in the form of balconies and winter gardens to all elevations of the proposed buildings. The development also includes vehicular, pedestrian, and cycle accesses, drop off areas, boundary treatments, services, and all associated ancillary and site development works.

2.0 Flood Risk

DBFL Consulting Engineers Ltd were appointed to undertake a Site Specific Flood Risk Assessment to accompany a planning submission for an residential development a site on Glenamuck Road, Dublin 18.

A stage 1 assessment, identification of flood risk for the proposed site was undertaken. From all sources of information consulted, it was apparent the site is located partially within Flood Zone A due to the Carrickmines River. The presence of another watercourse, the Golf/Glenamuck Stream, is also located around the northern boundary of the site, although this watercourse was not part of the flood modelling project CFRAMS.

Due to the identified flood risk, the full site specific flood risk assessment can be found in DBFL reports 170063-Rep-002 – SSFRA.

3.0 SITE ACCESS AND ROAD LAYOUT

3.1 Existing Access

In the past the land was split into several different dwellings and therefore there are multiple access points, all from Golf Lane, onto the subject site.

3.2 Proposed Site Access

The development proposals allow for one main vehicular entrance, approximately 260m from the Glenamuck Road Roundabout, on the south eastern side of the subject site, shown in Figure 3-1.

All site user vehicles entering the site will be directed down a ramp into the basement cark parks; while other vehicles such as deliveries, drop-offs and visitor spaces will be accommodated at podium level.

Sightlines of 49m at a setback of 2.4m at the main entrance are provided which meet the requirements for the Design Manual for Urban Roads & Streets (DMURS) for a 50kph street (which includes visibility for Bus routes), refer to DBFL Drawing 170063-2100 for details.

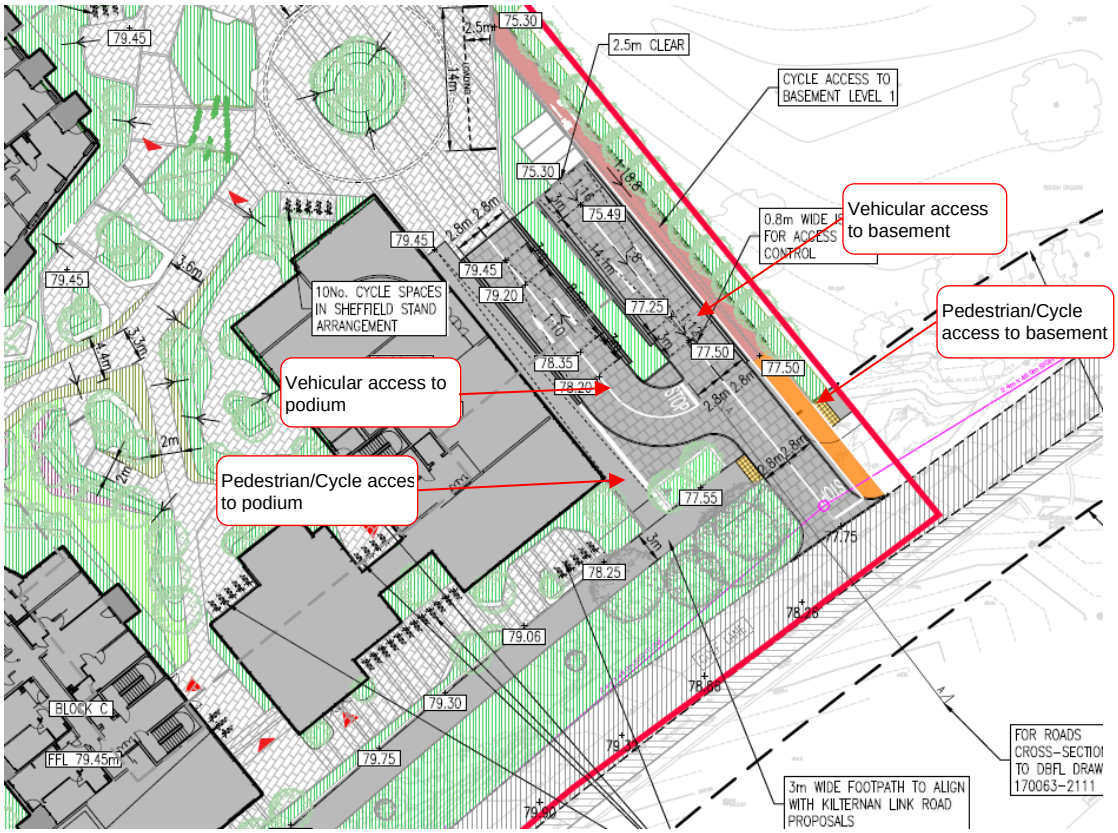


Figure 3-1: Proposed Site Access

3.3 Kilternan Link Road

As part of the Cherrywood Strategic Development Zone (SDZ), a new link road bridging the M50 is proposed to link the SDZ with Carrickmines and Kilternan.

The proposed road will be 50kph consisting of a 3.5m standard lane and 3m wide bus lane on both the northbound and southbound carriageways. A 1.5m wide cycle lane and 3m wide footpath will also be accommodated on both sides of the road. Refer to Figure 3-2 and Figure 3-3 for details. DBFL drawing 170063-2111 shows indicative sections through the proposed Kilternan Link Road as obtained from the Cherrywood SDZ proposals.

As part of the design process for the previous planning application PAC/SHD/165, correspondence was sought with DLRCoCo to clarify the reserved land for the proposed road and the design status of project.

At the time of writing this report no vertical alignment had been progressed although the road extents were issued to identify the reserved lands through the subject site. DLRCoCo requested a temporary footpath be located at the back of the proposed Kilternan Link Road extents to clearly delineate the road extent which can be found on DBFL drawing 170063-2100 and the Landscape drawings.

The design of the development takes account of the reserved land and also ensures the access to the development is easily adjustable to the proposed Kilternan Link Road to minimise works to the development when the road is constructed. Please note the proposed levels are an approximation only and were not received from DLRCoCo. It can be expected that due to several access points onto Golf Lane that the proposed road levels will be similar to the existing Golf Lane levels.

The junction for the proposed development has been designed to ensure it can be easily modified to suit the proposed Kilternan Link Road and has been demonstrated on DBFL drawing 170063-2103.

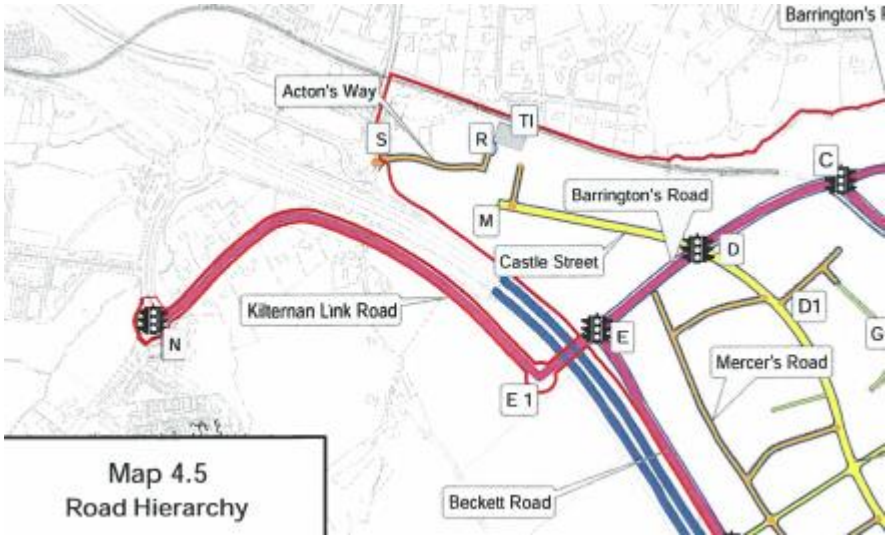


Figure 3-2: Extract from Cherrywood SDZ showing location of Kilternan Link Road

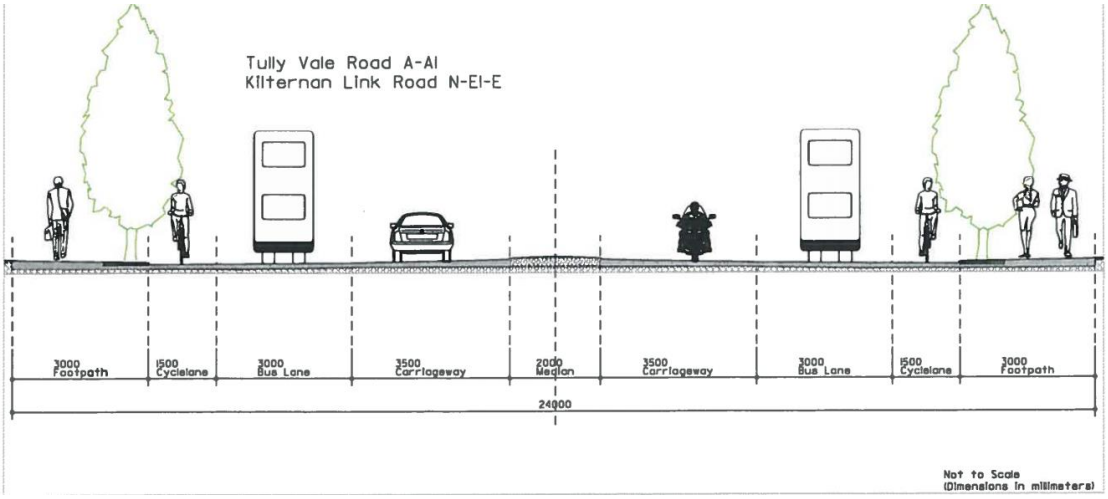


Figure 3-3: Extract from Cherrywood SDZ showing section of Kilternan Link Road

3.4 Proposed Parking/Set Down

The development will provide 303 no. car parking spaces including mobility impaired parking bays. A number of these are provided as electric car charging points in line with the Development Plan requirements.

11 no. Motorcycle spaces will also be provided within the basement.

In total the design provides a total of 240 short stay bicycle spaces at ground level in proximity to each building and 910 long stay bicycle spaces within the basement in primary positions. This quantum is in exceedance of Dún Laoghaire-Rathdown County Council's Cycling Policy (January 2018) and in accordance with the DHPLG Design Standards for new apartments.

At podium level, 1 no. set-down space, and 3 no. regular parking spaces are provided.

3.5 Cycle Pedestrian Route and Proposed Toucan Crossing

As part of the development a cycle and pedestrian route will be created linking Golf Lane to Glenamuck Road, including provision of a toucan crossing across Glenamuck Road to facilitate access to Ballyogan Wood LUAS stop, nearby bus stops and the neighbouring commercial development to the west.

A 4.5m wide route has been accommodated through the development which will be clearly legible by differing paving and signage. The route has been designed so that there is no conflict with vehicles other than at road crossings.

The cycle/pedestrian route will be linked from the development to the Glenamuck Road via a clear span bridge to cross Golf Stream allowing access to the proposed staggered toucan crossing.

4.0 EXISTING SERVICES AND UTILITIES

4.1 General

A comprehensive topographical site survey was carried out for the subject site and existing drainage and utility records in the vicinity of the site obtained and surveyed in detail. A summary of the existing main services is provided under this section.

4.2 Foul Sewer

There is a new 225mm diameter foul sewer under Golf Lane, due to the recent development on the south-eastern side of the road, draining north-east shown on *Figure 4-1*. There is also a 300mm diameter Irish Water foul sewer located to the north of the subject site draining south-east. This sewer is believed to be of recent construction to create a mains connection for one or more of the previous dwellings.

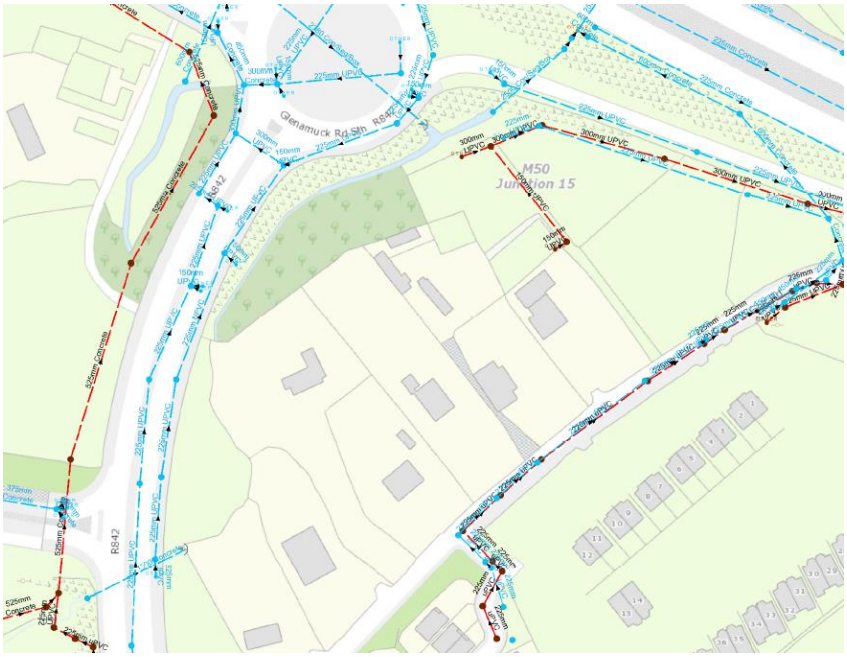


Figure 4-1: Extract of Irish Water Sewer Records

4.3 Surface Water Drainage

There is an extensive surface water network that surrounds the subject site. To the north of the site a 225mm diameter UPVC sewer runs parallel to the foul sewer stated in the previous section. There is also a surface water network in Golf Lane which runs north towards the M50 where it meets the SW sewer from the subject site and discharges into the Carrickmines River culvert between the slipway and motorway. There is also an extensive surface water network on Glemanuck Road, although it is believed that the surrounding area's surface water discharges into the Carrickmines River or tributaries.

4.4 Water Supply

From available water main records, an existing 3-inch diameter Cast iron watermain was identified running along Golf Lane adjacent to the subject site shown in *Figure 4-2*. A 200mm Ductile Iron watermain in Golf Lane also serves the recently constructed development on the opposite side of Golf Lane.

