Engineering Assessment Report

Proposed Residential Development, Brookfield Road, Fettercairn, Tallaght, Dublin 24

November 2023

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Comments

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1. Introduction

This report has been prepared by Waterman Moylan, on behalf of South Dublin County Council, as part of a S179A planning submission to South Dublin County Council, for the proposed 16-unit residential development on a site located at, Brookfield Road, Fettercairn, Tallaght, Dublin 24.

The proposal includes two new Social Housing apartment blocks, separated by a new entrance road and gate to the Brookfield Enterprise Centre and grouped around a communal garden space.

Block 1 is three storeys consisting of 11 separate apartments units with own-door access. Block is two storeys with a three storey corner pop-up, consisting of 5 separate apartment units with own-door access.

Each unit is provided with a private front entrance along street boundaries and private bin storage. The ground floor units have private back garden space and private open space for the first floor and second floor apartments are provided with balcony spaces, designed in accordance with DHPLG guidelines. Private terrace spaces vary throughout – recessed terraces featuring in both blocks of the scheme.

This report aims to provide a comprehensive overview of the engineering design criteria of the proposed development.

This report shall be read in conjunction with the detailed architectural planning submission.

2. Subject Site

2.1. Existing Site Location

The site is located along Brookfield Road, Fettercairn, Tallaght, Dublin 24. The subject site is located within a well-developed area, surrounded by various elements including Brookfield Road, an open green space and private houses to the west; the junction of Brookfield Road and Rossfield Avenue as well as residential apartments to the North; Brookfield Health Centre and Brookfield Enterprise Centre and Pharmacy to the South, and additional private residences to the East.

The approximate coordinates for the centroid of the subject site are N53°17'19'' W06°24'13''. The location of the site and surrounding areas, including a zoomed-in view of the site, can be seen in Figure 2-1 below.

Figure 2-1: Site Location Map

2.2. Existing Site Description

The subject site is currently in a brownfield state, consisting of an existing building, a central dividing access road, hardstanding, footpaths and unsurfaced natural planted areas (mostly overgrown).

The existing site topography has a continuous gradient of approximately 1:50 from the southeastern corner of the site to the northwestern boundary. The highest existing level on the site is approximately 108.144m OD Malin, which is found along the southern boundary whilst the lowest existing level is 106.676m OD Malin along the northern boundary of Rossfield Avenue.

Refer to Figure 2-2 for a Google Earth 3D-image of the site and approximate site boundary.

Figure 2-2: 3D Image of Existing Site – taken from Google Earth

2.3. Proposed Development

The total site area of 0.2487 ha includes the construction of 16 no. apartment units, green spaces, and all associated civil infrastructure including water supply, surface water and foul water drainage networks, footpaths and roads serving the proposed development. Refer to the architect's drawing 2235-PA-001-SITE LAYOUT PLAN for the current layout of the proposed development.

The final finished floor levels (FFLs) of the development will be set at a minimum of 117.20 m OD Malin.

The existing access road into Brookfield Enterprise Centre that passes through the site will remain a live road and will be maintained partially open in safe operating conditions during the construction works. A proposed controlled access gate will be installed to access the Enterprise Centre. The internal roads will be constructed such that adjacent FFLs are circa (c.) 300 mm above the road level. Appropriate road levels will be designed to ensure compliance with DMURS and will tie into the existing road network on either end.

The surrounding paths, and roadways – including the access road into Brookfield Enterprise Centre – are already in the charge of South Dublin County Council.

Surface water will be captured, intercepted, and reduced via various Sustainable Urban Drainage Systems (SUDS) with green roofs proposed for the apartment blocks as well as the use of permeable paving, bio-retention rainwater gardens and bio-retention tree pits. It is proposed that the development will attenuate the surface water via these SUDS measures, on site, before discharging it, at a restricted rate, to the existing surface water network located on Rossfield Avenue. The restricted rate (limited outflow) will be significantly less than the current brownfield runoff rate and designed in line with the Greater Dublin Strategic Drainage Study and the Institute of Hydrology report No 124 "Flood Estimation for Small Catchments", using the UK SUDS Website.

The proposal includes the provision of 12 no. car parking spaces (including 2 no. accessible parking spaces), as agreed with SDCC during pre-planning.

Refer to the latest Architect's planning submission for a detailed description of the development.

3. Foul Water Drainage

3.1 Irish Water Confirmation of Feasibility

A pre-connection enquiry for the water and wastewater connection requirements of the proposed development was submitted by Waterman Moylan to Irish Water on 07 July 2023. A Confirmation of Feasibility (COF) with reference no. CDS23005099 was received from Irish Water on 18 July 2023. The COF confirm that both water and foul water connection are feasible without an upgrade of Irish Water infrastructure. Refer to Appendix A for the Irish Water COF.

3.2 Existing Foul Drainage

There are two existing public foul water sewers located to the west of the subject site on Brookfield Road, 1 no. 225 mm diameter foul water sewer and 1no. 525mm diameter foul water sewer. There is an existing 225 mm diameter public foul water sewer located to the north of the subject site within Rossfield Avenue, as shown in *Figure 3-1* below.

It is proposed that the foul water connection will be into the 225mm diameter foul water network located on Rossfield Avenue at the junction of the site access road and Rossfield Avenue.

All of the above-mentioned foul water networks ultimately discharge at the rings end wastewater treatment works.

Figure 3-1 Existing Foul Drainage Network – As per Irish Water GIS

3.3 Proposed Foul Drainage - Calculations

The proposed residential development will consist of 16 no. apartment units.

Based on the Irish Code of Practice for Wastewater Infrastructure and the EPA Wastewater Treatment Manual Guidelines as a reference, the foul flow from the proposed development will be as follows:

Table 3-1: Calculation of proposed Foul Water Demand

Description	No. of Units	Population	Flow l/h/day	Infiltration Factor	Total Discharge (l/d)
Standard Residential	16	2.7	150	1.1	7,128

Calculation of Proposed Peak Foul Flow		
Total Daily Discharge (from above table)	7,128	ℓ/d
Dry Weather Flow (DWF)	0.0825	ℓ/s
Peak Foul Flow (= 6 x DWF)	**0.495**	**ℓ/s**

The proposed total peak foul flow from the development is **0.495 ℓ/s.**

3.4 Proposed Foul Drainage Network

It is intended to connect the proposed foul sewer network from the subject site to the existing foul drainage network north of the site on Rossfield Avenue, tying into the existing public foul water network via an existing manhole. Only one connection is required for the site.

The proposed foul water outfall from the development is one 225mm diameter pipe laid at a minimum gradient of 1:150, giving a capacity of 52.95 l/s. Therefore, the proposed outfall has adequate capacity to cater to the flows from the development.

Foul water sewers will consist of uPVC or concrete socket and spigot pipes (to IS 6) and will lay strictly in accordance with the Irish Water's code of practice or Wastewater Infrastructure and requirements for taking charge.

All manholes will be constructed in block work or cast in-situ concrete. Construction details for the proposed drainage systems are included in the accompanying planning submission drawings.

In accordance with the Irish Water "Code of Practice for Wastewater Supply", 150mm nominal internal diameter sewers have been proposed for carrying wastewater from 20 properties or less; whilst 225mm nominal internal diameter carrying Wastewater from more than 20 properties. Furthermore, where there are at least ten dwelling units connected, the 150mm diameter pipes are laid at a minimum gradient of 1:150 and a steeper gradient of 1:60 for up to nine connected dwelling units.

For the private drainage, house drains will be uPVC and will be laid to comply with the Building Regulations 2010, and in accordance with the recommendations contained in the Technical Guidance Documents, Section H.

As depicted in *Figure 3-2* below, it is proposed that the proposed foul water sewer shall discharge into the existing public foul water sewer in Rossfield Avenue. Refer to Waterman Moylan Drainage layout "BRFD-C-ZZ-00-GA-P-0200 - Proposed Drainage Layout".

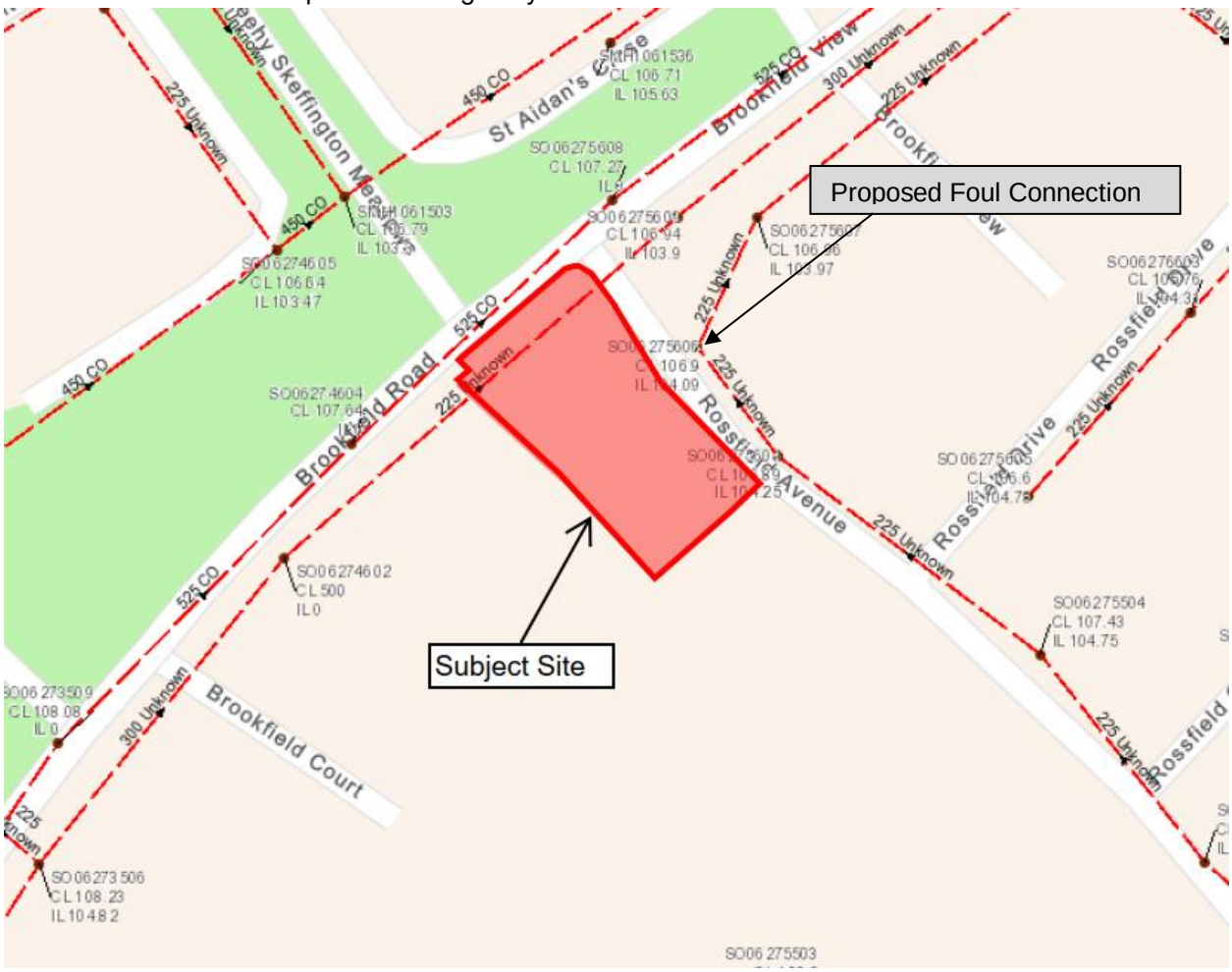


Figure 3-2 Proposed connections into the existing foul network.

4. Surface Water Drainage

4.1 Existing Surface Water Drainage

The subject site is currently in a brownfield state, consisting of an existing building, an existing access road, hardstanding, footpaths and unsurfaced natural planted areas (mostly overgrown).

Due to the limited size of the development area, the site is considered as 1 single small urban catchment area. The existing site topography has a continuous gradient of approximately 1:50 from the southeastern corner of the site to the northwestern boundary. The highest existing level on the site is approximately 108.144m OD Malin, which is found along the southern boundary whilst the lowest existing level is 106.676m OD Malin along the northern boundary of Rossfield Avenue.