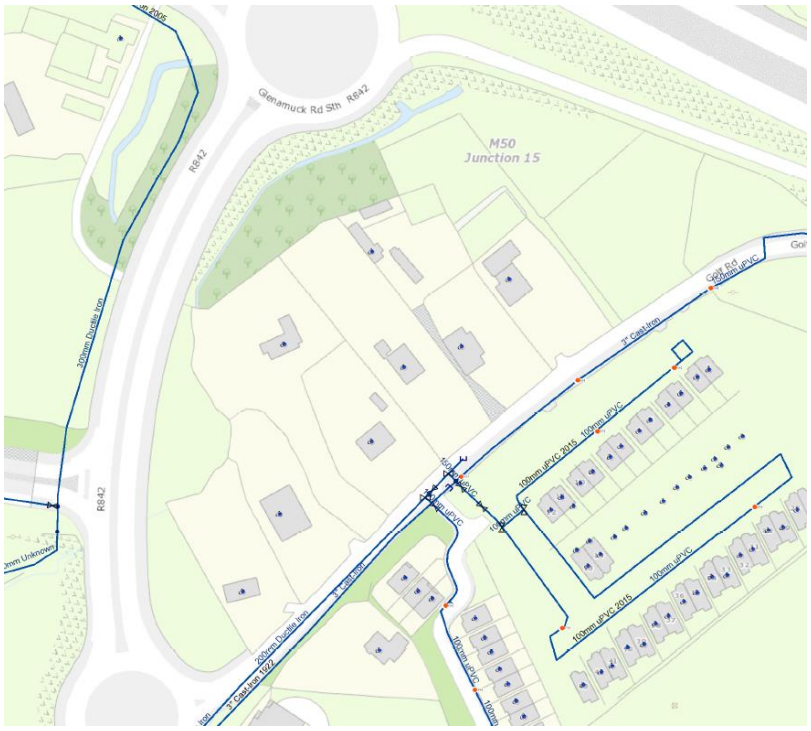


Figure 4-2: Extract of Irish Water main Records

5.0 PROPOSED SURFACE WATER DRAINAGE

5.1 Surface Water Policy

The management of surface water for the proposed development has been designed to comply with the policies and guidelines outlined in the Greater Dublin Strategic Drainage Study (GDSDS) and with the requirements of Dún Laoghaire-Rathdown County Council. The guidelines require the following 4 main criteria to be provided by the design:

- Criterion 1: River Water Quality Protection – satisfied by providing interception storage and treatment within the green roof, permeable paving and rainwater harvesting.
- Criterion 2: River Regime Protection – satisfied by attenuating to greenfield run-off rates.
- Criterion 3: Level of Service (flooding) for the site – satisfied by the development's surface water drainage design, planned flood routing, run-off contained within site, flood storage and building set greater than 0.5m above 100-year flood level.
- Criterion 4: River flood protection – attenuation volume and discharge limit designed to greenfield run-off rates (long term storage not provided).

5.2 Surface Water Strategy

To meet the requirements of the surface water policy above the surface water strategy has been described in this section give a clearer indication of how the design development has progressed to the submitted design.

The surface water strategy incorporates attenuation of storm water to limit discharge from the site, although storage facilities and Sustainable Urban Drainage Systems (SUDS) elements will be designed to allow infiltration or reduction of run-off volumes and rates where possible.

The first part of the treatment train for managing surface water on the site, in accordance with the Dun Laoghaire Rathdown County Development Plan, allows for a minimum of 60% of the roof area to be green roof to reduce run-off and provide biodiversity benefits. A graphical and tabulated form of the catchment areas can be found on DBFL drawing 170063-3105.

Runoff from the podium slab and green roofs will be conveyed by a slung drainage system, within the basement extents, to the north of the subject site.

The podiums will consist of green areas and raised planters, providing interception storage and treatment. Bioretention type systems with a drainage board will be used, to convey runoff from the podium to gullies at the podium slab level. The hard-standing areas of the podium have been designed to drain to the filter drains, green areas and bioretention areas.

'Stormtech' systems have been introduced as an additional treatment stage and an additional SUDS feature that allows infiltration to ground (although this had been assumed as zero infiltration in the attenuation calculations to simulate the worst-case scenario when soil is completely saturated). This type of system has been tested under the State Environmental Protection Act (SEPA) demonstrating improvements to water quality. The 'Stormtech' units also allow the required attenuation volume to be provided for the site in the 100-year design event + 10% allowance for climate change.

For smaller storm events, the discharge from the site will be minimal and the flow rate will be vastly reduced due to the SUDS features.

The final discharge point for the site will be to the Golf Stream. The outlet will be located above the 10% AEP flood level and a flap valve will be constructed as part of the outfall to ensure flood water cannot enter the system. Flow controls will be constructed to restrict the surface water discharge to Greenfield run-off rates, in accordance with the GDSDS and Local Authority Policy.

The final discharge point for the site will be the Golf Stream that bounds the subject site on the north-western side. The outlet will be located above the 10% AEP.

5.3 Sustainable Urban Drainage Systems (SUDS)

In accordance with the GDSDS it is proposed to provide SUDS for managing surface water from the facility. The aim of the SUDS strategy for the site will be to:

- Attenuate surface water runoff;
- Reduce surface runoff;
- Reduce pollution impact; and
- Replicate the natural characteristics of rainfall runoff for the site.

An assessment of the potential SUDS that could be incorporated within the site was conducted using the SUDS Manual, CIRIA 753. The SUDS elements which were found applicable to the proposed scheme design and layout include the following:

1. Bio-swales, filter drains and rain gardens have been included in the scheme to provide attenuation, treatment and where possible, infiltration. Bioretention, will have the inclusion of under drains as not to be reliant on ground conditions and infiltration rates as in accordance with CIRIA 753. The interception and treatment benefits of bioretention systems are a major benefit within the treatment train and a vital part of the surface water management of the site. The location of bioretention has been selected in more level areas of the site to ensure these are as effective as possible.
2. Attenuation storage will be an online infiltration / filtration type system to encourage infiltration and treatment of run-off.

3. Green roofs provided to the new development, approximate area 3212m^2. Blocks A-D will have green roofs to satisfy the minimum requirement of 60% in DLRCC's Green Roof Guidance Document and will be a minimum of 100mm depth.

4. Green podium with landscaped areas and raised planters to reduce run-off rates and total impermeable area.

The incorporation of the above SUDS elements will provide a sustainable way to disperse surface water from the site, encourage groundwater recharge and provide treatment of run-off and subsequent improvement of discharge quality.

5.4 Attenuation

Attenuation volumes have been calculated based on an allowable outflow / green field runoff rate of 3.9 l/sec ($QBAR_{RURAL}$ calculated in accordance with Institute of Hydrology Report 124, see Appendix A).

The subject site boundary encompasses an overall area of 1.78Ha. However, there is 0.18Ha of land, comprising green open space, within this boundary draining to Golf Lane. There are no development proposals for this portion of the subject site nor do these areas drain into the proposed development's drainage system, therefore it has not been included as part of the $QBAR_{RURAL}$ calculation. The $QBAR_{RURAL}$ calculation was therefore based on a site area of 1.60Ha.

The drainage design uses SOIL type 2 for the site's QBar greenfield run-off calculations. To derive the soil type, table 4.5 of the Flood Studies Report was used as recommended by the GDSDS. Table 5-1 and Figure 5-1 is a summary of the site characteristics used in the selection of the pre-development soil value.

Table 5-1: Summary of Site Characteristics

Characteristic	Value	Description
Drainage Group	1 (Rarely Waterlogged within 60cm at any time)	Drainage group 1 was selected as the site I rarely waterlogged within 60cm at any time i.e. it is well drained.
Depth to impermeable layer	1 (>80cm)	Impermeable layers (i.e. granite bedrock) were encountered at depths of 0.80m BGL to 3.50m BGL during the site investigation. The lager depth i.e. 3.50m BGL was used in this instance as a conservative value.
Permeability group (above 'impermeable' layers or to 80cm)	Slow	The permeability group of the soil was set conservatively as "Slow" due to the clay deposits encountered during the site investigation.
Slope	2 - 8°	The fall across the site varies within the range of 2° to 8°.

Table 4.5 The classification of soils by winter rain acceptance rate from soil survey data.

Drainage Class Group	Depth to impermeable layer (cm)	Slope classes								
		0 - 2°			2 - 8°			>8°		
		Permeability rates above impermeable layers								
		(1) Rapid	(2) Medium	(3) Slow	(1) Rapid	(2) Medium	(3) Slow	(1) Rapid	(2) Medium	(3) Slow
1	>80	1			1			1	2	3
	40 - 80					2		3		4
	<40	—	—	—	—	—	—	—	—	—
2	>80	2		3			4	—		
	40 - 80									
	<40	3								
3	>80				5			—		
	40 - 80							—		
	<40									

Figure 5-1: Extract of Table 4.5 for classification of SOIL type for the development

The site area in these calculations has been calculated as the developable area (calculations can be found in Appendix A), as shown in DBFL drawing 170063-3105, due to the large amount of soft landscaping that will be retained as part of the site.

Run-off from the new development and pavement is attenuated to calculated green field run-off rates in accordance with the requirements of the GDSDS, using two hydro-brakes as a flow control device.

The impermeable areas contributing to the attenuation volume have had the following reduction factors applied:

- Flat impermeable roofs, hard standing podium, footpaths and roads; a 5% reduction of the surface area is applied to take account of run-off not collected and stored within the micro and macro texture of the surfacing. Various sources recommend different reduction coefficients e.g. IS EN752 recommends Runoff Coefficient (C for the Rational Method) of 0.9 to 1.0 for impermeable areas and steeply sloping roofs. For flat roofs it recommends 0.5 to 1.0 depending on area.

- Green roofs, the proposed build-up will be an extensive type with 100mm minimum construction depth and sedum planting. The soil build-up will partially absorb some of the initial run-off and once saturated will reduce flow rates through the green roof medium to the outlets and final attenuation storage location. If the large extensive green-roof area even acts similarly to a normal flat-roof in the design storm event, then a 5% reduction factor, as detailed in the item above, is applicable. Research is still being undertaken into the runoff reductions applicable for larger return periods and therefore there is no definitive guidance for the

reduction for a 1% AEP storm event. The SUDS Manual indicates "hydraulic performance of green roofs once saturated tends to be fairly similar to standard roofs" and "only tend to attenuate runoff during…… initial stages of an event" i.e. after the initial interception storage has been used which is widely outlined as up to 5mm. The German FLL Guidelines for Green Roofs further indicate a reduction of up to 40% for annual storm events but that this reduces for higher return periods.

- Raised Planters & Green Areas over Podium, planters will have an intensive build-up to facilitate planting and soft landscaping for larger shrubs and small trees. The soil depth will be in excess of 750mm and therefore the SUDS Manual guidelines for green-roofs apply. Green soft landscaped podium areas will have typical soil depths of up to 300mm to facilitate grassed areas, plants, shrubs and trees i.e. similar to a deep intensive green roof build up. For runoff calculations, a reduction factor of 20% has been applied (refer to SUDS Manual & German FLL Guidelines for Green Roofs).

- Areas draining to Filter Drains, Rain Gardens and Bio-Retention Areas; a conservative reduction factor of 20% has been used for these areas over the podium. Firstly, rainfall will 'wet' the initial surface of the paving, allowing water to be stored in the micro and macrotexture of the surfacing and will be lost to evapotranspiration, giving a reduction in volume. As run-off drains to these SUDS elements and through the build-up, the aggregate/soil surface area will also 'wet' giving another reduction of volume due to evapotranspiration and natural storage within the SUDS feature. There will also be a reduction of velocity as the aggregate/filter material used in the SUDS feature slows the run-off at source, changing the input hydrograph which will ultimately reduce the peak inflow for attenuation calculations. The SUDS Manual outlines that they "can help reduce flow rates from a site by providing some attenuation storage and can reduce storage volume requirements where infiltration occurs".

Throughout the site, an arch type proprietary storage system has been selected and designed to provide the required volume for the 100-year storm event, using Microdrainage software, refer to Appendix B for summary of results for various storm-water durations. Calculations indicate that approximately 780m^3 of storage volume for the 100-year event (+10% climate change) is needed.

The attenuation storage volume has been separated between 2 no. attenuation storage tanks discharging via common outfall, at the northern side of the proposed development, into the Golf Stream, as shown on DBFL drawing 170063-3100. Tank 1 is located on the north western side of the proposed development (shown in Figure 5-2) and accounts for 270m^3 of the proposed storage with a discharge of 1.6l/s controlled by a 'Hydrobrake Optimum' flow control device. Tank 2 is located on the northern side of the proposed

development (shown in Figure 5-3) and accounts for 510m^3 of the proposed storage with a discharge of 2.3l/s controlled by a 'Hydrobrake Optimum' flow control device.

Surface water attenuation calculations can be found in Appendix B.

Table 5-2: Summary of surface water runoff reduction factors

Description	Catchment Draining to Attenuation Tank 1 (m^2)	Catchment Draining to Attenuation Tank 2 (m^2)	Reduction Factor
Roofs - Hardstanding (draining to gullies)	455	808	5%
Roofs - Green	1336	2375	5%
Podium - Draining to SUDS features	2086	3708	20%
Roads and Footpaths - Draining to gullies	607	1079	5%
Grassed Areas / Soft Landscaping	1305	2200	95%

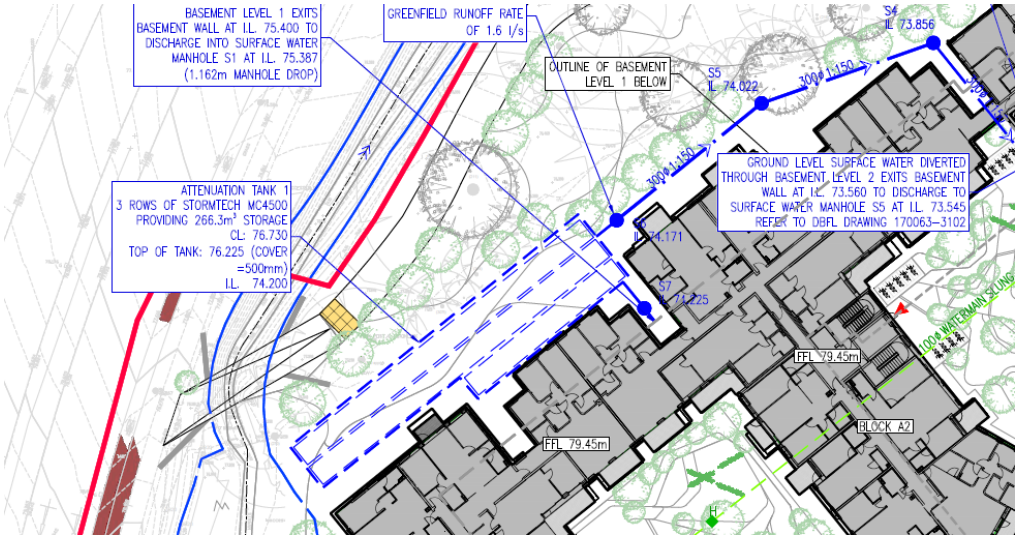


Figure 5-2: Attenuation Tank 1

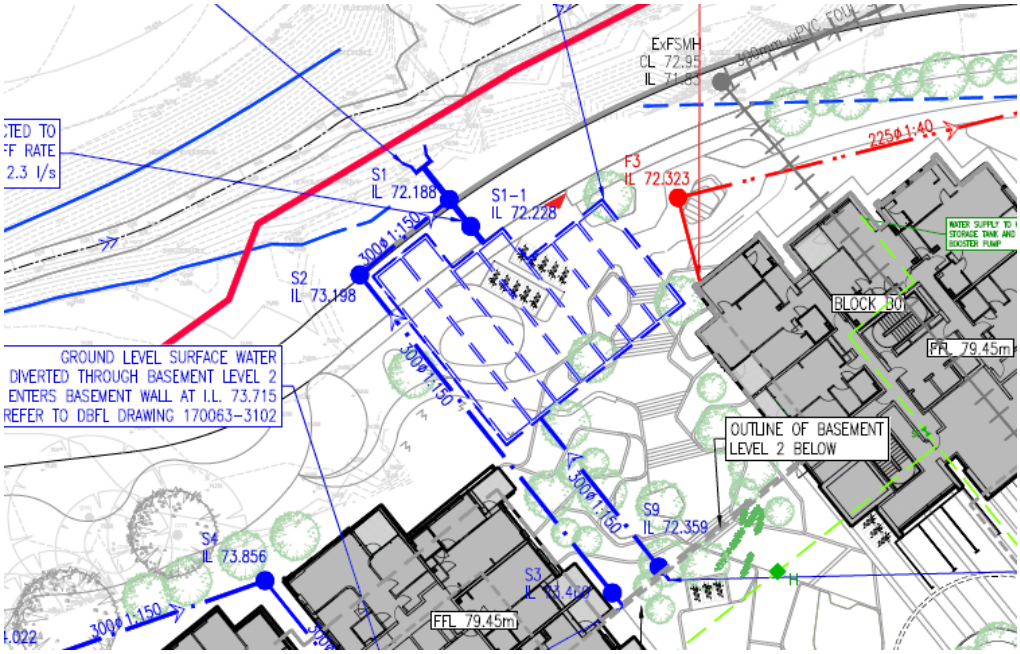


Figure 5-3: Attenuation Tank 2

5.5 Interception of First Flush of Rainfall

The GDSDS recommends that no run-off should pass directly to a river for rainfall depths of 5mm and up to 10mm if possible, i.e. interception. The development's drainage design allows for collection of most of the site's run-off via SUDS features e.g. Greenroofs, filter drains and bioretention, providing interception at source. In turn resulting runoff is conveyed to on-line 'Stormtech' attenuation storage systems which remove pollutants and facilitate the infiltration of runoff to ground in its base. Calculations in accordance with the GDSDS recommendations can be found in Appendix A and indicate a minimum of 34.4m^3 of interception volume should be provided. To enable this the outfall pipes from the 'Stormtech' storage systems will be set 50mm from the bottom of the tank giving a storage volume of 36m^3 within the stone below the unit i.e. this volume will not be able to discharge downstream. In addition to interception provided within the 'Stormtech' units. As a further measure an element of interception will occur within the green roof and raised planters further providing 0.8m^3 interception volume.

5.6 Design Standards

Storm-water drainage has been designed in accordance with the Greater Dublin Code of Practice for Drainage Works. The following design parameters are applicable to the design:

- All impermeable access roads, hard-standing areas, parking and footpaths assumed to be 95% impermeable if draining to gullies.
- Landscaped areas and green open space are assumed not to be contributing due to the topography.
- Run-off from green roofs assumed to also be 95% impermeable as a conservative value due to the use of extensive green roof.
- For green podium a runoff factor of 80% has been applied due to the interception and evapotranspiration properties of these areas.
- Time of entry: 4 minutes
- Pipe Friction (Ks): 0.6 mm
- Minimum Velocity: 1.0 m/s
- Standard Average Annual Rainfall: 892mm
- M5-60: 17.00mm
- Ratio r (M5-60/M5-2D): 0.3
- Attenuation Tank Storm Return Event GDSDS Volume 2, p61, Criterion 3

  30 year no flooding on site.

  100 year check no internal property flooding. Flood routing plan. FFL

freeboard above 100-year flood level. No flooding to adjacent areas.

- Climate Change 10% for rainfall intensities, as GDSDS

Surface water sewers have been designed in accordance with IS EN 752 and the recommendations of the 'Greater Dublin Strategic Drainage Study', (GDSDS).

The minimum pipe diameter for public surface water sewers is 225mm. Private drains comprise of diameters from 100mm.

5.7 Climate Change

Surface water calculations for the development made use of rainfall values for the Carrickmines area as provided by Met Eireann. Rainfall intensities were increased by a factor of 10% to take account of climate change, as required by the GDSDS for attenuation storage design.

5.8 Flooding Provision

The surface water network, attenuation storage and site levels are designed to accommodate a 100-year storm event and includes climate change provision, refer to Microdrainage simulation calculations in Appendix B. For storms greater than the design storm of 100-year design event + climate change provisions have been discussed in the Site Specific Flood Risk Assessment, DBFL Report 170063-Rep-002 -SSFRA.

5.9 Surface Water Quality Impact

The type of development is low risk i.e. it does not present a high risk of run-off contamination. The development's design and layout further reduce the risk of contaminants entering the surface water network as most of the site coverage will either be roof area or green/pedestrianised podium areas with most of the vehicle parking provided in an underground basement. Run-off from roofs will have a first stage of treatment by draining through green-roof medium which in turn drain to the on-line attenuation storage systems. Soft and hard landscaped podiums will drain via their build-ups to a slung system which in turn also drain via the 'Stormtech' online attenuation storage systems which provide further secondary removal of pollutants within its isolator row, geotextiles and filter stone before final discharge to the watercourse.

The highest risk of contaminated surface water run-off from the site would be from the access road and basement ramp which is a relatively small area. The set down areas at ground level are designated as medium risk to surface water quality and therefore are designed to pass through a filter drain or be constructed in permeable paving.

All basement drainage is discharged separately via a Class 2 separator to the foul sewer. In this way it is considered that the development provides treatment of collected run-off, provides a SUDS treatment train approach and is low risk of pollutants.

The proposed surface water system has therefore been designed to incorporate SUDS techniques which naturally reduce pollutants and improve water quality.

5.10 Maintenance

The proposed drainage system shall be maintained on a regular basis to reduce the risk of blockage. Operation and maintenance procedures for the proposed SUDS components shall be carried out as per the requirements set out in The SUDS Manual (refer to Table 5-3 for a summary of these procedures), while the proposed surface water manholes and sewers have been designed in accordance with GDSDS to facilitate regular maintenance.

Table 5-3: Summary of operation and maintenance activities required for key SUDS components (source: CIRIA Report C753: The SUDS Manual)

Operation and maintenance activity	SuDS component												
	Pond	Wetland	Detention basin	Infiltration basin	Soakaway	Infiltration trench	Filter drain	Modular storage	Pervious pavement	Swale/bioretention/ trees	Filter strip	Green roofs	Proprietary treatment systems
Regular maintenance													
Inspection	■	■	■	■	■	■	■	■	■	■	■	■	■
Litter and debris removal	■	■	■	■	□	■	■	□	■	■	■		□
Grass cutting	■	■	■	■	□	■	■	□	□	■	■		
Weed and invasive plant control	□	□	□	□		□	□		□		□	■	
Shrub management (including pruning)	□	□	□	□					□	□	□		
Shoreline vegetation management	■	■	□										
Aquatic vegetation management	■	■	□										
Occasional maintenance													
Sediment management[1]	■	■	■	■	■	■	■	■	■	■	■		■
Vegetation replacement	□	□	□	□						□	□	■	
Vacuum sweeping and brushing									■				
Remedial maintenance													
Structure rehabilitation /repair	□	□	□	□	□	□	□	□	□	□	□	□	
Infiltration surface reconditioning				□	□	□	□		□	□	□		

Key
■ will be required
□ may be required
Notes
1 Sediment should be collected and managed in pre-treatment systems, upstream of the main device.

5.11 Proposed Restoration of Overland Flow Path

The CFRAMs studies for the streams surrounding the subject site, which is discussed in detail under DBFL Report 170063-Rep-002-SSFRA, illustrates an overland flow path from the Golf Stream to the M50 at the northern boundary of the subject site. The levels to the north of the subject site have been filled, after the CFRAMs study, thus impeding the overland flow path.

As part of the development, it is proposed to restore these original levels to ensure the flood mechanism of this area is consistent with CFRAMS. Figure 5-4 shows the existing ground at the overland flow path while Figure 5-5 shows the proposed restored ground.

Figure 5-4: Existing Ground at overland flow path

Figure 5-5: Proposed ground at overland flow path

6.0 PROPOSED FOUL DRAINAGE

6.1 Proposed Foul Layout

The proposed foul drainage layout for the development is largely reliant on slung drainage in the basement. As the basement extents cover the majority of the site, slung drainage will be located by foul stacks which will be drained at high level under the podium slab. DBFL drawing 170046-3101 shows an indicative layout of slung drainage which is designed based on a maximum 700mm service void to reach the furthest points of the basement at the required gradients.

Due to the size of the basement and to keep the service void to a minimum the foul exits the basement at two locations. Therefore, the external foul collection network extends to two points along the north eastern corner of the proposed development to collect the slung drainage. The external drainage then gravitates towards a single discharge point, to the north of the development to the Irish Water foul sewer.

Car parking drainage at basement level, will gravitate to the lowest point before passing through an interceptor, where this will be pumped to the foul network

A confirmation of feasibility and statement of design acceptance has been received from Irish Water for the proposed development and has been included under Appendix F and G respectively.

6.2 Design Calculations

All new main foul sewers are designed to discharge by gravity. Minimum gradients and pipe diameters for collector and main sewers are designed in accordance with the Building Regulations and Irish Water's Code of Practice for wastewater infrastructure and Standard Details for wastewater infrastructure. The sewer network is designed in accordance with the principles and methods set out in IS EN 752 (2008), IS EN12056: Part2. Design criteria are as follows:

Pipe Roughness Coefficient	1.5 mm
Minimum Velocity	0.75 m/s (self-cleansing)
Maximum Velocity	3.0 m/s

Estimated peak foul loading generated by the proposed development is provided in *Table 6-1* and *Table 6-2*.

Table 6-1: Estimated Residential Foul Loading

Use Type	No. of Units	Occupancy Rate	Population (P)	Loading (G) (l/day/person) *	Daily Loading (PG) (l/day)	Daily Loading (l/s))
Residential	482 dwellings	2.7 people / dwelling	1301	150	195,210	2.26
					Residential Daily Loading (l/s)	**2.26**
					Growth Factor	1
					Infiltration @ 10% (as Cop App C 1.2.4)	0.23
					Dry Weather Flow l/s	**2.49**
					Residential Peaking factor (as CoP App C 1.2.5)	3
					Design Foul Flow (l/s)	**7.46**
					Surface Water Allowance SWE @ 1.5%	0.11
					Design Flow (l/s)	**7.57**
***Flow rates calculated using** IW **CoP for Wastewater Infrastructure Appendix C**						

Table 6-2: Estimated Commercial Foul Loading

Use Type	Floor Area (m^2)	Occupancy Rate	Population (P)	Loading (G) (l/day/person) *	Daily Loading (PG) (l/day)	Daily Loading (l/s)
Residential Amenity	558	20 m^2 / person	28	50	1,395	0.016
Retail	154	10 m^2 / person	15	12	185	0.002
Creche	300	20 m^2 / person	15	12	750	0.009
Gym	340	20 m^2 / person	17	50	850	0.010
					Commercial Daily Loading (l/s)	**0.037**
					Growth Factor	1
					Infiltration @ 10% (as Cop App C 1.2.4)	0.004
					Dry Weather Flow l/s	**0.040**
					Commercial Peaking factor (as CoP App C 1.2.5)	4.5
					Design Foul Flow (l/s)	**0.182**
					Surface Water Allowance SWE @ 1.5%	0.003
					Design Flow (l/s)	**0.185**
***Flow rates calculated using** IW **CoP for Wastewater Infrastructure Appendix C**						

7.0 WATER SUPPLY AND DISTRIBUTION

7.1 Proposed Water main and Supply

As part of the development proposals the existing 200mm ductile iron water main in Golf Lane will be utilised. This will supply water storage tank at basement level via a proposed 100mm watermain, which will in turn supply each block. Due to the extent of the development's basement, the ring main will be slung at high level and hydrants provided at podium level through the basement slab, refer to DBFL drawing 170063-3100. A confirmation of feasibility and statement of design acceptance has been received from Irish Water for the proposed development and has been included under Appendix F and G respectively.

7.2 Water main Standards and Details

The water main layout and details including valves, hydrants, metering etc. will be in accordance with Irish Water's Code of Practice and Standard Details for water infrastructure.

7.3 Hydrants

Hydrants shall comply with the requirements of BS 750:2012 and shall be installed in accordance with Irish Water's Code of Practice and Standard Details.

7.4 Design Calculations

The water demand is designed in accordance with the principles and methods set out in Irish Water's Code of Practice for Water Infrastructure Connections and Developer Services Design & Construction Requirements for Self-Lay Developments December 2017, section 3.7.2, as outlined below:

Per-capita consumption domestic	150l/person/day
Average day/week demand factor	1.25
Peak demand factor	5.0

Estimated water demand for the proposed development is provided in Table 7-1 and Table 7-2.