There is an existing 900mm diameter public surface water pipe located to the west of the subject site within Brookfield Road, the exact location of said pipe is to be determined by a detailed site survey. There is an existing 375mm diameter public surface pipe located to the north of the subject site on Rossfield Avenue that connects to the aforementioned western-located 900mm diameter surface water pipe along Brookfield Road. This is depicted in Figure 4-1.

The current hardstanding areas drain into the existing public surface water network located to the north of the site on Rossfield Avenue via a piped connection.

The existing brownfield site is approximately 62% hard standing. There is no evidence on records drawings and site records of any existing attenuation, and it is assumed that the existing hardstanding is discharging into the existing public surface water network in Rosefield Avenue unattenuated.

Refer to Appendix B for a simulation estimating the surface water discharge from the brownfield site.

The post-development surface water runoff shall discharge at a restricted rate, in line with the GDSDS, to the existing public surface water network located to the north of the subject site on Rossfield Avenue.

Figure 4-1: Existing Surface Water Drainage in the Vicinity of the Site – as per GIS records

4.2 Proposed Surface Water Strategy

The drainage strategy for the proposed site intends to manage rainfall in such a manner that mimics natural drainage processes and reduces the impact of development on the receiving environment. It is proposed that the surface water from the proposed development will be captured by various on-site SuDS interventions prior to discharging to the existing public surface water network. The proposed SuDS interventions have been implemented to ensure runoff is treated to the standards and requirements set out in:

- the Greater Dublin Strategic Drainage,
- the SDCC Development Plan 2022-2028 - Policy GI4: Sustainable Urban Drainage Systems,
- the SDCC Sustainable Drainage Explanatory Design and Evaluation Guide 2022, and
- the Ciria SuDS Manual.

Refer to Waterman Moylan drawing BRFD-WMC-ZZ-XX-DR-C - P200 for the proposed drainage network design and BRFD-WMC-ZZ-00-GA-P-0201 - Proposed SuDS Layout.

It is proposed that surface water in the development will be attenuated within the proposed SuDS measure, including bio-retention rain gardens, bio-retention tree pits, permeable paving, a filter strip and potential greenroofs. Overflow pipes and interconnecting pipe networks linking the SuDS treatment train shall ultimately discharge to the existing public surface water network in Rossfield Avenue via a flow control device.

In line with the SDCC Sustainable Drainage Explanatory Design and Evaluation Guide 2022, an allowance for 20% climate change has been allowed. No urban creep has been allowed for by a percentage increase, but the private landscaping has been simulated as 100% runoff as an allowance.

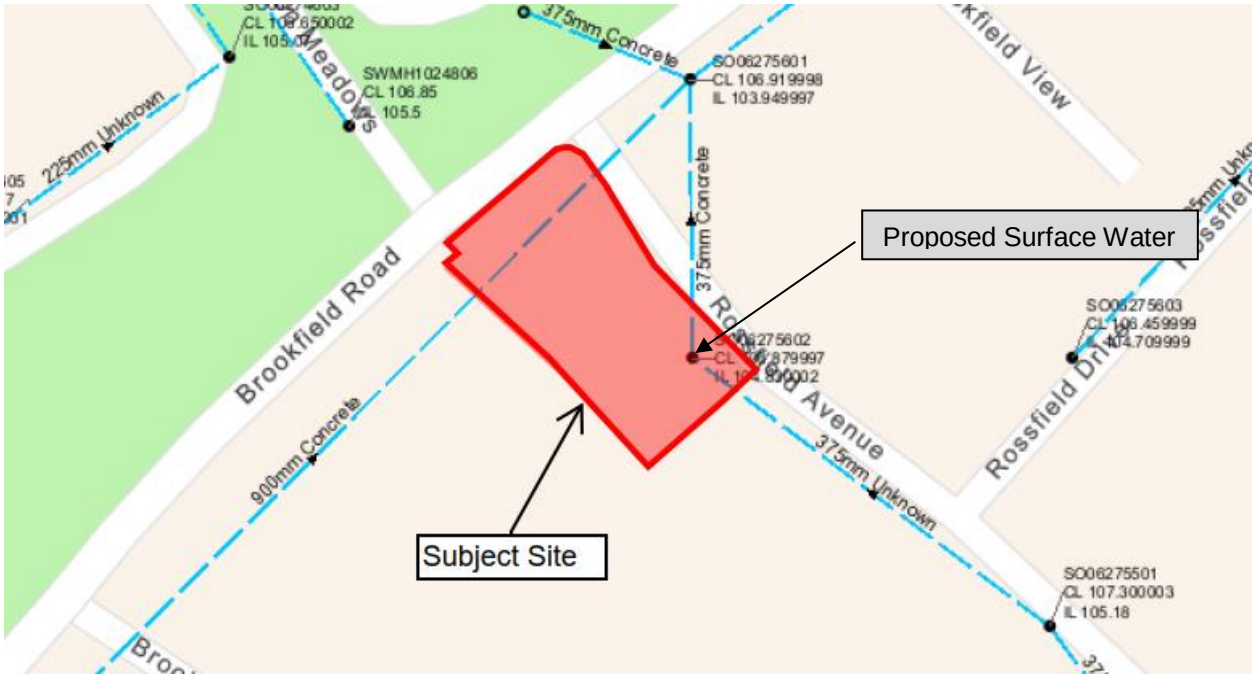


Figure 4-2 Proposed connection into existing surface water infrastructure

The allowable flow discharging from the development is referred to as the 'outflow limit', also referred to as the greenfield runoff rate of a site. This is calculated in accordance with the Institute of Hydrology report No 124 "Flood Estimation for Small Catchments", using the below equations:

$Qbar = 0.00108(Area)^{0.89} \times (SAAR)^{1.17} \times (SOIL)^{2.1}$

Greenfield Run-off = Qbar x ("n-year" factor)

Allowable Discharge = Greenfield Run-off x Area

- *Q_{bar} is the max. annual peak flow rate*
- *Greenfield run-off is the equivalent flow rate of the undeveloped site*

Subject Site	Definition	
Area	50 ha (0.5km^2)	Site area in km^2 (Or 50 hectares if the site is less than 50 Hectares)
SAAR	808.5mm	As per Met Eireann Historical Rainfall Data Records
SOIL	Type 2 (SPR of 3)	Runoff constant (Varies between 0.1 and 0.53: Given as 0.3 for an average soil)

Thus, $Qbar_{rural} = 0.00108(0.5)^{0.89} \times (808.5)^{1.17} \times (0.3)^{2.17}$

$Qbar_{rural} = 0.107\ m^3/s$ (for a 50-ha site)
$= 107.85\ \ell/s$

$Qbar_{rural} = 2.16\ \ell/s/ha$

According to the Greater Dublin Regional Code of Practice, the maximum discharge rate for the site will be the Qbar or 2 ℓ/s/ha, whichever is greater. Therefore, the Qbar for the site remains at 2.16 ℓ/s/ha.

Hence, the permitted outflow (greenfield runoff rate) for the subject site with a total area of 0.2487 ha is 0.54 ℓ/s. Refer to Appendix C for the greenfield runoff rate estimation for sites - www.ukSuDS.com.

4.3 Post-Development Runoff Rate

The required ultimate flow control (hydrobrake or similar approved) for the site is unable to achieve a discharge of 0.54l/s and maintain a practical orifice diameter limiting potential blockage and maintenance issues. To this effect, and in line with the requirements of the GDSDS Clause 6.3.3.1, a hydrobrake of orifice diameter of 75mm shall be employed which is estimated to restrict the post-development discharge to a maximum of 2.0/s. The **post-development discharge rate of 2.0/s** (in the worst-case scenario) is 3.8% of the current brownfield surface water discharge, providing a significant improvement to the site's surface water discharge.

With acknowledgement for the SDCC Sustainable Drainage Explanatory Design and Evaluation Guide 2022, Section 8.4.11.1, "*Small sites and sub-catchments of larger sites may need to meet minimal outflow flow rates. Flows can be controlled down to 0.5 – 2 l/s using small openings (15-20mm diameter) with shallow depth of storage."* The outlet from each source control shall limit said individual control utilising a suitably sized small opening, ensuring each individual control measure is providing relative attenuation to the interception area.

A summary of the subject site's pre- and post-development discharge/runoff rate is shown in Table 4-1.

Table 4-1: Summary of site catchment characteristics and discharge rates.

Pre-development/Current - Brownfield				
	C-factor	Area (m^2)	Factored Area (m^2)	
Hardstanding	0.95	1392	1322.4	
Landscaped	0.2	1095	219	
		2487	**1541.4**	**62% hardstanding coverage**
Post-development				
	C factor	Area (m^2)	Factored Area (m^2)	
Hardstanding	0.95	2270	2156.5	
Landscaped	0.2	217	43.4	
		2487	**2199.9**	**88% hardstanding coverage**
				26% Increase in hardstanding

	Surface Water Discharge Rate (l/s)			
Return Period	(A) Greenfield*	(B) Current - Brownfield	(C) Post-Development without SUDS	(D) Post-development with SUDS
1: 1	0.46	16.7	23.9	1.6
1: 10	-	32.2	46.1	1.7
1: 30	1.14	40.4	57.7	1.8
1: 100	1.4	51.7	88.7**	2.0**

*Qbar = 2.17l/s/ha - as per greenfield runoff rate estimation for sites - www.uksuds.com
***100+20%Climate Change*

(A) The catchment area in Greenfield condition
(B) The current brownfield site as it stands
(C) The proposed site without consideration for any SUDS measures
(D) The proposed site with the full compliment of the proposed SUDS and Flow Control (75mm diameter).

Notes: In line with GDSDS Clause 6.3.3.1 and the Institute of Hydrology report No 124 "Flood Estimation for Small Catchments", where the Greenfields discharge rates are less than 5l/s, the flow control device has been set to a reasonably practical discharge rate of 2l/s for the 1:100+20% year return period with a minimum orifice size of 75mm diameter.

Refer to the following appendices for the relative drainage calculations;

Appendix C – Greenfield runoff estimation

Appendix B – Brownfield runoff estimation - Flow Causeway

Appendix D– Post-development runoff estimation – excluding SuDS – Flow Causeway

Appendix E – Post-development design model – with SuDS – Flow Causeway

4.4 Proposed Surface Water Design

The total area of the catchment, including roads, car parking, green areas, and potential green roofs, is approximately 0.2487 ha, with a net hardstanding contributing area of 0.2199 ha, which equates to approximately 88% hardstanding area.

It is proposed that surface water will be attenuated within the proposed SuDS measures, including bio-retention rain gardens, bio-retention tree pits, permeable paving, a filter strip and green roofs. Overflow pipes and interconnecting pipe networks linking the SuDS treatment train shall ultimately discharge to the existing public surface water network in Rossfield Avenue via a flow control device.

The green roof has been agreed with SDCC Planning Department to a restricted portion of the full roof area on a trial basis, as proposed by SDCC Planning Department. Depending on the outcome of the SDCC trial period, the green roof shall remain in its current proposed location or be retrofitted to cover the full complement of the proposed green roof area. It is proposed that the full roof area be designed to cater for the structural loading of the green roof which shall be determined during detailed design.

Of the total site area, a minimum of 23% of the site area shall be covered by SuDS measures excluding the potential trial green roof area. If the potential green roof area is included the SuDS of the site shall increase to a total coverage of 44%. The SuDS areas for the proposed design are shown in Table 4-2.

Table 4-2: Summary of SuDS area and proportional site coverage.

The proportional area of the post-development hardstanding covered by SuDS features as follows.				
	Area (m^2)	% of proposed hardstanding	% of proposed total site area	
Private Permeable Paving (300mm thick)	200	8.8%	8.0%	
Public Permeable Paving (450mm thick)	230	10.1%	9.2%	
Proposed green roof for construction	40	1.8%	1.6%	
Bioretention tree pit	43	1.9%	1.7%	
Private Bioretention tree Pit	22.2	1.0%	0.9%	
Rain garden	38	1.7%	1.5%	
23% Total proposed proportion of SUDS within Post development area - excluding potential green roof				
Future Potential green roof for construction	510	22.5%	20.5%	
44% Total proposed proportion of SUDS within Post development area-including potential green roof				

Calculations for pipe sizes and gradients are based on stormwater management modelling conducted in Causeway Flow, simulating the relative return period rainfall, surface runoff and function of the proposed infrastructure. The rainfall input data is based on historical rainfall data obtained from Met Eireann.

Strict separation of surface water and wastewater will be implemented within the development. Drains will be laid out to minimise the risk of inadvertent connection of waste pipes etc. to the surface water system.

Surface water local drains will be a minimum of 225mm dia. and generally will consist of PVC (to IS 123) or concrete socket and spigot pipes (to IS 6). These drains will be laid to comply with the requirement of the Building Regulations 2010, and in accordance with the recommendations contained in the Technical Guidance Documents, Section H and will be laid strictly in accordance with the requirements of South Dublin County Council Taking in Charge policy.

4.5 On-Site Attenuation

The existing brownfield site is approximately 62% hardstanding. There is no evidence on records drawings and site records of any existing attenuation, and it is assumed that the existing hardstanding is discharging into the existing public surface water network in Rosefield Avenue unattenuated.

The proposed development increases the overall hardstanding by 26% to a total of 88% hardstanding, however, a significant portion of the proposed hardstanding shall be covered by SuDS measures. As previously mentioned, the site shall restrict the post-development discharge rate to a maximum of 2.0l/s.

The estimated required storage is approximately 108.66m^3 for the 1:100 + 20% critical storm event, as per the attenuation estimation found in Appendix F. The proposed SuDS volumes, excluding the potential green roof, are able to provide a total storage volume of 111.0m^3, allowing for a rainfall point depth of 44.63mm across the site area. When the full complement of the green roof is considered, this increases to a total SuDS storage volume of 171.2 m^3, allowing for a rainfall point depth of 68.83mm across the site area. Refer to Table 4-2 for a summary of the SuDS storage volumes. Refer to the SuDS volume calculations in Appendix G.

Table 4-3: Summary of SuDS Attenuation Storage Provided

SuDS Volumes				
	Area (m^2)	Depth (m)	Porosity (%)	Volume (m^3)
Private Permeable Paving (300mm thick)	200	0.35	40%	28.0
Public Permeable Paving (450mm thick)	230	0.45	40%	41.4
Proposed green roof trial portion	40			
Soil Component		0.2	40%	3.2
Drainage Core Component		0.04	95%	1.5
Private Bioretention Rain gardens	22.2	0.5	40%	4.4
Bioretention tree Pit	43	0.5	40%	8.6
Propopriety Cellular Storage	20.5	0.66	96%	13.0
Drainage Core Component	43	0.1	40%	1.7
Rain garden	38	0.6	40%	9.1
Proposed SUDS Volumes - excluding Potential Green Roofs				
Total Volume =	111.0	m^3		
(m^3 of runoff stored)/(m^2 of development)	0.045	m^3		
(mm depth of runoff stored)/(m^2 of development)	44.63	mm		
Potential SUDS Volumes - Including Potential Green Roofs				
	Area (m^2)	Depth (m)	Porosity (%)	Volume (m^3)
Potential Green Roofs	510			
Soil Component		0.2	40%	40.8
Drainage Core Component		0.04	95%	19.38
Total Volume =	171.2	m^3		
(m^3 of runoff stored)/(m^2 of development)	0.069	m^3		
(mm depth of runoff stored)/(m^2 of development)	68.83	mm		

In all instances, the provided attenuation storage is of a suitable volume and is a significant increase from the current brownfield development. Refer to Table 4-4 for a summary of the site attenuation storage comparison.

Table 4-4: Summary of the Site Attenuation Storage Comparison

		Attenuation Volumes (m^3)			
Retun Period		(A) Current - Brownfield	(B) Estimated required Volume for 2l/s disharge	(C) Post-Development excluding potenential green roofs	(D) Post-Development including potenential green roofs
1:	1	0	21	111.0	171.2
1:	10	0	46.42	111.0	171.2
1:	30	0	63.21	111.0	171.2
1:	100+20%	0	108.66	111.0	171.2

4.6 SUDS Assessment

Sustainable Urban Drainage systems (SuDS) have been developed and are in use to alleviate the detrimental effects of traditional urban stormwater drainage practices that typically consist of piping runoff of rainfall from developments to the nearest receiving watercourse. Surface water drainage methods that take account of quantity, quality and amenity issues are collectively referred to as sustainable urban drainage systems; they are typically made up of one or more structures built to manage surface water runoff.

Strict separation of surface water and wastewater will be implemented within the development. Drains will be laid out to minimise the risk of inadvertent connection of waste pipes etc. to the surface water system.

Sustainable drainage systems aim towards maintaining or restoring a more natural hydrological regime, such that the impact of urbanisation on downstream flooding and water quality is minimised. Originally, SuDS were introduced primarily as single-purpose facilities however this has now evolved into more integrated systems which serve a variety of purposes, including habitat and amenity enhancement. The main advantages of an integrated SuDS facility are the savings on land take and maintenance.

SuDS minimizes the impacts of urban runoff by capturing runoff as close to the source as possible and then releasing it slowly. The use of SuDS to control runoff also provides the additional benefit of reducing pollutants in the surface water by settling out suspended solids, and in some cases providing biological treatment.

The target development and design criteria for SuDS, set out in the CIRIA SuDS manual, are as follows:

- **Water Quantity** – Ensuring that the surface water runoff from the proposed development does not have a detrimental impact on the people, property and environment.
- **Water Quality –** Reducing urban runoff by SuDS and increasing the quality of the water
- **Amenity** – Aims to deliver pleasant, attractive and good-looking urban environments.
- **Biodiversity –** Creating new habitats and rehabilitating or enhancing habitats through SuDS measures.

The SUDS selection process used for this site is in accordance with the SuDS selection flow chart, Volume 3, Section 6.5, Figure 48 of the GDSDS and the SDCC SuDS Guideline Section 8.12.4. The characteristics of the site are utilised to select the various SuDS techniques that would be applicable.

The applicant has considered the use of all appropriate SuDS devices as part of the site SuDS strategy and has concluded that the following SuDS devices are most appropriate for the subject site. The SuDS treatment train flow diagram for the site is shown in Figure 4-2.

- Green Roofs
- Permeable Paving
- Bio-retention Ran Gardens
- Bio-retention Tree Pits
- Filter strip

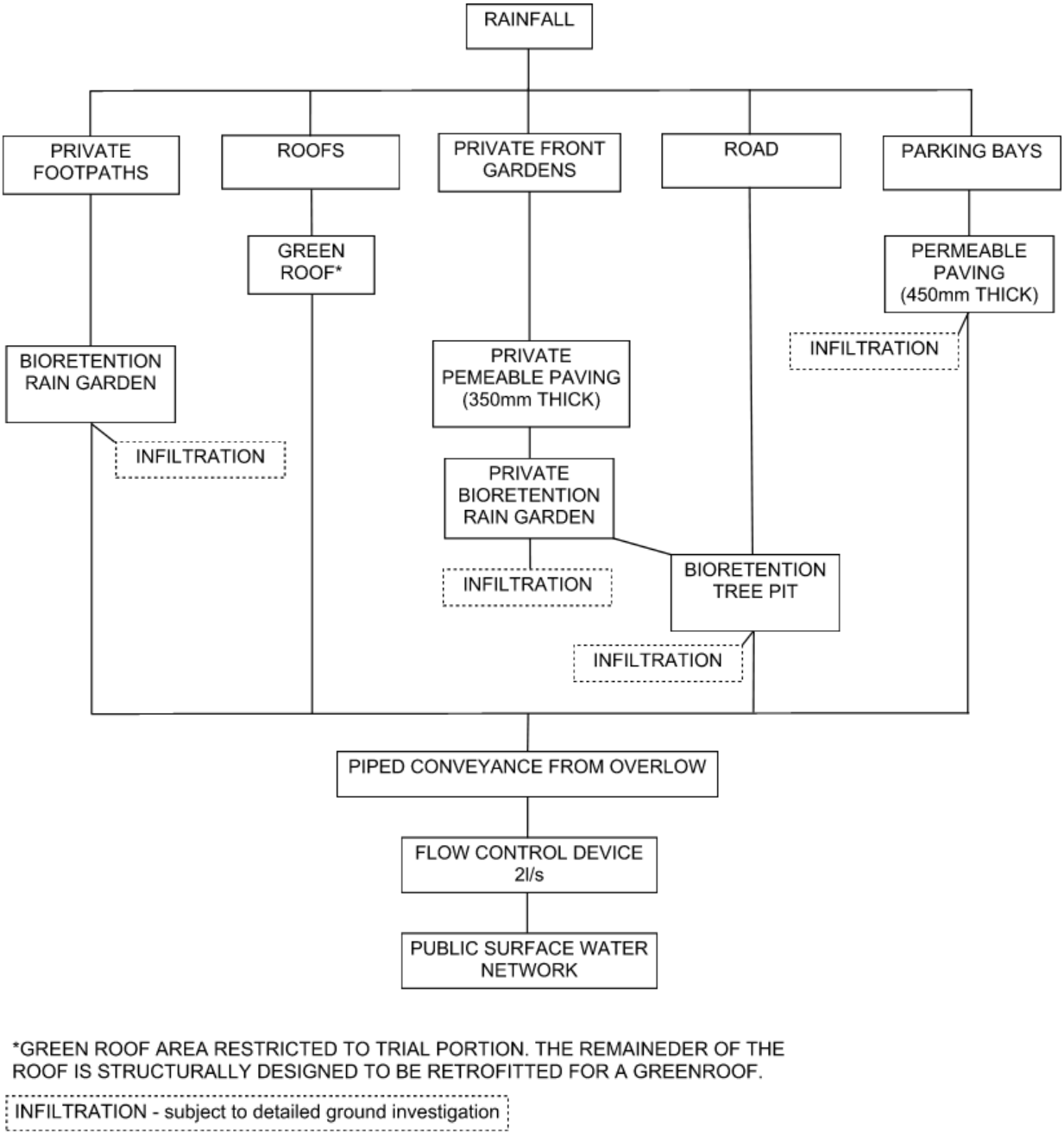


Figure 4-3: Proposed SuDS Treatment Train Flow Diagram

The applicant has considered the use of all appropriate SUDS measures as part of the site SuDS strategy, details are outlined in Table 4-5.

Table 4-5: Selected SuDS Measures

SUDS Stage	SUDS Measure	Measure Outline	Use on site
Source Control	Green Roofs	Green Roofs are roofs with a vegetated surface that can provide attenuation and treatment of rainwater. They also provide evapotranspiration from the roof's plants and substrate, reducing run-off volumes and the burden on the drainage network and improving the quality of water.	It is proposed to use Green Roofs on both the apartment blocks for both treatment and restriction of flow. The roof will provide surface water attenuation storage. The green roofs will initially be constructed to a restricted portion of the roof as a trial.
	Permeable Paving	Permeable paving provides a suitable pavement for vehicular traffic while allowing rainwater to infiltrate the surface and flow into the underlying structural layers. The rainwater is temporarily stored beneath the surface before infiltrating into the ground, or a controlled discharge point.	It is proposed to use permeable paving for all parking and selected private hardstanding areas. Rainfall will be caught and treated at the source. Infiltration shall be limited to a minimum of 2m away from the structure and shall be in accordance with the SDCC's "using SuDS close to Buildings"
	Filter Drains	Filter Drains are shallow trenches filled with gravel and wrapped in a geotextile membrane to treat and temporarily store surface water run-off.	Filter Drains are provided for the footpath and podium level surface water treatment to treat surface water at source before conveying it to the adjacent bio-retention rain garden.
Site Control	Bio-Retention Tree Pits & Rainwater Gardens	Bio-retention systems (including rain gardens) are shallow landscaped depressions that can reduce runoff rates and volumes and treat pollution through the use of engineered soils and vegetation. These are particularly effective in delivering interception of rainfall.	It is proposed to use Bio-retention tree pits, positioned at the front and side of one apartment block, along with a rainwater garden situated at the rear of the other block. These SuDS features will intercept and treat rainfall directly before discharging into the surface water network.
Regional Control	Flow control (Hydro-Brake)	Hydro-Brake or similar vortex flow control structures are used to restrict the outfall from the attenuation tank to the equivalent of the existing greenfield run-off. This ensures the development will not give rise to any impact downstream of the site.	A Hydro-Brake (or similar approved) will be installed downstream of the surface water network, before connecting into the existing surface water network, to ensure the outfall flow is restricted to 2.0 ℓ/s.