Table 7-1: Estimated water demand for Residential development

Use Type	No. of units	Occupancy Rate	Population (P)	Average daily domestic demand (l/day)	Average daily domestic demand (l/s)	Average day/peak week demand (l/s)	Peak hour water demand (l/s)
Residential	482 dwellings	2.7 people / dwelling	1,301	195,210	2.26	2.82	14.12
						Peak hour water demand (l/s)	**14.12**

Table 7-2: Estimated water demand for Commercial development

Use Type	Floor Area (m^2)	Occupancy Rate	Population (P)	Average daily demand (l/day)	Average daily demand (l/s)	Average day/peak week demand (l/s)	Peak hour water demand (l/s)
Residential Amenity	558	20 m^2 / person	28	4,185	0.050	0.063	0.315
Retail	154	10 m^2 / person	15	2,310	0.027	0.034	0.170
Creche	300	20 m^2 / person	15	2,250	0.026	0.033	0.165
Gym	340	20 m^2 / person	17	2,550	0.030	0.038	0.190
						Peak hour water demand (l/s)	**0.84**

Appendix A

PERMISSIBLE OUTFLOW CALCULATIONS

PROJECT Lands at Kilruddery			**JOB REF.** 170063
SUBJECT Surface Water Calculations - Permissible Site Discharge			**Calc. Sheet No.** 1
Drawing ref. 170063-3105	**Calculations by** PCC	**Checked by** NJF	**Date** 10-Nov-20

PERMISSIBLE SURFACE WATER DISCHARGE CALCULATIONS

Site Area

What is the overall site area? **1.60** Hectares (ha) Site is Less than 50 Hectares

Pre-Development Catchment Soil Characteristics

Are there different soil types present on the pre-developed site? No

Catchment This refers to the entire site area	1.60	
Area	1.60	Hectares (ha)
Drainage Group	2	Class
Depth to Impermeable Layers	2	Class
Permeability Group above Impermeable Layers	2	Class
Slope [o]	2	Class
SOIL Type	**2**	From FSR Table
[1]**SOIL Index**	0.30	

SOIL	SOIL Value	SPR
1	0.15	0.10
2	0.30	0.30
3	0.40	0.37
4	0.45	0.47
5	0.50	0.53

Site SOIL Index Value **0.30**

Site SPR Value **0.30**

Post-Development Catchment Characteristics

Is the development divided into sub-catchments? Yes

How many sub-catchments? 2

Catchment 1

What is the overall site area for Catchment 1? 0.58 Hectares (ha)

Catchment 1	Area (m^2)	Runoff Coeff.	Effective Area (m^2)
Roofs - Hardstanding (draining to gullies)	455.0	0.95	432.3
Roofs - Green	1336.0	0.95	1269.2
Podium - Hardstanding (draining to gullies)	0.0	0.95	0.0
Podium - Hardstanding (draining to SUDS features)	2086.2	0.80	1669.0
Green Areas on Podium	0.0	0.80	0.0
Roads and Footpaths - Draining to gullies	607.3	0.95	577.0
Grassed Areas / Soft Landscaping	1305.0	0.05	65.3

Include Public Open Space in Effective Catchment Area 1? Yes

Catchment 1 - Effective Catchment Area **4012.6** m^2

Catchment 1 - Effective Catchment Runoff Coefficient **0.69**

Catchment 2

What is the overall site area for Catchment 2? 1.02 Hectares (ha)

Catchment 2		Runoff Coeff.	Effective Area (m^2)
Roofs - Hardstanding (draining to gullies)	808.0	0.95	767.6
Roofs - Green	2375.0	0.95	2256.3
Podium - Hardstanding (draining to gullies)	0.0	0.95	0.0
Podium - Hardstanding (draining to SUDS features)	3708.8	0.80	2967.0
Green Areas on Podium	0.0	0.80	0.0
Roads and Footpaths - Draining to gullies	1079.7	0.95	1025.7
Grassed Areas / Soft Landscaping	2200.0	0.05	110.0

Include Public Open Space in Effective Catchment Area 2? Yes

Catchment 2 - Effective Catchment Area **7126.6** m^2

Catchment 2 - Effective Catchment Runoff Coefficient **0.70**

Long-Term Storage

NO

Permissible Site Discharge

What is the Standard Average Annual Rainfall (SAAR)? 892.0 mm From Met Eireann, Co-ordinates 32000 , 226000

Is the overall site area less than 50 hectares? Yes

[5]$QBAR_{Rural}$ calculated for 50 ha and linearly interpolated for area of site 3.9 Litres/sec

Notes and Formulae

1. SOIL index value calculated from Flood Studies Report - The Classification of Soils from Winter Rainfall Acceptance Rate (Table 4.5).
2. SPR value calculated from GDSDS - Table 6.7.
3. Rainfall depth for 100 year return period, 6 hour duration with additional 10% for climate change.
4. Long-term storage Vol_{xs} (m^3) = Rainfall.Area.10.[(PIMP/100)(0.8.α)+(1-PIMP/100)(β.SPR)-SPR]. (GDSDS Section 6.7.3).
   Where long-term storage cannot be provided on-site due to ground conditions, Total Permissible Outflow is to be kept to $QBAR_{(Rural)}$.
5. Total Permissible Outflow - $QBAR_{(Rural)}$ calculated in accordance with GDSDS - Regional Drainage Policies
   (Volume 2 - Chapter 6), i.e. $QBAR(m3/s)=0.00108x(Area)^{0.89}(SAAR)^{1.17}(SOIL)^{2.17}$ - For catchments greater than 50 hectares in area. Flow rates are linearly interpolated for areas smaller than 50hectares.
6. Where Total Permissible Outflow is less than 2.0l/s and not achievable, use 2.0 l/s or closest value possible.
7. QBAR multiplied by growth factors of 0.85 for 1 year, 2.1 for 30 year and 2.6 for 100 year return period events, from GDSDS Figure C2.

Appendix B

ATTENUATION CALCULATIONS

Appendix B1

ATTENUATION TANK 1

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	74.785	0.585	1.1	84.3	O K
30 min Summer	74.945	0.745	1.1	114.4	O K
60 min Summer	75.111	0.911	1.2	144.6	O K
120 min Summer	75.301	1.101	1.3	177.1	O K
180 min Summer	75.422	1.222	1.3	196.5	O K
240 min Summer	75.513	1.313	1.4	210.4	O K
360 min Summer	75.649	1.449	1.4	229.3	O K
480 min Summer	75.750	1.550	1.5	241.7	O K
600 min Summer	75.835	1.635	1.5	250.2	O K
720 min Summer	75.905	1.705	1.6	256.1	O K
960 min Summer	75.996	1.796	1.6	262.8	O K
1440 min Summer	76.039	1.839	1.6	265.9	O K
2160 min Summer	76.028	1.828	1.6	265.1	O K
2880 min Summer	75.978	1.778	1.6	261.5	O K
4320 min Summer	75.863	1.663	1.5	252.6	O K
5760 min Summer	75.763	1.563	1.5	243.1	O K
7200 min Summer	75.678	1.478	1.5	233.2	O K
8640 min Summer	75.603	1.403	1.4	223.2	O K
10080 min Summer	75.533	1.333	1.4	213.3	O K
15 min Winter	74.785	0.585	1.1	84.3	O K
30 min Winter	74.945	0.745	1.1	114.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	84.324	0.0	82.7	24
30 min Summer	57.437	0.0	83.8	39
60 min Summer	36.662	0.0	148.1	70
120 min Summer	22.829	0.0	180.6	128
180 min Summer	17.157	0.0	185.5	188
240 min Summer	13.990	0.0	189.3	248
360 min Summer	10.461	0.0	196.7	368
480 min Summer	8.501	0.0	204.0	486
600 min Summer	7.233	0.0	209.5	606
720 min Summer	6.337	0.0	213.7	726
960 min Summer	5.141	0.0	219.6	962
1440 min Summer	3.827	0.0	224.7	1288
2160 min Summer	2.849	0.0	406.4	1668
2880 min Summer	2.308	0.0	405.7	2056
4320 min Summer	1.714	0.0	398.8	2904
5760 min Summer	1.386	0.0	539.0	3744
7200 min Summer	1.176	0.0	571.4	4552
8640 min Summer	1.028	0.0	599.1	5376
10080 min Summer	0.917	0.0	623.1	6248
15 min Winter	84.324	0.0	82.7	24
30 min Winter	57.437	0.0	83.8	38

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	75.112	0.912	1.2	144.8	O K
120 min Winter	75.302	1.102	1.3	177.3	O K
180 min Winter	75.424	1.224	1.3	196.9	O K
240 min Winter	75.517	1.317	1.4	211.0	O K
360 min Winter	75.656	1.456	1.4	230.2	O K
480 min Winter	75.761	1.561	1.5	242.9	O K
600 min Winter	75.853	1.653	1.5	251.7	O K
720 min Winter	75.931	1.731	1.6	258.0	O K
960 min Winter	76.035	1.835	1.6	265.7	O K
1440 min Winter	76.097	1.897	1.6	270.1	O K
2160 min Winter	76.064	1.864	1.6	267.7	O K
2880 min Winter	75.996	1.796	1.6	262.9	O K
4320 min Winter	75.820	1.620	1.5	248.8	O K
5760 min Winter	75.683	1.483	1.5	233.8	O K
7200 min Winter	75.569	1.369	1.4	218.4	O K
8640 min Winter	75.465	1.265	1.4	203.2	O K
10080 min Winter	75.371	1.171	1.3	188.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	36.662	0.0	148.1	68
120 min Winter	22.829	0.0	180.5	126
180 min Winter	17.157	0.0	185.3	186
240 min Winter	13.990	0.0	189.0	244
360 min Winter	10.461	0.0	196.4	360
480 min Winter	8.501	0.0	203.6	478
600 min Winter	7.233	0.0	209.0	592
720 min Winter	6.337	0.0	213.1	706
960 min Winter	5.141	0.0	218.8	930
1440 min Winter	3.827	0.0	223.4	1360
2160 min Winter	2.849	0.0	405.0	1708
2880 min Winter	2.308	0.0	404.2	2168
4320 min Winter	1.714	0.0	397.8	3116
5760 min Winter	1.386	0.0	539.0	4032
7200 min Winter	1.176	0.0	571.4	4904
8640 min Winter	1.028	0.0	599.1	5792
10080 min Winter	0.917	0.0	623.2	6656

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
Region	Scotland and Ireland	Cv (Winter)	1.000
M5-60 (mm)	17.000	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.405

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	3	0.050	3	6	0.105	6	9	0.250

Model Details

Storage is Online Cover Level (m) 76.730

Tank or Pond Structure

Invert Level (m) 74.200

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	72.0	0.660	188.4	1.473	129.1	2.055	72.0
0.228	72.0	0.864	179.8	1.676	82.0	2.056	0.0
0.254	198.9	1.067	168.0	1.753	74.0		
0.457	194.6	1.270	152.2	1.778	72.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0052-1600-1800-1600
Design Head (m)	1.800
Design Flow (l/s)	1.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	52
Invert Level (m)	74.200
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	1.6
Flush-Flo™	0.229	1.1
Kick-Flo®	0.464	0.9
Mean Flow over Head Range	-	1.2

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)
0.100	1.0	1.200	1.3	3.000	2.0	7.000	3.0
0.200	1.1	1.400	1.4	3.500	2.2	7.500	3.1
0.300	1.0	1.600	1.5	4.000	2.3	8.000	3.2
0.400	1.0	1.800	1.6	4.500	2.4	8.500	3.3
0.500	0.9	2.000	1.7	5.000	2.5	9.000	3.4
0.600	1.0	2.200	1.7	5.500	2.7	9.500	3.4
0.800	1.1	2.400	1.8	6.000	2.8		
1.000	1.2	2.600	1.9	6.500	2.9		

STORMTECH Stormwater Management System Design Tool

ver: Jan18

PROJECT REF:	170063 - Residential Development at Glenamuck Road
LOCATION:	Attenuation Tank 1
DATE:	28-Sep-20
CREATED BY:	PCC

SYSTEM PARAMETERS

Required Total Storage	266	m^3
Stormtech chamber model	MC4500	
Filtration Permeable Geo or Impermeable Geo	Filter geo	
Number of Isolator Rows (IR)	1	

SITE PARAMETERS

Stone Porosity	30%		
Excavation Batter Angle (degrees)	60	°	*Minimum Requirement*
Stone Above Chambers	0.305	m	*0.30*
Stone Below Chambers	0.3	m	*0.23*
In-between Row Spacing	0.23	m	*0.23*
Additional Storage outside Excavation. E.g manholes, Header Pipe	0	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Parrallel to IR	
Diameter of Header Pipe	0.225	m
Length of Header Pipe	1.8	m

CHAMBER SYSTEM DIMENSIONS	Calculated	Adopted	
Number of Rows		3	ea
Number of units per Row		17	ea
System Installed Storage Depth (effective storage depth)	2.130		m
Tank overall installed Width at base	8.68	8.68	m
Tank overall installed Length at Base	23.07	23.07	m
Total Effective System Storage	**267.4**	**267.4**	m^3

STORMTECH SYSTEM DETAIL

StormTech Chamber Model	MC4500	
Unit Width	2.54	m
Unit Length	1.23	m
Unit Height	1.525	m
Min Cover Over System	0.3	m
Max Cover Over Chamber (see StormTech for greater cover)	2.1	m
Chamber Internal Storage Vol.	3.01	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

STONE AND EXCAVATION DETAIL

Volume of Dig for System	516	m^3
Width at base	8.68	m
Width at top	11.14	m
Length at base	23.07	m
Length at top	25.53	m
Depth Of System	2.13	m
Area of Dig at Base of System	200	m^2
Area of Dig at Top of System	284	m^2
Void Ratio	52%	
Stone Requirement - m3	353	m^3
Stone Requirement - tonne	579	tonne

Appendix B2

ATTENUATION TANK 2

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	72.804	0.554	1.7	148.1	O K
30 min Summer	72.955	0.705	1.7	201.1	O K
60 min Summer	73.112	0.862	1.7	254.7	O K
120 min Summer	73.291	1.041	1.8	312.8	O K
180 min Summer	73.405	1.155	1.9	348.0	O K
240 min Summer	73.492	1.242	1.9	373.8	O K
360 min Summer	73.620	1.370	2.0	409.5	O K
480 min Summer	73.715	1.465	2.1	433.7	O K
600 min Summer	73.791	1.541	2.1	451.3	O K
720 min Summer	73.855	1.605	2.2	464.4	O K
960 min Summer	73.956	1.706	2.2	481.8	O K
1440 min Summer	74.051	1.801	2.3	495.8	O K
2160 min Summer	74.062	1.812	2.3	497.4	O K
2880 min Summer	74.037	1.787	2.3	493.8	O K
4320 min Summer	73.955	1.705	2.2	481.5	O K
5760 min Summer	73.873	1.623	2.2	467.7	O K
7200 min Summer	73.799	1.549	2.1	453.2	O K
8640 min Summer	73.734	1.484	2.1	438.4	O K
10080 min Summer	73.673	1.423	2.1	423.3	O K
15 min Winter	72.804	0.554	1.7	148.1	O K
30 min Winter	72.955	0.705	1.7	201.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	84.324	0.0	136.7	24
30 min Summer	57.437	0.0	128.9	39
60 min Summer	36.662	0.0	256.5	70
120 min Summer	22.829	0.0	271.0	128
180 min Summer	17.157	0.0	274.5	188
240 min Summer	13.990	0.0	279.1	248
360 min Summer	10.461	0.0	290.7	368
480 min Summer	8.501	0.0	301.2	486
600 min Summer	7.233	0.0	308.9	606
720 min Summer	6.337	0.0	314.9	726
960 min Summer	5.141	0.0	323.2	964
1440 min Summer	3.827	0.0	330.7	1440
2160 min Summer	2.849	0.0	612.0	1828
2880 min Summer	2.308	0.0	619.3	2220
4320 min Summer	1.714	0.0	610.6	3028
5760 min Summer	1.386	0.0	944.6	3864
7200 min Summer	1.176	0.0	1001.1	4688
8640 min Summer	1.028	0.0	1045.2	5536
10080 min Summer	0.917	0.0	1002.3	6360
15 min Winter	84.324	0.0	136.7	24
30 min Winter	57.437	0.0	128.9	38