Refer to Waterman Moylan Drawings for the proposed drainage and SuDS design;

- BRFD-WMC-ZZ-00-GA-P-0200 - Proposed Drainage Layout
- BRFD-WMC-ZZ-00-GA-P-0201 - Proposed SuDS Layout
- BRFD-WMC-ZZ-00-GA-P-0202 - Proposed SuDS Standard Details

All SuDS measures shall be constructed in lien with the SDCC taking in Charge policy.

4.7 SUDS Maintenance

For the SuDS strategy to work as designed it is important that the entire drainage system is well maintained. It will be the responsibility of the landowners and site management team to ensure the drainage system is maintained. Maintenance and cleaning of gullies, and manholes will ensure adequate performance. The recommended program is outlined in the tables below.

Table 4-6: Permeable Paving Maintenance Schedule

SUDS Element	Maintenance		
Permeable Paving	Maintenance period	Maintenance Task	Frequency
	Regular	Brushing and vacuuming (standard cosmetic sweep over the whole surface)	Once a year, after autumn leaf fall, or as required, based on site-specific observations of clogging or manufacturer's recommendations.
	Occasional	Removal of weeds	As required
	Remedial work	Remediation work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users	As required
	Monitoring	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
		Monitor inspection chambers	Annually

Table 4-7: Green Roof Maintenance Schedule

SUDS Element	Maintenance		
Green Roof	**Maintenance period**	Maintenance Task	Frequency
	Regular Inspections	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
		Inspect soil substrate for evidence of erosion channels and identify any sediment sources	Annually and after severe storms
		Inspect drains inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	Annually and after severe storms
		Inspect underside of roof for evidence of leakage	Annually and after severe storms
	Regular maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six month and annually or as required
		During establishment (ie year one), replace dead plants as required	Monthly (but usually responsibility of manufacturer)
		Post establishment, replace dead plants as required (Where > 5% of coverage)	Annually (in Autumn)
		Remove fallen leaves and debris from deciduous plant foliage	Six monthly or as required
		Remove nuisance and invasive vegetation, including weeds	Six monthly or as required
		Mow grasses, prune shrubs and manage other planting (if appropriate) as required – Clippings should be removed and not allowed to accumulate	Six monthly or as required
	Remedial actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and source of erosion damage should be identified and controlled	As required
		If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

Table 4-8: Swale and Filter Strips Maintenance Schedule

	Maintenance period	Maintenance Task	Frequency
Filter Strips	Regular	Remove the litter and debris	Monthly, or as required
		Cut grass – to retain height within specified design range.	Monthly (during growing season), or as required
		Manage other vegetation and remove nuisance plants.	Monthly at start, then as required
		Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
		Inspect infiltration coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
		Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
	Occasional	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if soil is exposed over 10% or more of the swale treatment area
	Remedial actions	Repair erosion or other damage by re-turfing or re-seeding	As required
		Re-level uneven surfaces and reinstate design levels	As required
		Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
		Remove and dispose of oils or petrol residues using safe standards practices	As required

Table 4-9: Bio-retention Maintenance Schedule

	Maintenance period	Maintenance Task	Frequency
Bio-retention	Regular	Remove the litter and debris	Monthly, or as required
		Cut grass – to retain height within specified design range.	Monthly (during growing season), or as required
		Manage other vegetation and remove nuisance plants.	Monthly at start, then as required
		Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
		Inspect infiltration coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
		Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
	Occasional	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if soil is exposed over 10% or more of the swale treatment area
	Remedial actions	Repair erosion or other damage by re-turfing or re-seeding	As required
		Re-level uneven surfaces and reinstate design levels	As required
		Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
		Remove and dispose of oils or petrol residues using safe standards practices	As required

5. Water Supply

5.1 Irish Water Confirmation of Feasibility

A pre-connection enquiry for the water and wastewater connection requirements of the proposed development was submitted by Waterman Moylan to Irish Water on 07 July 2023. A Confirmation of Feasibility (COF) with reference no. CDS23005099 was received from Irish Water on 18 July 2023. The COF confirm that both water and foul water connection are feasible without an upgrade of Irish Water infrastructure. Refer to Appendix A for the Irish Water COF.

5.2 Existing Infrastructure

There is an existing 200mm diameter watermain located to the west of the site on Brookfield Road. There is an existing 100mm diameter watermain located to the north of the site along Rossfield Avenue, onto which it is proposed that the site shall connect into.

Figure 5-1: Existing Water Supply Network – As per Irish Water GIS records

5.3 Watermain Network Design

It is proposed that a new 100mm diameter loop network be connected to the existing 100mm diameter water network is Rossfield Avenue.

The water supply design has been designed and shall be constructed in line with the Irish Water Code Of PraticeWater mains suitable for works and approved by Irish Water shall be polyethylene (PE), with PE80 or PE100 rating (MDPE, HDPE or HPPE).

The minimum depth of cover from the finished ground level to the external crown of a watermain shall be 900mm. A greater depth of cover and/or greater strength pipe and/or a higher class of bedding may be required where high traffic loading is anticipated. Depths may be altered to avoid obstructions, including separation distances between other utility services. The desirable maximum cover for a Service Connection pipe or a Water Main should be 1200 mm, where practicable.

Refer to Waterman Moylan drawing no. BRFD-WMC-ZZ-00-GA-P-0300 details of the watermain to serve the subject lands. It is proposed to connect to the existing 100 mm diameter watermain pipe along Rossfield Avenue as shown in *Figure 6-2.*

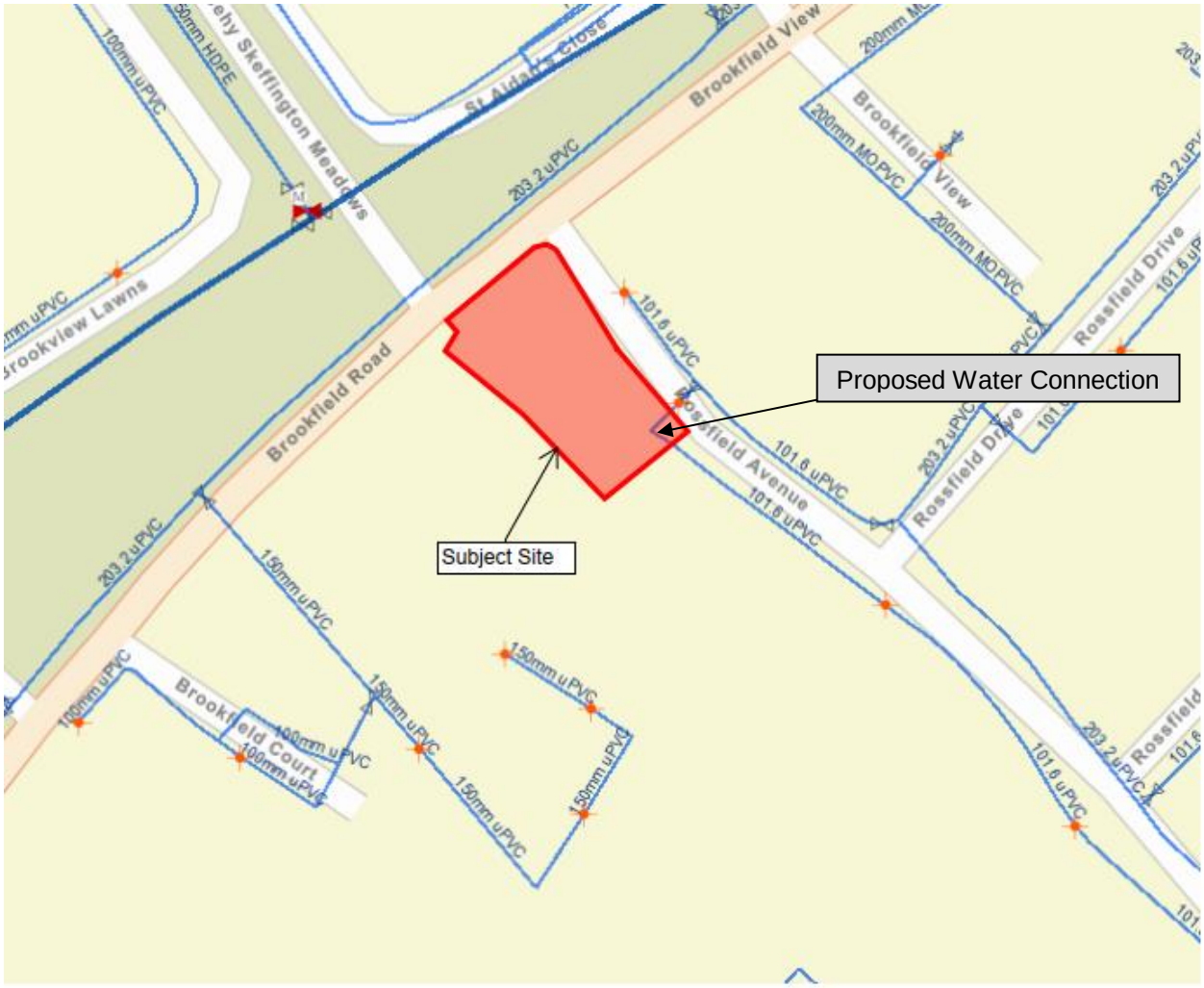


Figure 5-2: Proposed location of Water Connection– As per Irish Water GIS records

5.4 Water Demand Calculation

An estimate of water demand from the public water supply system for the proposed site has been based on the development of 16 no. residential units using Irish Waters expected household demand of 150 ℓ//h/d Details of the water demand calculation are included below.

Table 5-1: Total Water Demand Calculation

Description	No. of Units	Flow (ℓ/h/day)	Population per Unit	Total Discharge (ℓ/d)
Residential Units	16 no.	150	2.7	6,480

The total water requirement, from the public supply, for the development, is estimated at **6.48 m³/day**.

5.5 Water Conservation

The water demand for the development can be subdivided as follows:

- Potable / Non-potable Breakdown

Detailed studies have quantified the breakdown between potable and non-potable uses for residential uses. According to the guideline: Promoting Sustainable Household Water Consumption, issued by Irish Water in September 2019, Figure 2.3 of the document (shown in 3 below) illustrates the water use patterns that have been documented for a three-person household in the UK (insufficient data is available from Ireland households).

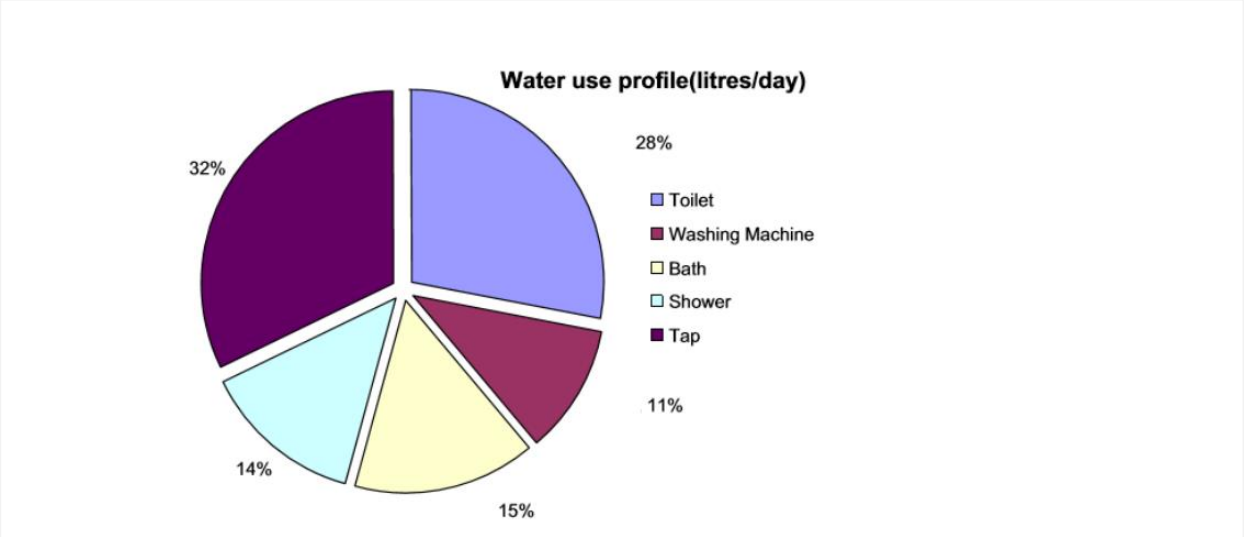


Figure 5-3: Water use patterns for 3-person households

The following water conservation measures will be used, to reduce overall water demand – water saving device installations including:

- Kitchen tap swivel aerator
- Water saving shower heads
- Spray taps
- Low volume flush / dual flush WC's
- Draw off tap controls
- Leak detection measures – through the metering of supply

6. Roads

6.1 Proposed Roads

Site access shall be gained for the existing access road off Rossfield Avenue. The existing access road shall be reduced to a width of 5m. The existing junction radii shall be tightened to R3.5m as per DMURS advise notice 6. In line with DMURS Advise notice 6, the 3m concrete footpath shall be continued across the road in the form of a raised table where the concrete footpath across the road shall provide a material contrast for the pedestrian crossing.

The existing vehicular and pedestrian access gate shall be relocated southward toward the existing commercial development.

The on-site corner radius for the junction of Rossfield Avenue to Brookfield Road shall be tightened to 4.5m, reducing the pedestrian crossing distance across the existing junction. The existing footpath and driveway access to the northeast of the site shall be extended to be in line with the existing restricted road crossing.

Refer to the architect site layout drawing and the BRFD-WMC-ZZ-00-GA-P-0100 - Proposed General Arrangement & Levels Layout and BRFD-WMC-ZZ-00-GA-P-0101 - Proposed Kerbing Layout and Cross Section.

The proposed road amendments have been analysed for vehicular access and tracking for both fire truck and refuse vehicles, refer to BRFD-WMC-ZZ-00-GA-P-0104 - Proposed Fire Tender and Refuse Vehicle Autotrack Analysis.

6.2 Proposed Sightlines

Stopping Sight Distances (SSD) is defined as the minimum distance a driver would require to safely stop their vehicle, should an object unexpectedly enter its path. The SSD is determined using the design speed of the roadway. The SSD has been implemented into this design to ensure adequate driver safety for vehicles along Brookfield Road and the vehicles entering/exiting the proposed development.

The existing Brookfield Road has a design speed of 50 km/hr. As a bus route exists along this road, the corresponding SSD standard is 49m according to DMURS table 4.2. The new proposed parallel on the southern arm of Brookfield Road is located outside of the junction sightlines.

The junction of the site access road onto Rossfield Avenue has an SSD of 45 m according to DMURS table 4.2. The existing western visibility splay is the critical sight line 34m to the centreline of Brookfield Road.

Refer to Waterman Moylan Drawing no. BRFD-WMC-ZZ-00-GA-P-0113 - Proposed Visibility Splays which has been prepared to show that the minimum SSD requirements are met for both the intersection with Brookfield Road and Rossfield Avenue.

7. Transport

7.1 Pedestrian Site Access

The existing surrounding footpath on Brookfield Road and Rossfield Avenue currently provides access to the existing site and shall be maintained as the pedestrian access to the site the existing footpath along the western site boundary shall be upgraded to a 3.2m wide footpath seated behind the new proposed parallel parking. The southwestern connection into the existing southbound pedestrian footpath and Brookfield pedestrian road crossing shall be maintained.

The east-west footpath to the north of the site, along Rossfield Avenue, shall be upgraded to a 3m wide footpath, seated behind the new proposed parallel disabled parking and bio-retention tree pit. Where the 3m footpath crosses the site access road, it is proposed that there is a DMURS-compliant raised crossing in line with DMURS advise notice 6. At said crossing, the road corner radii shall be reduced to R3.5m to limit the pedestrian crossing width.

It is proposed that a 2.5m footpath shall be provided on either side of the access road providing suitable access to the existing Brookfield Health Centre and Brookfield Enterprise Centre and Pharmacy.

7.2 Cyclist Site Access

There is no dedicated cycling infrastructure in fhte form of off street cycle lanes in the surrounding area, any cyclists in the area currently share the road infrastructure with vehicles.

7.3 Proposed Site Access

The proposed site is located to the east of Brookfield Road which links to the R136 140m to the north of the subject site, as indicated in Figure 7-1. Via the R136, the N81 is approximately 1.5km to the southeast of the site and the N7 is approximately 2km northwest, as indicated in Figure 7-2.

The planned access to the site will be through the road linked to the Brookfield Enterprise Centre located to the south of the site. This road will be maintained in part through the development construction to ensure its continual operation throughout and after the construction period. Furthermore, there is a proposal to incorporate a gate along the access road leading to the Brookfield Enterprise Centre.

Figure 7-1: Surrounding Roads and Proposed Site Access

Figure 7-2: Site location relative to surrounding national roads

7.4 Parking

7.4.1 Car Parking

Maximum parking rates are outlined by the SDCC in the South Dublin Development Plan (2022-2028), as follows:

- Zone 1: General rate applicable throughout the County
- Zone 2: (Non-Residential): More restrictive rates for application within town and village centres, within 800 metres of a train or Luas station and within 400 metres of a high-quality bus service (including proposed services that have proceeded to construction).
- Zone 2 (Residential): More restrictive rates for application within town and village centres, within 400 metres of a high-quality public transport service (includes a train station, Luas station or bus stop with a high-quality service).

Table 7-1 obtained from the South Dublin Development Plan (2022-2028), shows the maximum number of car spaces for different zones.

Table 7-1 Maximum Car Parking Spaces according to the South Dublin Development Plan (2022-2028),

Dwelling Type	No. of Bedrooms	Zone 1	Zone 2
Apartment Duplex	1 Bed	1 space	0.75 space
	2 Bed	1.25 spaces	1 space
	3 Bed+	1.5 spaces	1.25 spaces
House	1 Bed	1 space	1 space
	2 Bed	1.5 spaces	1.25 spaces
	3 Bed+	2 spaces	1.5 spaces

The subject site is a 40m away from the Dublin Bus Route no. 27 and 300m away from the Cheeverstown Luas Station hence it falls into the Zone 2 Residential parking rates.

Table 7-2: No. of Car Parking Spaces Required as per the South Dublin Development Plan (2022-2028)

	No. of Apartments	Zone 2	No. of spaces
1 Bed	7	0.75	5.25
2 Bed	5	1	5
3 Bed	4	1.25	5
Total Maximum No. Spaces			15.25

The total maximum number of spaces that should be provided is 15.25. It has been agreed with the SDCC that 12 no. parking spaces will be provided including 2 disabled access spaces.

7.4.2 Cycle Parking

SDCC cycle parking standards are set out in the South Dublin Development Plan (2022-2028) and are divided into two main categories:

Long Term: These are to be designed for use by residents and employees. Such spaces should be located in a secure area that is not freely accessible to the general public.

Short Stay: These are to be designed for ease of use by the general public. Such spaces should be located in highly visible areas that are easy to access.

Table 7-2, obtained from the South Dublin Development Plan (2022-2028) shows the number of spaces required for different types of accommodation.

Table 7-3: Minimum Bicycle Parking according to the South Dublin Development Plan (2022-2028)

Category	Land-Use	Long Term	Short Stay
Accommodation	Hotel[1]	1 per 5 staff	1 per 10 bedrooms
	Nursing Home	1 per 5 staff	1 per 10 residents
	Residential Apartment	1 per bedroom	1 per two apartments
	Student Accommodation	1 per bedroom	1 per 5 bedrooms

The proposed development is a residential apartment, hence the cycle parking spaces required on site are long term.

Refer to Table 7-3 for the number of cycle parking spaces required for the subject site.

Table 7-4 No. of Cycle Parking Spaces Required as per the South Dublin Development Plan (2022-2028)

	No. of Apartments	No. of Bedrooms
1 Bed	7	7
2 Bed	5	10
3 Bed	4	12
Total No. of Bedrooms		29

As the proposed development has 29 bedrooms, and the SDCC requirements are a minimum of 1 no. space per bedroom, then the minimum no. of cycle parking spaces required is 29.

All bicycle parking spaces shall be designed in accordance with the requirements of the Cycle Design Manual, NTA (2023).

7.5 Public Transport

The subject site is located in a well-developed area where the existing public transport network surrounding the site is well-established.

The subject site is within a 2-minute walk of Dublin Bus Stops 2628 and 4441, serving Dublin Bus Routes 27 (Jobstown-Clarehall) and W62 (The Square-Newcastle). Additionally, within a few minutes' walk, are Dublin Bus Stops 2624, 2629, and 8087, all part of Dublin Bus route W4.

The Luas Red Line Cheeverstown Stop is located 350mm walking distance from the subject site. The Station operates between 05:50hrs to 00:59hrs from Monday to Friday, from 06:49hrs to 00:51hr on Saturdays, and from 07:19hrs to 23:52hrs on Sundays and Bank Holidays.

Refer to Table 7-5 for a summary of the existing public transport links in the vicinity of the proposed site.

Table 7-5 Existing Transport Links

Brookfield, Tallaght				
Stop	Service	Service Route	Frequency	Distance from Site (m)
Cheeverstown	Luas Red Line	Eastbound: Connoly/The Point Westbound; Saggart	3-20 min	350
Stop 2628	Bus - 27	Clare Hall - Jobstown	10 min	90
Stop 2628	Bus – W62	The Square - Newcastle	30 min	90
Stop 4441	Bus - 27	Jobstown – Clare Hall	10 min.	100
Stop 4441	Bus – W62	Newcastle – The Square	30 min	100
Stop 2624	Bus – W4	The Square - Blanchardstown	30 min	300
Stop 2629	Bus – W4	Blanchardstown - The Square	30 min	450
Stop 8087	Bus – W4	Blanchardstown - The Square	30 min	450

Refer to Figure 7-3 for the public transport in the vicinity of the proposed development.

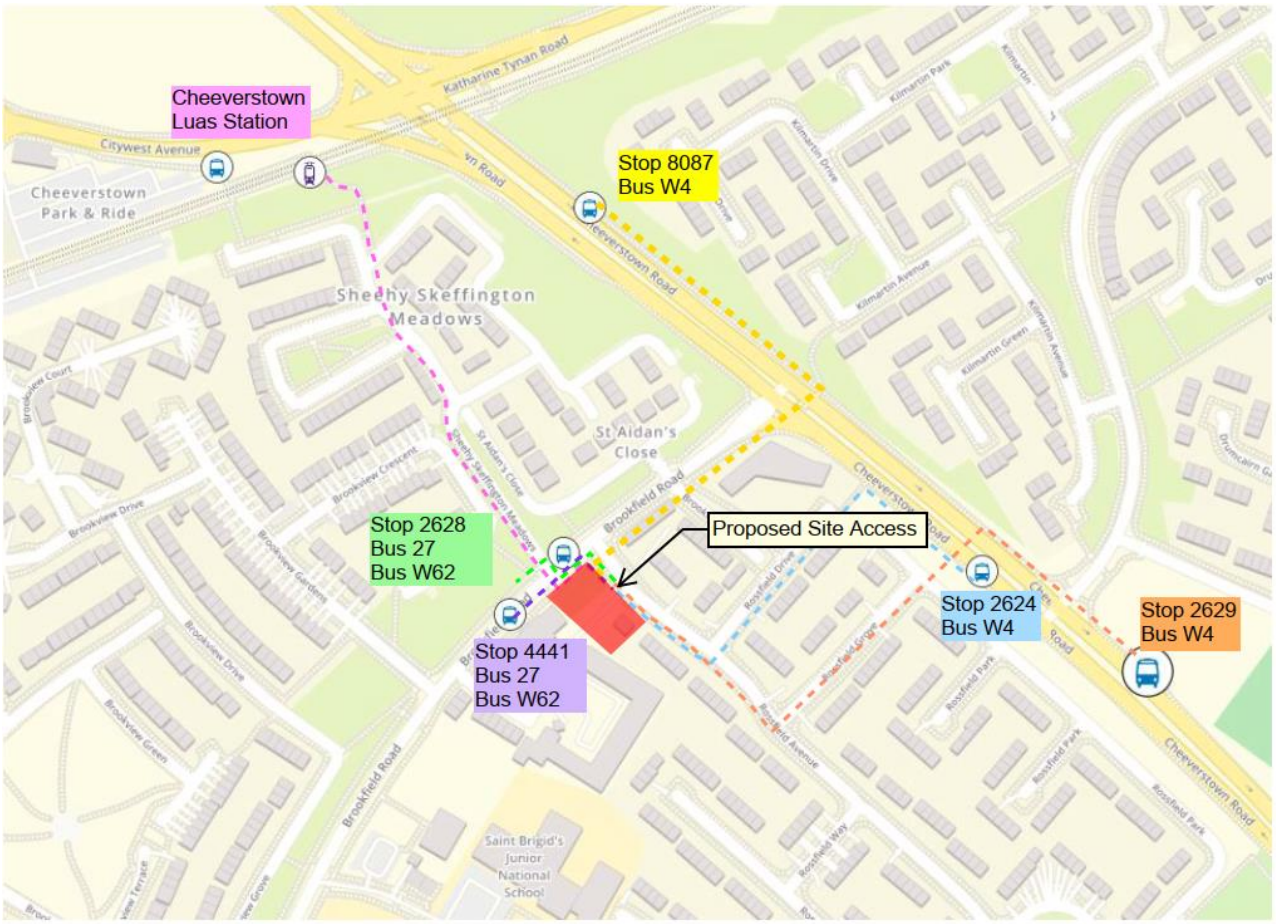


Figure 7-3: Public Transport in the Vicinity of the Subject Site

APPENDICES

A. Irish Water Confirmation of Feasibility Letter

CONFIRMATION OF FEASIBILITY

Uisce Éireann
Bosca OP448
Oifig Sheachadta na
Cathrach Theas
Cathair Chorcaí

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

www.water.ie

Jason Burger

Waterman Moylan
Block S
Eastpoint Business Park
Alfie Byrne Road
Eastwall
D03K7W7
Dublin