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	73.113	0.863	1.7	254.8	O K
120 min Winter	73.292	1.042	1.8	313.1	O K
180 min Winter	73.407	1.157	1.9	348.6	O K
240 min Winter	73.494	1.244	1.9	374.6	O K
360 min Winter	73.625	1.375	2.0	410.7	O K
480 min Winter	73.722	1.472	2.1	435.5	O K
600 min Winter	73.801	1.551	2.1	453.6	O K
720 min Winter	73.870	1.620	2.2	467.2	O K
960 min Winter	73.982	1.732	2.3	485.7	O K
1440 min Winter	74.098	1.848	2.3	502.6	O K
2160 min Winter	74.109	1.859	2.3	504.2	O K
2880 min Winter	74.071	1.821	2.3	498.7	O K
4320 min Winter	73.952	1.702	2.2	481.0	O K
5760 min Winter	73.829	1.579	2.2	459.3	O K
7200 min Winter	73.726	1.476	2.1	436.4	O K
8640 min Winter	73.633	1.383	2.0	413.0	O K
10080 min Winter	73.548	1.298	2.0	389.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	36.662	0.0	256.5	68
120 min Winter	22.829	0.0	270.8	126
180 min Winter	17.157	0.0	274.2	186
240 min Winter	13.990	0.0	278.7	244
360 min Winter	10.461	0.0	290.2	362
480 min Winter	8.501	0.0	300.4	478
600 min Winter	7.233	0.0	308.0	596
720 min Winter	6.337	0.0	313.7	712
960 min Winter	5.141	0.0	321.7	940
1440 min Winter	3.827	0.0	328.4	1386
2160 min Winter	2.849	0.0	609.4	2000
2880 min Winter	2.308	0.0	616.7	2276
4320 min Winter	1.714	0.0	607.9	3204
5760 min Winter	1.386	0.0	944.6	4152
7200 min Winter	1.176	0.0	1001.1	5048
8640 min Winter	1.028	0.0	1045.6	5968
10080 min Winter	0.917	0.0	1005.2	6856

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
Region	Scotland and Ireland	Cv (Winter)	1.000
M5-60 (mm)	17.000	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.710

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	3	0.110	3	6	0.200	6	9	0.400

Model Details

Storage is Online Cover Level (m) 74.750

Tank or Pond Structure

Invert Level (m) 72.250

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	144.8	0.660	350.0	1.473	245.0	2.055	144.0
0.229	144.8	0.864	334.0	1.676	163.0	2.056	0.0
0.254	368.0	1.067	314.0	1.753	148.0		
0.457	361.0	1.270	286.0	1.778	144.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0063-2300-1800-2300
Design Head (m)	1.800
Design Flow (l/s)	2.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	63
Invert Level (m)	72.250
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	2.3
Flush-Flo™	0.276	1.7
Kick-Flo®	0.561	1.4
Mean Flow over Head Range	-	1.7

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)
0.100	1.4	1.200	1.9	3.000	2.9	7.000	4.3
0.200	1.6	1.400	2.0	3.500	3.1	7.500	4.5
0.300	1.7	1.600	2.2	4.000	3.3	8.000	4.6
0.400	1.6	1.800	2.3	4.500	3.5	8.500	4.7
0.500	1.5	2.000	2.4	5.000	3.7	9.000	4.9
0.600	1.4	2.200	2.5	5.500	3.9	9.500	5.0
0.800	1.6	2.400	2.6	6.000	4.0		
1.000	1.8	2.600	2.7	6.500	4.2		

STORMTECH Stormwater Management System Design Tool

ver: Jan18

PROJECT REF:	170063 - Residential Development at Glenamuck Road
LOCATION:	Attenuation Tank 2
DATE:	28-Sep-20
CREATED BY:	PCC

SYSTEM PARAMETERS

Required Total Storage	**507**	m^3
Stormtech chamber model	**MC4500**	
Filtration Permeable Geo or Impermeable Geo	Filter geo	
Number of Isolator Rows (IR)	1	

SITE PARAMETERS

Stone Porosity	30%		
Excavation Batter Angle (degrees)	60	°	*Minimum Requirement*
Stone Above Chambers	0.305	m	*0.30*
Stone Below Chambers	0.3	m	*0.23*
In-between Row Spacing	0.23	m	*0.23*
Additional Storage outside Excavation. E.g manholes, Header Pipe	0	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Parrallel to IR	
Diameter of Header Pipe	0.225	m
Length of Header Pipe	1.8	m

CHAMBER SYSTEM DIMENSIONS

	Calculated	Adopted	
Number of Rows		7	ea
Number of units per Row		14.5	ea
System Installed Storage Depth (effective storage depth)	2.130		m
Tank overall installed Width at base	19.76	19.76	m
Tank overall installed Length at Base	19.995	19.995	m
Total Effective System Storage	**512.7**	**512.7**	m^3

STORMTECH SYSTEM DETAIL

StormTech Chamber Model	MC4500	
Unit Width	2.54	m
Unit Length	1.23	m
Unit Height	1.525	m
Min Cover Over System	0.3	m
Max Cover Over Chamber (see StormTech for greater cover)	2.1	m
Chamber Internal Storage Vol.	3.01	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

STONE AND EXCAVATION DETAIL

Volume of Dig for System	952	m^3
Width at base	19.76	m
Width at top	22.22	m
Length at base	20.00	m
Length at top	22.45	m
Depth Of System	2.13	m
Area of Dig at Base of System	395	m^2
Area of Dig at Top of System	499	m^2
Void Ratio	54%	
Stone Requirement - m3	629	m^3
Stone Requirement - tonne	1032	tonne

Appendix C

STORMWATER NETWORK CALCULATIONS

Appendix C1

ANALYSIS WITH UNSUBMERGED OUTFALL

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Water

Pipe Sizes STANDARD Manhole Sizes MANHOLESFA5

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	17.000	Add Flow / Climate Change (%)	0
Ratio R	0.300	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 Surface Water

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.391	4-8	0.496	8-12	0.228

Total Area Contributing (ha) = 1.115

Total Pipe Volume (m³) = 14.184

Network Design Table for Surface Water

- Indicates pipe length does not match coordinates

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
S1.000	1.911	0.013	147.0	0.405	9.00	0.0	0.600	o	300	Pipe/Conduit	
S1.001	3.774	0.025	151.0	0.000	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)
S1.000	41.49	9.02	75.400	0.405	0.0	0.0	0.0	1.29	91.5	60.7
S1.001	41.38	9.07	74.230	0.405	0.0	0.0	0.0	1.28	90.3	60.7

Network Design Table for Surface Water

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
S1.002	0.500#	0.005	100.0	0.000	0.00	0.0	0.070	o	300	Pipe/Conduit	
S1.003	2.884	0.024	120.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	20.782	0.139	149.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	20.336	0.136	149.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	6.418	0.043	149.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.007	14.635	0.098	149.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.008	22.597	0.151	149.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.009	2.221	0.015	148.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.010	34.806	0.232	150.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.011	10.029	0.067	149.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	1.448	0.010	144.8	0.710	9.00	0.0	0.600	o	450	Pipe/Conduit	
S2.001	16.315	0.109	149.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.002	0.500#	0.005	100.0	0.000	0.00	0.0	0.070	o	450	Pipe/Conduit	
S2.003	1.791	0.012	149.3	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.004	2.927	0.021	139.4	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.012	3.582	0.027	132.7	0.000	0.00	0.0	0.600	o	450	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)
S1.002	41.38	9.08	74.205	0.405	0.0	0.0	0.0	1.95	137.6	60.7
S1.003	41.30	9.11	74.200	0.405	0.0	0.0	0.0	1.43	101.3	60.7
S1.004	40.73	9.38	74.176	0.405	0.0	0.0	0.0	1.28	90.7	60.7
S1.005	40.19	9.65	74.037	0.405	0.0	0.0	0.0	1.28	90.7	60.7
S1.006	40.02	9.73	73.901	0.405	0.0	0.0	0.0	1.28	90.8	60.7
S1.007	39.65	9.92	73.858	0.405	0.0	0.0	0.0	1.28	90.8	60.7
S1.008	39.08	10.21	73.760	0.405	0.0	0.0	0.0	1.28	90.7	60.7
S1.009	39.03	10.24	73.609	0.405	0.0	0.0	0.0	1.29	91.2	60.7
S1.010	38.20	10.69	73.594	0.405	0.0	0.0	0.0	1.28	90.6	60.7
S1.011	37.97	10.82	73.362	0.405	0.0	0.0	0.0	1.28	90.7	60.7
S2.000	41.51	9.01	72.373	0.710	0.0	0.0	0.0	1.69	268.4	106.4
S2.001	41.16	9.18	72.363	0.710	0.0	0.0	0.0	1.66	263.9	106.4
S2.002	41.15	9.18	72.254	0.710	0.0	0.0	0.0	2.51	398.5	106.4
S2.003	41.11	9.20	72.249	0.710	0.0	0.0	0.0	1.66	264.3	106.4
S2.004	41.05	9.23	72.237	0.710	0.0	0.0	0.0	1.72	273.6	106.4
S1.012	37.91	10.86	72.216	1.115	0.0	0.0	0.0	1.76	280.5	152.6

Free Flowing Outfall Details for Surface Water

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.012	SS1-13	72.770	72.189	0.000	0	0

Simulation Criteria for Surface Water

Volumetric Runoff Coeff	0.750	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 2	Number of Storage Structures 2	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.000	Storm Duration (mins)	30
Ratio R	0.300		

Online Controls for Surface Water

Hydro-Brake® Optimum Manhole: SS1-3, DS/PN: S1.003, Volume (m³): 2.7

Unit Reference	MD-SHE-0052-1600-1800-1600
Design Head (m)	1.800
Design Flow (l/s)	1.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	52
Invert Level (m)	74.200
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)	1.800	1.6	Kick-Flo®	0.464	0.9
Flush-Flo™	0.229	1.1	Mean Flow over Head Range	-	1.2

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)
0.100	1.0	1.200	1.3	3.000	2.0	7.000	3.0
0.200	1.1	1.400	1.4	3.500	2.2	7.500	3.1
0.300	1.0	1.600	1.5	4.000	2.3	8.000	3.2
0.400	1.0	1.800	1.6	4.500	2.4	8.500	3.3
0.500	0.9	2.000	1.7	5.000	2.5	9.000	3.4
0.600	1.0	2.200	1.7	5.500	2.7	9.500	3.4
0.800	1.1	2.400	1.8	6.000	2.8		
1.000	1.2	2.600	1.9	6.500	2.9		

Hydro-Brake® Optimum Manhole: SS2-3, DS/PN: S2.003, Volume (m³): 3.7

Unit Reference	MD-SHE-0063-2300-1800-2300
Design Head (m)	1.800
Design Flow (l/s)	2.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	63
Invert Level (m)	72.249
Minimum Outlet Pipe Diameter (mm)	75

Hydro-Brake® Optimum Manhole: SS2-3, DS/PN: S2.003, Volume (m³): 3.7

Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	2.3	Kick-Flo®	0.561	1.4
Flush-Flo™	0.276	1.7	Mean Flow over Head Range	-	1.7

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)
0.100	1.4	1.200	1.9	3.000	2.9	7.000	4.3
0.200	1.6	1.400	2.0	3.500	3.1	7.500	4.5
0.300	1.7	1.600	2.2	4.000	3.3	8.000	4.6
0.400	1.6	1.800	2.3	4.500	3.5	8.500	4.7
0.500	1.5	2.000	2.4	5.000	3.7	9.000	4.9
0.600	1.4	2.200	2.5	5.500	3.9	9.500	5.0
0.800	1.6	2.400	2.6	6.000	4.0		
1.000	1.8	2.600	2.7	6.500	4.2		

Summary of Critical Results by Maximum Level (Rank 1) for Surface Water

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 2 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.300
Region Scotland and Ireland Cv (Summer) 1.000
M5-60 (mm) 17.000 Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 0.0 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)	1, 30, 100
Climate Change (%)	10, 10, 10

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	SS1-0	30 Summer	100	+10%	30/15 Summer				75.994
S1.001	SS1-1	1440 Winter	100	+10%	1/30 Summer				75.981
S1.002	SS1-2	1440 Winter	100	+10%	1/30 Summer				75.981
S1.003	SS1-3	1440 Winter	100	+10%	1/30 Summer				75.981
S1.004	SS1-4	1440 Winter	100	+10%					74.204
S1.005	SS1-5	1440 Winter	100	+10%					74.065
S1.006	SS1-6	1440 Winter	100	+10%					73.933
S1.007	SS1-7	1440 Winter	100	+10%					73.888
S1.008	SS1-8	1440 Winter	100	+10%					73.788
S1.009	SS1-9	1440 Winter	100	+10%					73.643
S1.010	SS1-10	1440 Winter	100	+10%					73.621
S1.011	SS1-11	1440 Winter	100	+10%					73.393
S2.000	SS2-0	2160 Winter	100	+10%	1/600 Winter				74.039
S2.001	SS2-1	2160 Winter	100	+10%	1/600 Summer				74.039
S2.002	SS2-2	2160 Winter	100	+10%	1/180 Summer				74.039
S2.003	SS2-3	2160 Winter	100	+10%	1/180 Summer				74.039