18 July 2023

Our Ref: CDS23005099 Pre-Connection Enquiry
Brookfield Road, Fettercairn, Dublin 24, Dublin

Dear Applicant/Agent,

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

Irish Water has reviewed the pre-connection enquiry in relation to a Water & Wastewater connection for a Housing Development of 16 unit(s) at Brookfield Road, Fettercairn, Dublin 24, Dublin, (the **Development)**.

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

- **Water Connection** - Feasible without infrastructure upgrade by Irish Water

- A water booster pump may be required for the connection subject to available water pressure at a connection application stage.
- The proposed Development indicates that Uisce Éireann assets are present on the site. The Developer has to demonstrate that proposed structures and works will not inhibit access for maintenance or endanger structural or functional integrity of the assets during and after the works. Drawings (showing clearance distances, changing to ground levels) and Method Statements should be included in the Detailed Design of the Development. A wayleave in favour of Uisce Éireann will be required over the assets that are not located within the Public Space. For design submissions and queries related to diversion/build near or over, please contact UÉ Diversion Team via email address diversions@water.ie

- **Wastewater Connection** - Feasible without infrastructure upgrade by Irish Water

- The proposed Development indicates that Uisce Éireann assets are present on the site. The Developer has to demonstrate that proposed structures and works will not inhibit access for maintenance or endanger structural or functional integrity of the assets during and after the works. Drawings (showing clearance distances, changing to ground levels) and Method Statements should be included in the Detailed Design of the Development. A wayleave in favour of Uisce Éireann will be required over the assets that are not located within the Public Space. For design submissions and queries related to diversion/build near or over, please contact UÉ Diversion Team via email address diversions@water.ie

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

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

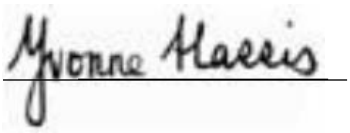
Where can you find more information?

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

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

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

Yours sincerely,



Yvonne Harris
Head of Customer Operations

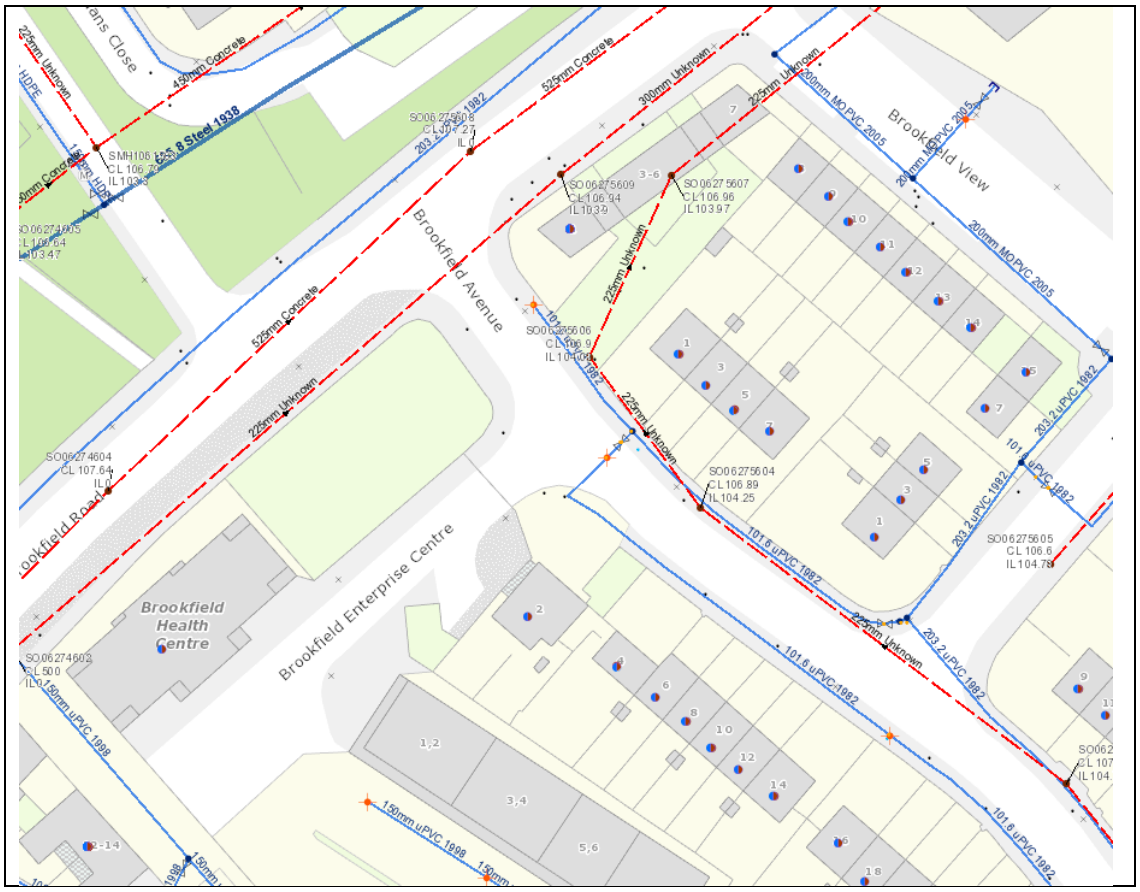
Section A - What is important to know?

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

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

Section B – Details of Irish Water's Network(s)

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



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

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

B. Brownfield Run-off Rates Calculation (Causeway FLOW)

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	16.600	Minimum Backdrop Height (m)	0.200
Ratio-R	0.270	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
1	0.154	4.00	107.000	1900	1.629
MHS04			106.850	1900	2.105

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	MHS04	4.000	0.600	105.371	104.745	0.626	6.4	1000	4.01	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	13.267	10419.8	20.9	0.629	1.105	0.154	0.0	32	2.730

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	4.000	6.4	1000	Circular	107.000	105.371	0.629	106.850	104.745	1.105

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1900	Manhole	Adoptable	MHS04	1900	Manhole	Adoptable

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1	107.000	1.629	1900	0	1.000	105.371	1000
MHS04	106.850	2.105	1900	1	1.000	104.745	1000

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	16.600	Drain Down Time (mins)	240
Ratio-R	0.270	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
5	0	0	0
10	0	0	0
30	0	0	0
100	0	0	0

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	105.403	0.032	16.7	0.1528	0.0000	OK
15 minute winter	MHS04	10	104.775	0.029	16.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	MHS04	16.7	2.453	0.002	0.0272	7.3

Results for 5 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	105.413	0.042	28.1	0.1980	0.0000	OK
15 minute winter	MHS04	10	104.783	0.037	28.1	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	MHS04	28.1	2.811	0.003	0.0400	12.3

Results for 10 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	105.416	0.045	32.2	0.2120	0.0000	OK
15 minute winter	MHS04	10	104.785	0.040	32.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	MHS04	32.2	2.909	0.003	0.0444	14.1

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	105.421	0.050	40.4	0.2369	0.0000	OK
15 minute winter	MHS04	10	104.790	0.045	40.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	MHS04	40.4	3.052	0.004	0.0529	17.6

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	105.428	0.057	51.6	0.2698	0.0000	OK
15 minute winter	MHS04	10	104.795	0.050	51.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	MHS04	51.7	3.236	0.005	0.0639	22.6

C. Greenfield Run-off Rates Estimation

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Jason Burger
Site name:	Rossfield Avenue SDCC Part 8
Site location:	

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

Site Details

Latitude:	53.28856° N
Longitude:	6.40375° W
Reference:	3597277626
Date:	Nov 17 2023 12:00

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	0.2487

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	1005	808.5
Hydrological region:	12	12
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.13	2.13
Growth curve factor 100 years:	2.61	2.61
Growth curve factor 200 years:	2.86	2.86

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	0.69	0.54
1 in 1 year (l/s):	0.59	0.46
1 in 30 years (l/s):	1.47	1.14
1 in 100 year (l/s):	1.81	1.4
1 in 200 years (l/s):	1.98	1.53

D. Post-development runoff estimation – excluding SuDS – (Causeway FLOW)

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	16.600	Minimum Backdrop Height (m)	0.200
Ratio-R	0.270	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
1	0.220	4.00	107.000	1900	1.629
MHS04			106.850	1900	2.105

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	MHS04	4.000	0.600	105.371	104.745	0.626	6.4	1000	4.01	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	13.267	10419.8	29.8	0.629	1.105	0.220	0.0	38	3.048

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	4.000	6.4	1000	Circular	107.000	105.371	0.629	106.850	104.745	1.105

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1900	Manhole	Adoptable	MHS04	1900	Manhole	Adoptable

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1	107.000	1.629	1900	0	1.000	105.371	1000
MHS04	106.850	2.105	1900	1	1.000	104.745	1000

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	16.600	Drain Down Time (mins)	240
Ratio-R	0.270	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
5	0	0	0
10	0	0	0
30	0	0	0
100	20	0	0

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	105.410	0.039	23.9	0.2138	0.0000	OK
15 minute winter	MHS04	10	104.780	0.035	23.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	MHS04	23.9	2.699	0.002	0.0354	10.4

Results for 5 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	105.421	0.050	40.2	0.2768	0.0000	OK
15 minute winter	MHS04	10	104.790	0.045	40.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	MHS04	40.2	3.049	0.004	0.0527	17.5

Results for 10 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	105.425	0.054	46.0	0.2972	0.0000	OK
15 minute winter	MHS04	10	104.792	0.047	46.1	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	MHS04	46.1	3.149	0.004	0.0585	20.1

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	105.432	0.061	57.6	0.3358	0.0000	OK
15 minute winter	MHS04	10	104.797	0.052	57.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	MHS04	57.7	3.323	0.006	0.0694	25.2

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	105.448	0.077	88.6	0.4250	0.0000	OK
15 minute winter	MHS04	10	104.809	0.064	88.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	MHS04	88.7	3.686	0.009	0.0965	38.7