Summary of Critical Results by Maximum Level (Rank 1) for Surface Water

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SS1-0	0.294	0.000	2.60		141.6	SURCHARGED	
S1.001	SS1-1	1.451	0.000	0.20		10.8	SURCHARGED	
S1.002	SS1-2	1.476	0.000	0.18		10.7	SURCHARGED	
S1.003	SS1-3	1.481	0.000	0.03		1.6	SURCHARGED	
S1.004	SS1-4	-0.272	0.000	0.02		1.6	OK	
S1.005	SS1-5	-0.272	0.000	0.02		1.6	OK	
S1.006	SS1-6	-0.268	0.000	0.03		1.6	OK	
S1.007	SS1-7	-0.270	0.000	0.02		1.6	OK	
S1.008	SS1-8	-0.272	0.000	0.02		1.6	OK	
S1.009	SS1-9	-0.266	0.000	0.03		1.6	OK	
S1.010	SS1-10	-0.273	0.000	0.02		1.6	OK	
S1.011	SS1-11	-0.269	0.000	0.02		1.6	OK	
S2.000	SS2-0	1.216	0.000	0.11		14.0	SURCHARGED	
S2.001	SS2-1	1.226	0.000	0.08		14.0	SURCHARGED	
S2.002	SS2-2	1.335	0.000	0.10		13.9	SURCHARGED	
S2.003	SS2-3	1.340	0.000	0.02		2.3	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for Surface Water

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S2.004	SS2-4	2160 Winter	100	+10%					72.275
S1.012	SS1-12	1440 Winter	100	+10%					72.265

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.004	SS2-4	-0.412	0.000	0.02		2.3	OK	
S1.012	SS1-12	-0.401	0.000	0.03		3.8	OK	

Appendix C2

ANALYSIS WITH OUTFALL SUBMERGED DURING THE 0.1% AEP EVENT OF THE GOLF STREAM

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Water

Pipe Sizes STANDARD Manhole Sizes MANHOLESFA5

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	17.000	Add Flow / Climate Change (%)	0
Ratio R	0.300	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 Surface Water

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.391	4-8	0.496	8-12	0.228

Total Area Contributing (ha) = 1.115

Total Pipe Volume (m³) = 14.184

Network Design Table for Surface Water

- Indicates pipe length does not match coordinates

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
S1.000	1.911	0.013	147.0	0.405	9.00	0.0	0.600	o	300	Pipe/Conduit	
S1.001	3.774	0.025	151.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	0.500#	0.005	100.0	0.000	0.00	0.0	0.070	o	300	Pipe/Conduit	
S1.003	2.884	0.024	120.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	20.782	0.139	149.5	0.000	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)
S1.000	41.49	9.02	75.400	0.405	0.0	0.0	0.0	1.29	91.5	60.7
S1.001	41.38	9.07	74.230	0.405	0.0	0.0	0.0	1.28	90.3	60.7
S1.002	41.38	9.08	74.205	0.405	0.0	0.0	0.0	1.95	137.6	60.7
S1.003	41.30	9.11	74.200	0.405	0.0	0.0	0.0	1.43	101.3	60.7
S1.004	40.73	9.38	74.176	0.405	0.0	0.0	0.0	1.28	90.7	60.7

Network Design Table for Surface Water

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
S1.005	20.336	0.136	149.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	6.418	0.043	149.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.007	14.635	0.098	149.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.008	22.597	0.151	149.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.009	2.221	0.015	148.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.010	34.806	0.232	150.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.011	10.029	0.067	149.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	1.448	0.010	144.8	0.710	9.00	0.0	0.600	o	450	Pipe/Conduit	
S2.001	16.315	0.109	149.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.002	0.500#	0.005	100.0	0.000	0.00	0.0	0.070	o	450	Pipe/Conduit	
S2.003	1.791	0.012	149.3	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.004	2.927	0.021	139.4	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.012	3.582	0.027	132.7	0.000	0.00	0.0	0.600	o	450	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)
S1.005	40.19	9.65	74.037	0.405	0.0	0.0	0.0	1.28	90.7	60.7
S1.006	40.02	9.73	73.901	0.405	0.0	0.0	0.0	1.28	90.8	60.7
S1.007	39.65	9.92	73.858	0.405	0.0	0.0	0.0	1.28	90.8	60.7
S1.008	39.08	10.21	73.760	0.405	0.0	0.0	0.0	1.28	90.7	60.7
S1.009	39.03	10.24	73.609	0.405	0.0	0.0	0.0	1.29	91.2	60.7
S1.010	38.20	10.69	73.594	0.405	0.0	0.0	0.0	1.28	90.6	60.7
S1.011	37.97	10.82	73.362	0.405	0.0	0.0	0.0	1.28	90.7	60.7
S2.000	41.51	9.01	72.373	0.710	0.0	0.0	0.0	1.69	268.4	106.4
S2.001	41.16	9.18	72.363	0.710	0.0	0.0	0.0	1.66	263.9	106.4
S2.002	41.15	9.18	72.254	0.710	0.0	0.0	0.0	2.51	398.5	106.4
S2.003	41.11	9.20	72.249	0.710	0.0	0.0	0.0	1.66	264.3	106.4
S2.004	41.05	9.23	72.237	0.710	0.0	0.0	0.0	1.72	273.6	106.4
S1.012	37.91	10.86	72.216	1.115	0.0	0.0	0.0	1.76	280.5	152.6

Surcharged Outfall Details for Surface Water

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.012	SS1-13	72.770	72.189	0.000	0	0

Datum (m) 0.000 Offset (mins) -1000

Surcharged Outfall Details for Surface Water

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1000	73.070	5000	73.070	9000	73.070	13000	73.070	17000	73.070
2000	73.070	6000	73.070	10000	73.070	14000	73.070	18000	73.070
3000	73.070	7000	73.070	11000	73.070	15000	73.070	19000	73.070
4000	73.070	8000	73.070	12000	73.070	16000	73.070	20000	73.070

Simulation Criteria for Surface Water

Volumetric Runoff Coeff	0.750	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 Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.000	Storm Duration (mins)	30
Ratio R	0.300		

Online Controls for Surface Water

Hydro-Brake® Optimum Manhole: SS1-3, DS/PN: S1.003, Volume (m³): 2.7

Unit Reference	MD-SHE-0052-1600-1800-1600
Design Head (m)	1.800
Design Flow (l/s)	1.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	52
Invert Level (m)	74.200
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	1.6
Flush-Flo™	0.229	1.1
Kick-Flo®	0.464	0.9
Mean Flow over Head Range	-	1.2

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)
0.100	1.0	1.200	1.3	3.000	2.0	7.000	3.0
0.200	1.1	1.400	1.4	3.500	2.2	7.500	3.1
0.300	1.0	1.600	1.5	4.000	2.3	8.000	3.2
0.400	1.0	1.800	1.6	4.500	2.4	8.500	3.3
0.500	0.9	2.000	1.7	5.000	2.5	9.000	3.4
0.600	1.0	2.200	1.7	5.500	2.7	9.500	3.4
0.800	1.1	2.400	1.8	6.000	2.8		
1.000	1.2	2.600	1.9	6.500	2.9		

Hydro-Brake® Optimum Manhole: SS2-3, DS/PN: S2.003, Volume (m³): 3.7

Unit Reference	MD-SHE-0063-2300-1800-2300
Design Head (m)	1.800
Design Flow (l/s)	2.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	63
Invert Level (m)	72.249
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Hydro-Brake® Optimum Manhole: SS2-3, DS/PN: S2.003, Volume (m³): 3.7

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	2.3
Flush-Flo™	0.276	1.7
Kick-Flo®	0.561	1.4
Mean Flow over Head Range	-	1.7

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)
0.100	1.4	1.200	1.9	3.000	2.9	7.000	4.3
0.200	1.6	1.400	2.0	3.500	3.1	7.500	4.5
0.300	1.7	1.600	2.2	4.000	3.3	8.000	4.6
0.400	1.6	1.800	2.3	4.500	3.5	8.500	4.7
0.500	1.5	2.000	2.4	5.000	3.7	9.000	4.9
0.600	1.4	2.200	2.5	5.500	3.9	9.500	5.0
0.800	1.6	2.400	2.6	6.000	4.0		
1.000	1.8	2.600	2.7	6.500	4.2		

Storage Structures for Surface Water

Tank or Pond Manhole: SS1-3, DS/PN: S1.003

Invert Level (m) 74.200

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	72.0	0.660	188.4	1.473	129.1	2.055	72.0
0.228	72.0	0.864	179.8	1.676	82.0	2.056	0.0
0.254	198.9	1.067	168.0	1.753	74.0		
0.457	194.6	1.270	152.2	1.778	72.0		

Tank or Pond Manhole: SS2-3, DS/PN: S2.003

Invert Level (m) 72.249

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	144.8	0.660	350.0	1.473	245.0	2.055	144.0
0.229	144.8	0.864	334.0	1.676	163.0	2.056	0.0
0.254	368.0	1.067	314.0	1.753	148.0		
0.457	361.0	1.270	286.0	1.778	144.0		

Summary of Critical Results by Maximum Level (Rank 1) for Surface Water

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 Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.300
Region	Scotland and Ireland	Cv (Summer)	1.000
M5-60 (mm)	17.000	Cv (Winter)	1.000

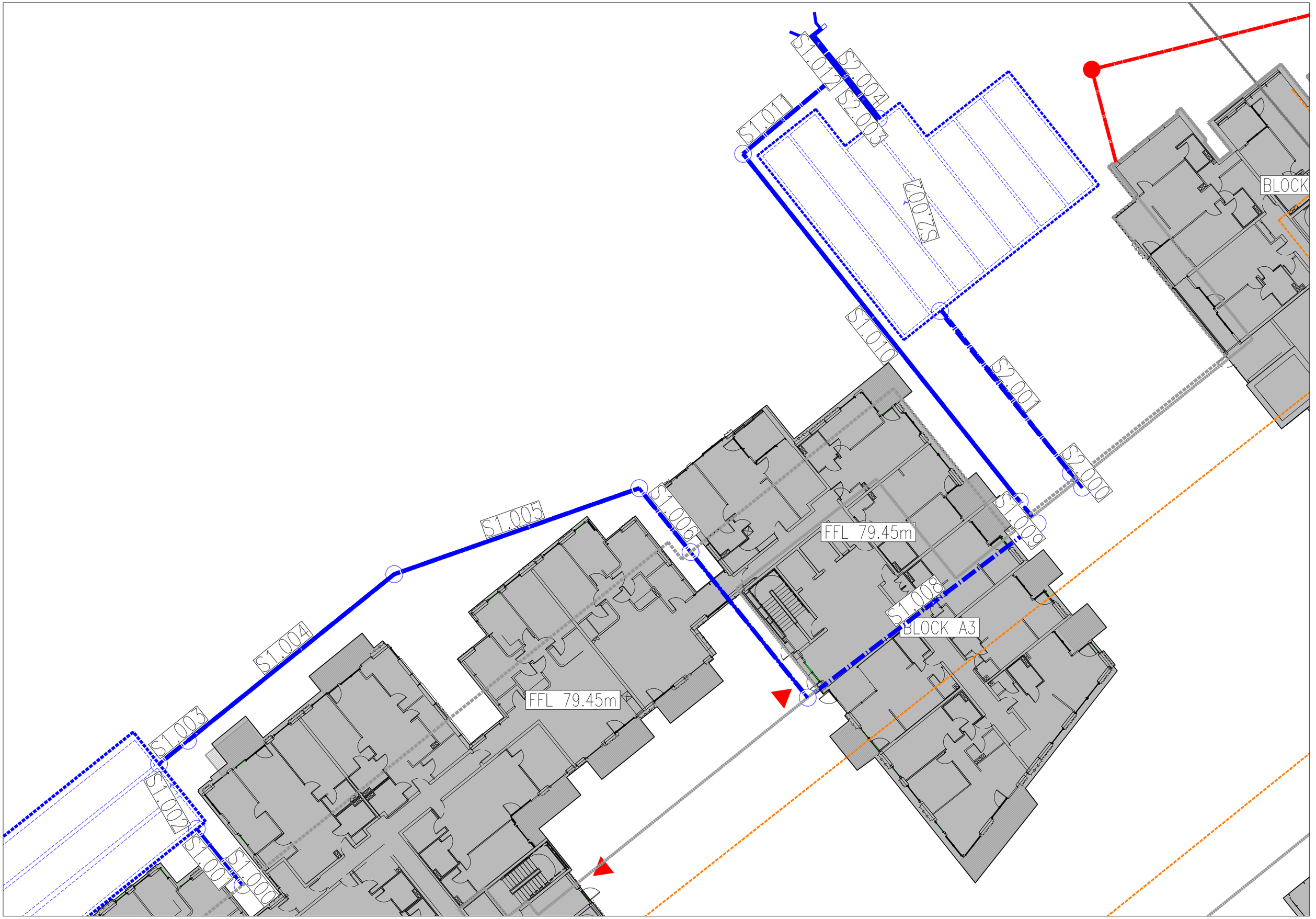
Margin for Flood Risk Warning (mm)	0.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

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)	1, 30, 100
Climate Change (%)	10, 10, 10

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	SS1-0	30 Summer	100	+10%	30/15 Summer			
S1.001	SS1-1	1440 Winter	100	+10%	1/30 Summer			
S1.002	SS1-2	1440 Winter	100	+10%	1/30 Summer			
S1.003	SS1-3	1440 Winter	100	+10%	1/30 Summer			
S1.004	SS1-4	1440 Winter	100	+10%				
S1.005	SS1-5	1440 Winter	100	+10%				
S1.006	SS1-6	1440 Winter	100	+10%				
S1.007	SS1-7	1440 Winter	100	+10%				
S1.008	SS1-8	1440 Winter	100	+10%				
S1.009	SS1-9	1440 Winter	100	+10%				
S1.010	SS1-10	1440 Winter	100	+10%				
S1.011	SS1-11	1440 Winter	100	+10%				
S2.000	SS2-0	7200 Summer	100	+10%	1/240 Summer			
S2.001	SS2-1	7200 Summer	100	+10%	1/240 Summer			
S2.002	SS2-2	7200 Summer	100	+10%	1/120 Summer	30/4320 Summer		
S2.003	SS2-3	7200 Summer	100	+10%	1/120 Summer	30/4320 Summer		
S2.004	SS2-4	2160 Summer	1	+10%	1/60 Summer			
S1.012	SS1-12	2160 Winter	100	+10%	1/30 Summer			

Summary of Critical Results by Maximum Level (Rank 1) for Surface Water

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SS1-0	75.994	0.294	0.000	2.60		141.6	SURCHARGED	
S1.001	SS1-1	75.982	1.452	0.000	0.20		10.8	SURCHARGED	
S1.002	SS1-2	75.981	1.476	0.000	0.18		10.7	SURCHARGED	
S1.003	SS1-3	75.981	1.481	0.000	0.03		1.6	SURCHARGED	
S1.004	SS1-4	74.204	-0.272	0.000	0.02		1.6	OK	
S1.005	SS1-5	74.065	-0.272	0.000	0.02		1.6	OK	
S1.006	SS1-6	73.933	-0.268	0.000	0.03		1.6	OK	
S1.007	SS1-7	73.888	-0.270	0.000	0.02		1.6	OK	
S1.008	SS1-8	73.788	-0.272	0.000	0.02		1.6	OK	
S1.009	SS1-9	73.643	-0.266	0.000	0.03		1.6	OK	
S1.010	SS1-10	73.621	-0.273	0.000	0.02		1.6	OK	
S1.011	SS1-11	73.393	-0.269	0.000	0.02		1.6	OK	
S2.000	SS2-0	74.988	2.165	0.000	0.07		9.0	SURCHARGED	
S2.001	SS2-1	74.988	2.175	0.000	0.05		8.9	SURCHARGED	
S2.002	SS2-2	74.987	2.283	86.795	0.08		10.5	FLOOD	20
S2.003	SS2-3	74.987	2.288	37.637	0.02		2.4	FLOOD	20
S2.004	SS2-4	73.071	0.384	0.000	0.01		1.4	SURCHARGED	
S1.012	SS1-12	73.071	0.405	0.000	0.03		3.9	SURCHARGED	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S2.003
S1.011
S2.002
S1.010
S2.001
S2.000
S1.009
S1.008
S1.007
S1.006
S1.005
S1.004
S1.003
S1.002
S1.001
S1.000
BLOCK
FFL 79.45m
BLOCK A3
FFL 79.45m

Appendix D

FOUL NETWORK CALCULATIONS

FOUL SEWERAGE DESIGN

Network Design Table for Foul - Unit

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.000	7.453	0.050	149.1	0.000	0.0	3.8	1.500	o	225	Pipe/Conduit	
F1.001	44.476	1.112	40.0	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F1.002	23.424	0.586	40.0	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F2.000	28.695	0.717	40.0	0.000	0.0	3.8	1.500	o	225	Pipe/Conduit	
F1.003	17.259	0.431	40.0	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Units	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.000	72.241	0.000	3.8	0.0	0.0	48	0.60	0.94	37.3	3.8
F1.001	72.191	0.000	3.8	0.0	0.0	35	0.96	1.82	72.3	3.8
F1.002	71.079	0.000	3.8	0.0	0.0	35	0.96	1.82	72.3	3.8
F2.000	72.346	0.000	3.8	0.0	0.0	35	0.96	1.82	72.3	3.8
F1.003	70.493	0.000	7.6	0.0	0.0	49	1.18	1.82	72.2	7.6

Simulation Criteria for Foul - Unit

Volumetric Runoff Coeff	0.750	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

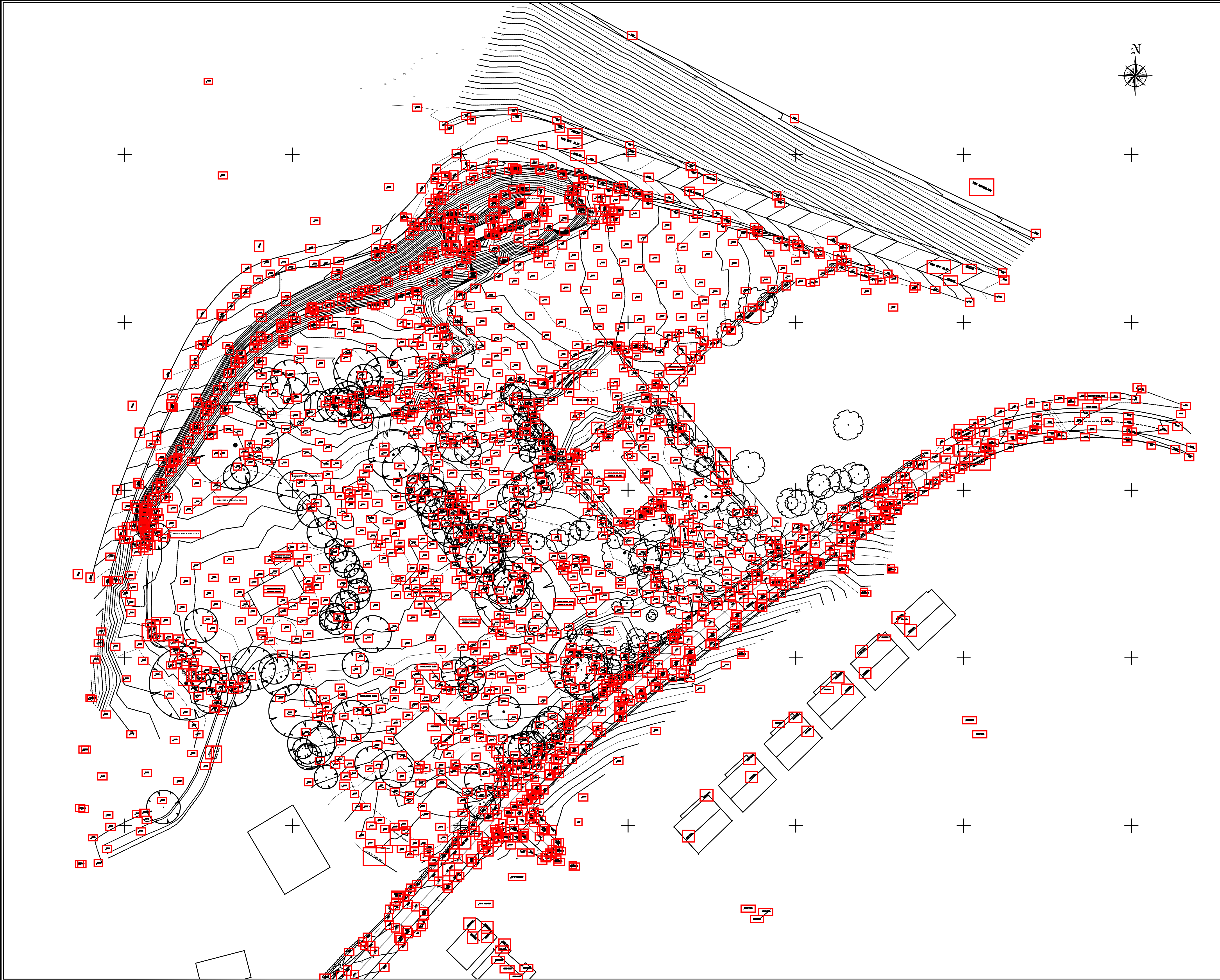
Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Profile Type Summer
Return Period (years)		0	Cv (Summer) 0.750
Region	England and Wales		Cv (Winter) 0.840
M5-60 (mm)	0.000	Storm Duration (mins)	30
Ratio R	0.000		

Appendix E

TOPOGRAPHICAL SURVEY



LEGEND

ABBREVIATIONS:

AJ	Armstrong Junction	MH	Manhole Cover
BE	Bench	M	Monument
B	Building	NL	UPC Cover
BC	Building Canopy	PB	Phone Box
BI	Litter Bin	PO	Post
BM	Benchmark	POST	Post Box
BO	Bollard	PE	Electric Pole
BX	Pillar/Cabinet Box	ROD	Earthing Rod
BS	Bus Stop	RC	Road Crown
CPS	Concrete Paving	RE	Road Edge
DP	Down Pipe	RES	Residential
D	Door	RL	Railing
EM	Eircom Cover	RS	Road Sign
EB	O/H Electric Cover	S	Sign
O/H EIR	Eircom Line	SC	Stopcock
O/H ESB	Electric Line	SV	Sluice Valve
F	Fence	ST	Steps
FFL	Finish Floor Level	TR	Traffic Cover
FB	Flower Box	TL	Traffic Light
GATE	GATE	TM	Ticket Machine
GS	GAS Cover	T	Tree
G	Gully	TAR	Tarmac
H	Fire Hydrant	TAC	Tactile Paving
IC	Inspection Cover	V	Vegetation Line
KC	Kerb Channel Line	W	Water Cover
K	Kerb Top	WT	Wall Top Level
LP	Lamp Post	GL	Ground Recessed Light
CRN	Pipe/Duct Crown (top)	PC	CCTV Pole
Rec	From CC Records	PC	CCTV Pole
DROP	Dropped Kerb	BD	Drain Backdrop
UTO	Unable to open MH	Br	Drain Branch Run/Pipe

DATUM

BENCHMARK BASED ON ORDNANCE DATUM MALIN HEAD (OSGM15)
SURVEY GRID IS IRISH TRANSVERSE MERCATOR

NOTES:

REV. SUFF.	DATE	INIT	REVISION DETAILS

Laser Surveys

SUITE 12, BLOCK 1, BROOMHALL BUSINESS PARK,
RATHNEW, CO. WICKLOW

Tel: 0404 61401 Fax: 0404 61402
Mobile: 087 236 4811 Email: kieran@lasersurveys.ie

CLIENT:

Architect
Ferreira Architecture

JOB TITLE:

Golf Road, Carrickmines, Co Dublin
Site Topographical Survey

PROJECT No:	SCALE:	DATE:
1704.786_Golf Road, Carrickmines_2D Survey	1:500 TEXT SCALED@1:200	08/05/17

SURVEYOR:	ISSUE No./Rev	DRAWING No:	SHEET SIZE
KOS	0	786_01_2D	A1

Appendix F

IRISH WATER CONFIRMATION OF FEASIBILITY

Nick Fenner
DBFL Consulting Engineers
Ormond House, Upper Ormond Quay
Dublin D07W704
Dublin
Ireland

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

Irish Water
PO Box 448,
South City
Delivery Office,
Cork City.

www.water.ie

21 January 2020

Dear Nick Fenner,

Re: Connection Reference No CDS19007932 pre-connection enquiry -
Subject to contract | Contract denied

Connection for Housing Development of 480 unit(s) at Golf Lane, Glenamuck Road, Dublin.

Irish Water has reviewed your pre-connection enquiry in relation to a water connection at Golf Lane, Glenamuck Road, Dublin.

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

Water:

New connection to the existing network (trough the 200mm watermain) is feasible without upgrade.

Wastewater:

New connection to the existing network (trough the 300mm sewer) is feasible without upgrade.

Diversion of the infrastructure may be required subject to layout proposal of the development and separation distances.

Strategic Housing Development

Irish Water notes that the scale of this development dictates that it is subject to the Strategic Housing Development planning process. In advance of submitting your full application to An Bord Pleanala for assessment, you must have reviewed this development with Irish Water and received a Statement of Design Acceptance in relation to the layout of water and wastewater services.

All infrastructure should be designed and installed in accordance with the Irish Water Codes of Practice and Standard Details. A design proposal for the water and/or wastewater infrastructure should be submitted to Irish Water for assessment. Prior to submitting your planning application, you are required to submit these detailed design proposals to Irish Water for review.

You are advised that this correspondence does not constitute an offer in whole or in part to provide a connection to any Irish Water infrastructure and is provided subject to a connection agreement being signed at a later date.

A connection agreement can be applied for by completing the connection application form available at **www.water.ie/connections**. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Regulation of Utilities.

If you have any further questions, please contact Marko Komso from the design team on (022) 54611 or email mkomso@water.ie. For further information, visit **www.water.ie/connections.**

Yours sincerely,

Maria O'Dwyer

Connections and Developer Services

Appendix G

IRISH WATER STATEMENT OF DESIGN ACCEPTANCE

Nick Fenner
DBFL Consulting Engineers
Ormond House, Upper Ormond Quay
Dublin
D07W704
Ireland

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

Irish Water
PO Box 448,
South City
Delivery Office,
Cork City.

www.water.ie

11 November 2020

Re: Design Submission for Golf Lane, Glenamuck Road, Dublin (the "Development") (the "Design Submission") / Connection Reference No: CDS19007932

Dear Nick Fenner,

Many thanks for your recent Design Submission.

We have reviewed your proposal for the connection(s) at the Development. Based on the information provided, which included the documents outlined in Appendix A to this letter, Irish Water has no objection to your proposals.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Irish Water infrastructure. Before you can connect to our network you must sign a connection agreement with Irish Water. This can be applied for by completing the connection application form at www.water.ie/connections. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Regulation of Utilities (CRU)(https://www.cru.ie/document_group/irish-waters-water-charges-plan-2018/).

You the Customer (including any designers/contractors or other related parties appointed by you) is entirely responsible for the design and construction of all water and/or wastewater infrastructure within the Development which is necessary to facilitate connection(s) from the boundary of the Development to Irish Water's network(s) (the "**Self-Lay Works**"), as reflected in your Design Submission. Acceptance of the Design Submission by Irish Water does not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.

If you have any further questions, please contact your Irish Water representative:
Name: Dario Alvarez
Email: dalvarez@water.ie

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

Appendix A

Document Title & Revision

- [170063-3100-170063-3100 - P02 Watermain and Drainage layout]
- [170063-3100-170063-3100 - P02 Drainage layout]
- [170063-3100-170063-3130 – P01 Foul Drainage longitudinal sections]

Standard Details/Code of Practice Exemption:

For further information, visit ***www.water.ie/connections***

Notwithstanding any matters listed above, the Customer (including any appointed designers/contractors, etc.) is entirely responsible for the design and construction of the Self-Lay Works. Acceptance of the Design Submission by Irish Water will not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.

Appendix H

RESPONSES TO DLRCC COMMENTS AND ABP OPINION

Statement of Response to Transport Department

Comment ID	Comment	Response
1	Full details and drawings of all the proposed works to be carried out at the Applicant's expense at Glenamuck Road and Golf Lane (future Kilternan Link Road) to facilitate this strategic housing development are recommended. These works include: a) Glenamuck Road Toucan crossing in accordance with National Cycle Manual (NCM) and Design Manual for Urban Roads & Streets (DMURS) guidance and standards. b) Glenamuck Road Interface with the proposed pedestrian cyclist bridge/s c) Golf Lane interim temporary vehicular access with the Kilternan Link Road in place. d) Golf Lane uncontrolled crossing.	Details of the proposed works are shown on DBFL drawing no. 170063-2100.
2	The Applicant should ensure the Kilternan Link Road reservation along the full extent of the Golf Lane site development frontage is maintained free of development. The construction of a boundary treatment, along or behind the road reservation line, shall be agreed.	The Kilternan Link Road reservation along the full extent of the Golf Lane site development frontage has been maintained free of development.
3	The Applicant is recommended to show within the Kilternan Link Road reservation provision of an area of land grassed and levelled between a temporary 3m wide footpath and the existing road edge at Golf Lane (Future KLR). Kerbing shall be provided along the existing Golf Lane road edge.	The Kilternan Link Road reservation proposals are shown on DBFL drawing no. 170063-2100. This includes an area of land grassed and levelled between a temporary 3m wide footpath.
4	The Applicant is requested to submit detailed plan indicating: The front boundary of the proposed development shown to be set back behind the line of the Kilternan Link Road reservation. The line of the back of future footpath (front face of new boundary) and a suitable boundary delineator at the Golf Lane site development frontage for the Kilternan Link Road Reservation shall be agreed with the Planning Authority.	These details are shown on DBFL drawing no. 170063-2103.
5	The Applicant shall confirm in writing that the area of land to be reserved free of development along the frontage of Golf Lane will be offered to be taken in charge by the Planning Authority and will be ceded to the Planning Authority to facilitate the Kilternan Link Road Cherrywood SDZ future road infrastructure.	