E. Post-development design model – with SuDS – (Causeway FLOW)

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	16.600	Minimum Backdrop Height (m)	0.200
Ratio-R	0.270	Preferred Cover Depth (m)	1.200
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Add Inflow (l/s)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
MHS01	0.016	4.00		107.300	1200	706432.902	727638.996	1.425
MHS02				107.510	1200	706421.335	727651.915	1.810
MHS03				106.897	1200	706443.440	727672.286	1.526
MHS04				106.850	1200	706447.062	727674.530	1.493
GR2		4.00	0.1	107.618		706422.260	727674.444	0.118
MHS03B				106.898	1200	706439.066	727675.273	1.198
MHS03A				107.100	1200	706424.857	727689.017	1.100
ICS05				107.400	1200	706421.721	727686.522	1.270
ICS01				107.400	1200	706402.068	727668.315	1.000
private perm 2	0.008	4.00		107.400		706419.785	727682.577	0.130
PrivBRRG2				107.400		706418.453	727685.625	1.000
GR1		4.00		107.618		706408.985	727662.263	0.118
private perm 1	0.010	4.00		107.400		706400.944	727665.689	0.350
PrivBRRG1				107.400		706400.230	727669.115	1.000
PP1	0.021	4.00		107.400		706416.598	727692.524	0.450
PP3	0.006	4.00		107.000		706434.059	727686.291	0.450
BRTP	0.047	4.00		107.000		706431.633	727684.435	1.100
PRIVATE PERM 3	0.004	4.00		107.000		706426.385	727681.588	0.350
PP5	0.017	4.00		107.500		706440.262	727666.247	0.450
PRIVATE PERM 4	0.005	4.00		107.300		706442.984	727661.678	0.350
PRIVATE PERM 5	0.002	4.00		107.400		706435.304	727654.521	0.350
GR4		4.00	0.2	107.618		706442.201	727650.944	0.118
GR3		4.00		107.618		706439.768	727654.569	0.118
NEW PP		4.00		107.618		706423.785	727643.146	0.118
BRRG2	0.005	4.00		107.300		706430.217	727637.099	1.000
BRRG1				107.300		706437.416	727634.795	1.000
PP4	0.015	4.00		106.900		706447.978	727667.120	0.500

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1	MHS01	MHS02	17.341	0.012	105.875	105.700	0.175	99.1	225	4.55	50.0
1.003	MHS02	MHS03	30.060	0.012	105.700	105.400	0.300	100.2	225	4.96	50.0
1.004	MHS03	MHS04	4.261	0.012	105.400	105.357	0.043	99.1	225	5.02	50.0
5.000	GR2	private perm 2	8.501	0.600	107.500	107.270	0.230	37.0	100	4.11	50.0
4.003	ICS01	ICS05	26.791	0.600	106.400	106.130	0.270	99.2	150	4.61	50.0
4.004	ICS05	MHS03A	4.007	0.600	106.130	106.000	0.130	30.8	150	4.65	50.0
4.005	MHS03A	BRTP	8.180	0.600	106.000	105.900	0.100	81.8	150	4.77	50.0
4.007	MHS03B	MHS03	5.297	0.600	105.700	105.400	0.300	17.7	150	4.96	50.0
4.000	GR1	private perm 1	8.740	0.600	107.500	107.270	0.230	38.0	100	4.12	50.0
6.000	PP1	MHS03A	8.973	0.600	106.950	106.000	0.950	9.4	100	4.06	50.0
8.000	PP3	BRTP	3.055	0.600	106.550	105.900	0.650	4.7	100	4.01	50.0
4.006	BRTP	MHS03B	11.798	0.600	105.900	105.700	0.200	59.0	150	4.92	50.0
7.000	PRIVATE PERM 3	BRTP	5.971	0.600	106.650	105.900	0.750	8.0	100	4.04	50.0
2.000	NEW PP	BRRG2	8.828	0.012	107.500	106.300	1.200	7.4	50	4.09	50.0
2.001	BRRG2	MHS01	3.288	0.600	106.300	105.875	0.425	7.7	225	4.10	50.0
1.001	BRRG1	MHS01	6.166	0.600	106.300	106.238	0.062	99.5	150	4.32	50.0
1.000	GR4	BRRG1	16.843	0.600	107.500	106.300	1.200	14.0	50	4.22	50.0
9.000	GR3	MHS03	18.094	0.600	107.500	105.371	2.129	8.5	100	4.11	50.0
10.000	PRIVATE PERM 4	MHS03	10.618	0.600	106.950	105.371	1.579	6.7	100	4.06	50.0
11.000	PP4	MHS03	6.876	0.600	106.400	105.371	1.029	6.7	150	4.03	50.0
12.000	PP5	MHS03	6.824	0.600	107.050	105.371	1.679	4.1	100	4.03	50.0
3.001	private perm 1	PrivBRRG1	3.500	0.600	107.050	106.400	0.650	5.4	100	4.13	50.0
3.002	PrivBRRG1	ICS01	2.005	0.600	106.400	106.400	0.000	0.0	100	4.17	50.0
4.001	private perm 2	PrivBRRG2	3.326	0.600	107.270	106.400	0.870	3.8	100	4.13	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1	1.229	48.9	3.9	1.200	1.585	0.021	0.2	44	0.741
1.003	1.222	48.6	3.9	1.585	1.272	0.021	0.2	44	0.737
1.004	1.229	48.9	28.2	1.272	1.268	0.155	0.3	123	1.273
5.000	1.272	10.0	0.1	0.018	0.030	0.000	0.1	7	0.404
4.003	1.009	17.8	1.7	0.850	1.120	0.010	0.0	32	0.645
4.004	1.820	32.2	3.4	1.120	0.950	0.018	0.1	33	1.179
4.005	1.112	19.7	7.1	0.950	0.950	0.039	0.1	62	1.024
4.007	2.408	42.6	17.2	1.048	1.347	0.095	0.1	67	2.286
4.000	1.255	9.9	0.0	0.018	0.030	0.000	0.0	0	0.000
6.000	2.530	19.9	3.7	0.350	1.000	0.021	0.0	29	1.939
8.000	3.591	28.2	1.0	0.350	1.000	0.006	0.0	13	1.674
4.006	1.312	23.2	17.2	0.950	1.048	0.095	0.1	96	1.434
7.000	2.756	21.6	0.7	0.250	1.000	0.004	0.0	12	1.232
2.000	1.655	3.2	0.0	0.068	0.950	0.000	0.0	0	0.000
2.001	4.733	188.2	0.9	0.775	1.200	0.005	0.0	11	1.197
1.001	1.007	17.8	0.2	0.850	0.912	0.000	0.2	11	0.331
1.000	1.303	2.6	0.2	0.068	0.950	0.000	0.2	10	0.773
9.000	2.667	20.9	0.0	0.018	1.426	0.000	0.0	0	0.000
10.000	3.000	23.6	0.9	0.250	1.426	0.005	0.0	14	1.452
11.000	3.923	69.3	2.7	0.350	1.376	0.015	0.0	20	1.906
12.000	3.863	30.3	3.1	0.350	1.426	0.017	0.0	21	2.478
3.001	3.354	26.3	1.7	0.250	0.900	0.010	0.0	18	1.904
3.002	1.000	7.9	1.7	0.900	0.900	0.010	0.0	0	∞
4.001	3.983	31.3	1.6	0.030	0.900	0.008	0.1	15	2.068

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
4.002	PrivBRRG2	ICS05	3.389	0.600	106.400	106.130	0.270	12.6	100	4.15	50.0
8.000_1	PRIVATE PERM 5	MHS03	19.539	0.600	107.050	105.371	1.679	11.6	100	4.14	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
4.002	2.193	17.2	1.6	0.900	1.170	0.008	0.1	21	1.373
8.000_1	2.278	17.9	0.3	0.250	1.426	0.002	0.0	10	0.881

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1	17.341	99.1	225	Circular	107.300	105.875	1.200	107.510	105.700	1.585
1.003	30.060	100.2	225	Circular	107.510	105.700	1.585	106.897	105.400	1.272
1.004	4.261	99.1	225	Circular	106.897	105.400	1.272	106.850	105.357	1.268
5.000	8.501	37.0	100	Circular	107.618	107.500	0.018	107.400	107.270	0.030
4.003	26.791	99.2	150	Circular	107.400	106.400	0.850	107.400	106.130	1.120
4.004	4.007	30.8	150	Circular	107.400	106.130	1.120	107.100	106.000	0.950
4.005	8.180	81.8	150	Circular	107.100	106.000	0.950	107.000	105.900	0.950
4.007	5.297	17.7	150	Circular	106.898	105.700	1.048	106.897	105.400	1.347
4.000	8.740	38.0	100	Circular	107.618	107.500	0.018	107.400	107.270	0.030
6.000	8.973	9.4	100	Circular	107.400	106.950	0.350	107.100	106.000	1.000
8.000	3.055	4.7	100	Circular	107.000	106.550	0.350	107.000	105.900	1.000
4.006	11.798	59.0	150	Circular	107.000	105.900	0.950	106.898	105.700	1.048
7.000	5.971	8.0	100	Circular	107.000	106.650	0.250	107.000	105.900	1.000
2.000	8.828	7.4	50	Circular	107.618	107.500	0.068	107.300	106.300	0.950
2.001	3.288	7.7	225	Circular	107.300	106.300	0.775	107.300	105.875	1.200
1.001	6.166	99.5	150	Circular	107.300	106.300	0.850	107.300	106.238	0.912
1.000	16.843	14.0	50	Circular	107.618	107.500	0.068	107.300	106.300	0.950
9.000	18.094	8.5	100	Circular	107.618	107.500	0.018	106.897	105.371	1.426

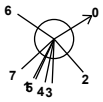
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1	MHS01	1200	Manhole	Adoptable	MHS02	1200	Manhole	Adoptable
1.003	MHS02	1200	Manhole	Adoptable	MHS03	1200	Manhole	Adoptable
1.004	MHS03	1200	Manhole	Adoptable	MHS04	1200	Manhole	Adoptable
5.000	GR2		Junction		private perm 2		Junction	
4.003	ICS01	1200	Manhole	Adoptable	ICS05	1200	Manhole	Adoptable
4.004	ICS05	1200	Manhole	Adoptable	MHS03A	1200	Manhole	Adoptable
4.005	MHS03A	1200	Manhole	Adoptable	BRTP		Junction	
4.007	MHS03B	1200	Manhole	Adoptable	MHS03	1200	Manhole	Adoptable
4.000	GR1		Junction		private perm 1		Junction	
6.000	PP1		Junction		MHS03A	1200	Manhole	Adoptable
8.000	PP3		Junction		BRTP		Junction	
4.006	BRTP		Junction		MHS03B	1200	Manhole	Adoptable
7.000	PRIVATE PERM 3		Junction		BRTP		Junction	
2.000	NEW PP		Junction		BRRG2		Junction	
2.001	BRRG2		Junction		MHS01	1200	Manhole	Adoptable
1.001	BRRG1		Junction		MHS01	1200	Manhole	Adoptable
1.000	GR4		Junction		BRRG1		Junction	
9.000	GR3		Junction		MHS03	1200	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
10.000	10.618	6.7	100	Circular	107.300	106.950	0.250	106.897	105.371	1.426
11.000	6.876	6.7	150	Circular	106.900	106.400	0.350	106.897	105.371	1.376
12.000	6.824	4.1	100	Circular	107.500	107.050	0.350	106.897	105.371	1.426
3.001	3.500	5.4	100	Circular	107.400	107.050	0.250	107.400	106.400	0.900
3.002	2.005	0.0	100	Circular	107.400	106.400	0.900	107.400	106.400	0.900
4.001	3.326	3.8	100	Circular	107.400	107.270	0.030	107.400	106.400	0.900
4.002	3.389	12.6	100	Circular	107.400	106.400	0.900	107.400	106.130	1.170
8.000_1	19.539	11.6	100	Circular	107.400	107.050	0.250	106.897	105.371	1.426