Comment ID	Comment	Response
6	The Applicant is requested to submit dimensioned details of the proposed development vehicular access at Golf Lane/Kilternan Link Road clearly demonstrating an interim temporary arrangement and a future permanent arrangement with the Kilteman Link Road in place. For both the temporary and permanent arrangements full details of the proposed development vehicular access including pedestrian crossing and junction details shall be provided. The Applicant is requested to demonstrate provision of adequate visibility and sightlines for vehicles, cyclists and pedestrians.	These details are shown on DBFL drawing no. 170063-2103.
7	The Applicant is requested to provide detailed drawings showing a minimum 4.0m wide Greenway throughout the development. This is recommended to include provision of a minimum 4m wide pedestrian and cycle bridge crossing and a continuous 4m wide pedestrian and cycle link from the proposed Glenamuck Road Signalised Toucan Crossing to the proposed devleopment Golf Lane (Kilternan Link Road) development pedestrian and cycle entrance. Taking in consideration concerns of Transport Infrastructure Ireland with respect to use of land outside the Applicant's control in proximity of the M50 corrdidor it is recommended to ensure the Greenway is indicated within the Applicant's boundary particularly at the northern site boundary.	DBFL drawing no. 170063-2100 shows a 4.5m wide pedestrian and cycle link from the proposed Glenamuck Road Signalised Toucan Crossing through to Golf Lane. Furthermore, a 4m wide greenway has been provided through the development at the northern side.
8	The Applicant is requested to submit detailed plan layout drawings showing how permeability and access to adjacent site (east and west) to accommodate future development can be facilitated. No grass strips between future access/permeability connections shall be shown.	Permeability through the proposed development is shown on DBFL Drawing no. 170063-2100.
9	The Applicant is requested to submit a detailed Quality Audit (which shall include a Road Safety Audit, Access Audit, Cycle Audit and a Walking Audit) to demonstrate that appropriate consideration has been given to all relevant aspects of the proposed residential development in accordance with DMURS. The independent Audit Team shall be approved by the Planning Authority (Transport Planning Section) and all measures recommended by the Auditor shall be undertaken unless the Planning Authority approves any departure in writing. A feedback report should also be submitte providing a response to each of the items.	A quality audit has been carried out and submitted for the proposed development.
10	The Applicant is requested to show on a detailed plan layout drawing the access and arrangements and vehicle manoeuvres required for refuse collection, emergency vehicles and delivery, collection etc. within the proposed residential development. The Applicant shall show the above on a detailed layout drawing by using CAD software.	The vehicle tracking for the proposed development is shown on DBFL drawing no. 170063-2104.

Comment ID	Comment	Response
11	The Applicant is requested to ensure that the proposed basement car park and access is in accordance with Section 8.2.4.10 of DLRCC Development Plan 2016-2022 and complies with requirements of the IStructE 'Design Recommendations for Multi Storey Underground Car Park Fourth Edition'. Minimu aisle width of 6.0m recommended.	The proposed basement car park access has been designed in accordance with the DLRCC Development Plan 2016-2022 and the IStrcutE guidelines.
12	The Applicant is requested to indicate on detailed drawings the provision of adequate space for correctly designed cycle parking facilities for residential and visitor cycle parking spaces to requirements of Section 8.2.4.7 of the 2016-2022 Dun Laoghaire-Rathdown County Development Plan and in accordance with Dun Laoghaire Rathdown County Council – Standards for Cycle Parking and associated Cycling Facilities for New Developments (2018). Dimensioned clearly indicated details of all proposed cycle access routes and access to and from cycle parking are recommended.	Cycle parking facilities are shown on DBFL drawings no. 170063-2100, 170063-2101 and 170063-2102.
13	The Applicant is requested to ensure provision of motorcycle parking spaces for the development in accordance with section 8.2.4.8 of DLRCC Development Plan 2016-2022.	12 no. motor cycle parking spaces have been included as shown on DBFL drawings no. 170063-2101 and 170063-2102.
14	The Applicant is requested to provide adequate space for up to 489 no. car parkng spaces within the proposed development.	This residential car parking provision fully outlined in the Traffic & Transport Assessment.
15	The Applicant is requested in accordance with Section 8.2.4.12 of the current County Development Plan (2016-2022) to show that the proposed devleopment car parking spaces are constructed capable of acccommodating future electric charging points for electrically operated vehilces. A minimum of one car parking space per 10 residential units shall have a function EV charging point.	49 no. EV parking spaces have been included as shown on DBFL drawings no. 170063-2101 and 170063-2102. This fulfils the requirement of one car parking space per 10 residential units.
16	The Applicant is requested to ensure provision of at least 4% of parking spaces within the proposed development reserved for use by disabled persons in accordance with Section 8.2.4.5 of the Dun Laoghaire-Rathdown County Development Plan, (2016-2022). Parking bay widths suitable for disabled parking bays shall be a minimum of 2.4m wide – with a 1.2m buffer on both sides – and 6m in depth.	12 no. disable parking spaces have been provided as shown on shown on DBFL drawings no. 170063-2101 and 170063-2102. This fulfils the requirement of 4% of parking spaces.
17	17. The Applicant is requested to submit a Travel Plan for the proposed residential development in accordance with Section 8.2.4.3 of CDP 2016-2022. The Applicant is requested to submit a Travel Plan for the proposed residential development in accordance with Section 8.2.4.3 of CDP 2016-2022.	A mobility management plan (DBFL Report no. 170063-rep-006) has been submitted.

Comment ID	Comment	Response
18	In accordance with the County Development Plan Policy EI20: Traffic Noise 'the effect of traffic noise on new development must be considered and appropriate measures undertaken to mitigate same.' The Applicant shall show what mitigation measures they intend to provide in order to keep noise wtihin the development to acceptable levels i.e. boundary treatment, and double/triple glazing etc.	
19	The Applicant is requested to submit a detailed Construction Management Plan indicating measures dealing with: a) Traffic management plan including Construction vehicular access to site in particular to avoid conflict between construction activities and traffic on Golf Lane and the local road network. b) How it will be intended to avoid conflict between construction activities and pedestrian movements on Golf Lane and the local road network during construction works. c) Proposed measures to minimise / eliminate nuisance caused by noise and dust, proposed working hours and measures to minimise / prevent transfer of dirt to the public road with associated measures to clean the public roads / gully's etc in the vicinity of the site and continuing replacesment of roads line markings resulting therefrom.	A preliminary construction and environmental management plan has been included (DBFL Report no. 170063-REP-005) and indicates measures dealing with the mentioned points.

Statement of Response to Drainage Department

Comment ID	Comment	Response
1	The applicant proposes a restricted flow discharge of 3.9 l/s, which would be expected given the net site area of 1.6Ha, SAAR of 829 and SOIL value Type 2 submitted by the applicant. However, there are numerous inconsistencies in the Infrastructure Design Report, Microdrainage analysis and the accompanying drawings that should be addressed to ensure the correct information is used to simulate the surface water drainage system and calculate the attenuation volume required.	These inconsistencies have been addressed and the information in the Infrastructure Design Report, Microdrainage analysis and accompanying drawings are all consistent.
2	The applicant has excluded the positively drained landscaped areas and applied reduced run-off rate to SuDS measures, giving a reduced contributing area of 1.1Ha in their Microdrainage calculations which is less than the 1.6Ha stated in the Infrastructure Design Report that the Qbar calculation is based on. This may result in the attenuation storage being undersized.	All positively drained areas contributing to the drainage system have now been included in the attenuation calculation giving a total contributing area of 1.6 Ha.
3	It should be noted that Microdrainage has default Cv values of 0.84 for Winter and 0.75 for Summer. These should be amended to a value of 1.0, particularly where an applicant proposed reduced runoff rates. Maintaining the default Cv values reduces the run-off in simulations of rainfall events, giving inaccurate simulation results which may lead to undersizing of the drainage system. The applicant is required to resubmit their Microdrainage calculations using the correct total contributing area and site specific or local data, such as SAAR, Soil Type, Rainfall Return Period Table (available from MET Eireann), rainfall intensity and other hydrological parameters. The applicant should carefully consider the relationship between reduced runoff rates and default Cv values to ensure the proposed drainage system is modelled accurately. The applicant must clearly state and justify all inputs used Microdrainage and agree these with Drainage Planning prior to submission of the final application.	The microdrainage CV values have been amended to 1.0 and all calculations have been carried out using the site specific data. The updated microdrainage calculations have been included under Appendix B.
4	The applicant has proposed to use two flow control devices and two attenuation systems. The applicant is requested to identify on a colour-coded drawing the various sub-catchments and the elements of interception/treatment for each and confirm if there is any interaction between the sub-catchments.	DBFL drawing no. 170063-3105 has been updated to indicate the various sub-catchments draining to each attenuation tank.
5	The applicant is required to submit the complete 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.	The Site Investigation Report has been included.

6	As standard, the applicant is required to submit long-sections of the surface water drainage system, clearly labelling cover levels, invert levels, pipe gradients and pipe diameters.	Long sections of the surface water and foul drainage systems have been added to DBFL drawing 170063- 3120.
7	The applicant shall confirm that all incidental surface run off from the basement carpark discharging to foul sewer and not surface water sewer.	All incidental surface water run off from the basement carpark will discharge to the foul sewer as show on DBFL drawings 170063-3110 and 170063-3111.
8	As standard, the applicant is required to demonstrate by calculation and by representation on a drawing that the proposed green roof extents are in accordance with the Council's Green Roof Policy such that the minimum coverage requirement of 60% is achieved. The applicant shall also provide details of maintenance access to the green roofs and should note that, in the absence of a stairwell type access to the roof, provision should be made for alternative maintenance and access arrangements such as external mobile access that will be centrally managed. A detailed cross section of the proposed build-up of the green roof should be provided, including dimensions. The applicant should comment on the compatibility of the green roof with PV panels if they are to be incorporated into the design.	DBFL drawing no. 170063-3105 has been updated to demonstrate the green roof and other catchment coverage. Refer to the architectural / landscape architectural drawings for further details on the green roofs.
9	The applicant has shown the flow control devices with a bypass door. The applicant is required to provide a penstock in the flow control device chambers and ensure that the flow control devices provided do not have a bypass door. The applicant shall also clarify whether a silt trap is being provided in the flow control device chambers and if not make provision for same.	DBFL drawings no. 170063-3107 and 170063-3108 have been updated to provide a penstock in the flow control device chambers. The isolator row unit of the Stormtech chambers will act as a silt trap therefore silt traps have not been provided in the flow control device chambers.
10	As standard, the applicant is required to submit supporting standard details, including cross-sections and long-sections, and commentary that demonstrates that all proposed SUDS measures, i.e. green roofs/podiums, bio-swales, filter drains and bioretention areas, have been designed in accordance with the recommendations of CIRIA C753 (The SUDS manual).	Commentary has been included in the Infrastructure Design Report under Section 5 on all the proposed SUDS measures. Details have been included on DBFL drawing no. 170063-3141.
11	It is noted that the applicant has included plans and sections of the proposed attenuation system, in this instance two Stormtech systems. As standard, the applicant is required to confirm the actual depths of cover to the systems particularly at points where less than industry standard cover, or excess cover, is provided. The applicant shall include confirmation from the chosen manufacturer of the storage system that the specific model chose, with the depth of cover being provided, has the required load bearing capacity to support the loading that may be imposed upon it. The applicant shall also confirm that the trees located on the attenuation system on the SUDS strategy drawing are removed.	The depths to cover for the attenuation tanks are shown on DBFL drawing 170063-3100, 170063-3107 and 170063-3108. These are all within the minimum required cover specified by the manufacturer.

12	As standard, the applicant is required 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 connections points to public utilities. Minimum separation distances shall be in accordance with applicable Codes of Practice.	Minimum separation distances as per the relevant Codes of Practice have been applied to the utilities.
13	As standard, the applicant is required 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.	DBFL drawing no. 170063-3105 has been updated to demonstrate the contributing catchments. The accompanying text and tabular submission are included in DBFL report no. 170063-REP-003 Infrastructure Design Report.
14	If the applicant proposes SUDS measures that incorporate the use of infiltration, the applicant is required to provide details of each SUDS measure and confirm whether it will be lined/tanked or not.	Details of proposed SUDS measures are shown on DBFL drawing 170063-3141.
15	A stormwater audit will be required for this application. In accordance with the stormwater audit policy, the audit shall be forwarded to DLRCC prior to lodging the planning application. All recommendations shall be compiled with, unless agreed in writing otherwise with DLRCC.	A stormwater audit has been carried out and has been submitted to DLRCC.

Statement of Response to Environment Department

Comment ID	Comment	Response

2.	**Existing Landscape and Soil** Given the proposal to install a double basement a thorough Hydrological regime analysis needs to be provided for the sites design as the site stands now versus post development (including Groundwater flow pathways) to demonstrate in 3D drawing format a 'source pathway receptor' assessment to risk assess against contamination and flooding (as groundwater vulnerability in this area is 'extreme' as highlighted by the applicants report). Similarly, a foundation structure design of the proposed dwellings is necessary to demonstrate the complete and full impacts below ground level. This shall contribute to providing a full complement of information for the team of consultant disciplines to evaluate this development proposal for planning.	The hydrological regime for the existing site and proposed development has been assessed as part of the development design. The Site-Specific Flood Risk Assessment assesses the hydrology of the subject site against the development proposals to ensure flood risk isn't increased. The Infrastructure Design report details the Surface Water treatment train to ensure contamination risk remains low and any associated flood risk from the development is mitigated. The Water and Land & Soils Chapter details the hydrological and hydrogeological features of the subject site (including basement excavation and interaction with ground water) and identifies and mitigates any potential risk to these receptors in the construction and operational phases of the development. The foundation design principles have been outlined in the Preliminary Construction & Environmental Management Plan under section 3.5.