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
10.000	PRIVATE PERM 4		Junction		MHS03	1200	Manhole	Adoptable
11.000	PP4		Junction		MHS03	1200	Manhole	Adoptable
12.000	PP5		Junction		MHS03	1200	Manhole	Adoptable
3.001	private perm 1		Junction		PrivBRRG1		Junction	
3.002	PrivBRRG1		Junction		ICS01	1200	Manhole	Adoptable
4.001	private perm 2		Junction		PrivBRRG2		Junction	
4.002	PrivBRRG2		Junction		ICS05	1200	Manhole	Adoptable
8.000_1	PRIVATE PERM 5		Junction		MHS03	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
MHS01	706432.902	727638.996	107.300	1.425	1200		1	2.001	105.875	225
							2	1.001	106.238	150
							0	1	105.875	225
MHS02	706421.335	727651.915	107.510	1.810	1200		1	1	105.700	225
							0	1.003	105.700	225
MHS03	706443.440	727672.286	106.897	1.526	1200		1	12.000	105.371	100
							2	11.000	105.371	150
							3	10.000	105.371	100
							4	9.000	105.371	100
							5	8.000_1	105.371	100
							6	4.007	105.400	150
							7	1.003	105.400	225
							0	1.004	105.400	225
MHS04	706447.062	727674.530	106.850	1.493	1200		1	1.004	105.357	225
GR2	706422.260	727674.444	107.618	0.118			0	5.000	107.500	100
MHS03B	706439.066	727675.273	106.898	1.198	1200		1	4.006	105.700	150
							0	4.007	105.700	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
MHS03A	706424.857	727689.017	107.100	1.100	1200	1	6.000	106.000	100
						2	4.004	106.000	150
						0	4.005	106.000	150
ICS05	706421.721	727686.522	107.400	1.270	1200	1	4.002	106.130	100
						2	4.003	106.130	150
						0	4.004	106.130	150
ICS01	706402.068	727668.315	107.400	1.000	1200	1	3.002	106.400	100
						0	4.003	106.400	150
private perm 2	706419.785	727682.577	107.400	0.130		1	5.000	107.270	100
						0	4.001	107.270	100
PrivBRRG2	706418.453	727685.625	107.400	1.000		1	4.001	106.400	100
						0	4.002	106.400	100
GR1	706408.985	727662.263	107.618	0.118		0	4.000	107.500	100
private perm 1	706400.944	727665.689	107.400	0.350		1	4.000	107.270	100
						0	3.001	107.050	100
PrivBRRG1	706400.230	727669.115	107.400	1.000		1	3.001	106.400	100
						0	3.002	106.400	100
PP1	706416.598	727692.524	107.400	0.450		0	6.000	106.950	100
PP3	706434.059	727686.291	107.000	0.450		0	8.000	106.550	100
BRTP	706431.633	727684.435	107.000	1.100		1	8.000	105.900	100
						2	7.000	105.900	100
						3	4.005	105.900	150
						0	4.006	105.900	150
PRIVATE PERM 3	706426.385	727681.588	107.000	0.350		0	7.000	106.650	100
PP5	706440.262	727666.247	107.500	0.450		0	12.000	107.050	100

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
PRIVATE PERM 4	706442.984	727661.678	107.300	0.350		 0	10.000	106.950	100
PRIVATE PERM 5	706435.304	727654.521	107.400	0.350		 0	8.000_1	107.050	100
GR4	706442.201	727650.944	107.618	0.118		 0	1.000	107.500	50
GR3	706439.768	727654.569	107.618	0.118		 0	9.000	107.500	100
NEW PP	706423.785	727643.146	107.618	0.118		 0	2.000	107.500	50
BRRG2	706430.217	727637.099	107.300	1.000		 1 0	2.000 2.001	106.300 106.300	50 225
BRRG1	706437.416	727634.795	107.300	1.000		 1 0	1.000 1.001	106.300 106.300	50 150
PP4	706447.978	727667.120	106.900	0.500		 0	11.000	106.400	150

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	Scotland and Ireland	Drain Down Time (mins)	240
M5-60 (mm)	16.600	Additional Storage (m³/ha)	0.0
Ratio-R	0.270	Check Discharge Rate(s)	x
Summer CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

Storm Durations

15	60	180	360	600	960	2160
30	120	240	480	720	1440	2880

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
5	0	0	0
10	0	0	0
30	0	0	0
100	20	0	0

Node MHS03 Online Hydro-Brake® Control

Flap Valve	x	Objective	(CL) Minimise blockage risk
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	105.400	Product Number	CTL-SCL-0058-2000-1500-2000
Design Depth (m)	1.500	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node GR2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	107.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	57.4	0.0	0.118	57.4	0.0	0.119	0.0	0.0

Node private perm 2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	107.270	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.300
Safety Factor	2.0	Width (m)	2.500	Inf Depth (m)	
Porosity	0.40	Length (m)	20.348		

Node PrivBRRG2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	106.400
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.40	Time to half empty (mins)	285

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	14.2	0.0	0.600	14.2	0.0	0.601	0.0	0.0

Node GR1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	107.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	196.6	0.0	0.118	196.6	0.0	0.119	0.0	0.0

Node private perm 1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	107.050	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.300
Safety Factor	2.0	Width (m)	2.500	Inf Depth (m)	
Porosity	0.40	Length (m)	22.200		

Node PrivBRRG1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	106.400
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.40	Time to half empty (mins)	285

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	3.7	0.0	0.600	3.7	0.0	0.601	0.0	0.0

Node PP1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	106.950	Slope (1:X)	40.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.450
Safety Factor	2.0	Width (m)	2.500	Inf Depth (m)	
Porosity	0.40	Length (m)	32.040		

Node PP3 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	106.550	Slope (1:X)	40.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.450
Safety Factor	2.0	Width (m)	13.600	Inf Depth (m)	
Porosity	0.40	Length (m)	2.500		

Node BRTP Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	105.900
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	22.6	0.0	0.650	22.6	0.0	0.651	0.0	0.0

Node PRIVATE PERM 3 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	106.650	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	300	Depth (m)	0.300
Safety Factor	2.0	Width (m)	2.100	Inf Depth (m)	
Porosity	0.40	Length (m)	12.570		

Node PP5 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	107.050	Slope (1:X)	40.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.450
Safety Factor	2.0	Width (m)	2.500	Inf Depth (m)	
Porosity	0.40	Length (m)	20.268		

Node PRIVATE PERM 4 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	106.950	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.300
Safety Factor	2.0	Width (m)	2.100	Inf Depth (m)	
Porosity	0.40	Length (m)	18.310		

Node PRIVATE PERM 5 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	107.050	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.300
Safety Factor	2.0	Width (m)	2.070	Inf Depth (m)	
Porosity	0.40	Length (m)	8.455		

Node GR4 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	107.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	126.0	0.0	0.118	126.0	0.0	0.119	0.0	0.0

Node GR3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	107.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	69.5	0.0	0.118	69.5	0.0	0.119	0.0	0.0

Node NEW PP Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	107.500	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.300
Safety Factor	2.0	Width (m)	5.500	Inf Depth (m)	
Porosity	0.40	Length (m)	7.200		

Node BRRG2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	106.300
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	13.2	0.0	0.600	13.2	0.0	0.601	0.0	0.0

Node BRRG1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	106.300
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	50.0	0.0	0.600	50.0	0.0	0.601	0.0	0.0

Node PP4 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	106.400	Slope (1:X)	40.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.450
Safety Factor	2.0	Width (m)	4.150	Inf Depth (m)	
Porosity	0.40	Length (m)	15.420		

Results for 1 year Critical Storm Duration. Lowest mass balance: 95.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute summer	MHS01	312	106.294	0.418	0.9	0.4733	0.0000	SURCHARGED
480 minute summer	MHS02	312	106.294	0.593	1.2	0.6712	0.0000	SURCHARGED
480 minute summer	MHS03	312	106.294	0.922	3.8	1.0433	0.0000	SURCHARGED
30 minute summer	MHS04	156	105.385	0.028	1.6	0.0000	0.0000	OK
960 minute summer	GR2	1110	107.508	0.008	0.1	0.4473	0.0000	OK
480 minute summer	MHS03B	312	106.294	0.594	2.3	0.6715	0.0000	SURCHARGED
480 minute summer	MHS03A	312	106.294	0.294	1.4	0.3327	0.0000	SURCHARGED
480 minute summer	ICS05	312	106.294	0.164	0.7	0.1857	0.0000	SURCHARGED
15 minute summer	ICS01	10	106.430	0.030	1.6	0.0338	0.0000	OK
15 minute summer	private perm 2	10	107.284	0.014	1.4	0.0118	0.0000	OK
15 minute summer	PrivBRRG2	10	106.419	0.019	1.4	0.1068	0.0000	OK
15 minute summer	GR1	1	107.500	0.000	0.0	0.0000	0.0000	OK
15 minute summer	private perm 1	10	107.067	0.017	1.6	0.0157	0.0000	OK
15 minute summer	PrivBRRG1	10	106.447	0.047	1.6	0.0693	0.0000	OK
15 minute summer	PP1	10	106.978	0.028	3.3	0.0113	0.0000	OK
15 minute summer	PP3	10	106.562	0.012	0.9	0.0175	0.0000	OK
480 minute summer	BRTP	312	106.294	0.394	3.3	8.9069	0.0000	SURCHARGED
15 minute summer	PRIVATE PERM 3	10	106.662	0.012	0.6	0.0067	0.0000	OK
15 minute summer	PP5	10	107.070	0.020	2.7	0.0092	0.0000	OK
15 minute summer	PRIVATE PERM 4	10	106.963	0.013	0.8	0.0080	0.0000	OK
15 minute summer	PRIVATE PERM 5	11	107.059	0.009	0.3	0.0043	0.0000	OK
720 minute summer	GR4	885	107.510	0.009	0.2	1.1958	0.0000	OK
15 minute summer	GR3	1	107.500	0.000	0.0	0.0000	0.0000	OK
15 minute summer	NEW PP	1	107.500	0.000	0.0	0.0000	0.0000	OK
15 minute summer	BRRG2	11	106.310	0.009	0.8	0.1253	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
480 minute summer	MHS01	1	MHS02	0.9	0.384	0.018	0.6897	
480 minute summer	MHS02	1.003	MHS03	0.8	0.082	0.016	1.1955	
480 minute summer	MHS03	1.004	MHS04	1.6	0.539	0.032	0.0126	48.1
960 minute summer	GR2	5.000	private perm 2	0.1	0.528	0.011	0.0021	
480 minute summer	MHS03B	4.007	MHS03	3.1	0.439	0.072	0.0933	
480 minute summer	MHS03A	4.005	BRTP	1.4	0.453	0.070	0.1440	
480 minute summer	ICS05	4.004	MHS03A	0.7	0.455	0.022	0.0705	
15 minute summer	ICS01	4.003	ICS05	1.5	0.613	0.086	0.0670	
15 minute summer	private perm 2	4.001	PrivBRRG2	1.4	1.784	0.045	0.0028	
15 minute summer	PrivBRRG2	4.002	ICS05	1.3	0.907	0.076	0.0051	
15 minute summer	GR1	4.000	private perm 1	0.0	0.000	0.000	0.0000	
15 minute summer	private perm 1	3.001	PrivBRRG1	1.6	1.005	0.061	0.0078	
15 minute summer	PrivBRRG1	3.002	ICS01	1.6	0.569	0.200	0.0056	
15 minute summer	PP1	6.000	MHS03A	3.3	1.175	0.166	0.0299	
15 minute summer	PP3	8.000	BRTP	0.9	0.944	0.032	0.0123	
480 minute summer	BRTP	4.006	MHS03B	2.3	0.860	0.099	0.2077	
15 minute summer	PRIVATE PERM 3	7.000	BRTP	0.6	0.459	0.028	0.0239	
15 minute summer	PP5	12.000	MHS03	2.7	1.238	0.089	0.0305	
15 minute summer	PRIVATE PERM 4	10.000	MHS03	0.8	0.229	0.034	0.0446	
15 minute summer	PRIVATE PERM 5	8.000_1	MHS03	0.3	0.062	0.017	0.0799	
720 minute summer	GR4	1.000	BRRG1	0.2	0.848	0.078	0.0050	
15 minute summer	GR3	9.000	MHS03	0.0	0.000	0.000	0.0708	
15 minute summer	NEW PP	2.000	BRRG2	0.0	0.000	0.000	0.0011	
15 minute summer	BRRG2	2.001	MHS01	0.6	0.282	0.003	0.0478	

Results for 1 year Critical Storm Duration. Lowest mass balance: 95.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute summer	BRRG1	840	106.311	0.011	0.2	0.5715	0.0000	OK
15 minute summer	PP4	10	106.419	0.019	2.4	0.0140	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute summer	BRRG1	1.001	MHS01	0.2	0.332	0.011	0.0177	
15 minute summer	PP4	11.000	MHS03	2.4	0.972	0.035	0.0650	

Results for 5 year Critical Storm Duration. Lowest mass balance: 95.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute summer	MHS01	328	106.411	0.535	2.7	0.6056	0.0000	SURCHARGED
480 minute summer	MHS02	328	106.410	0.710	2.1	0.8035	0.0000	SURCHARGED
480 minute summer	MHS03	328	106.410	1.039	4.1	1.1755	0.0000	SURCHARGED
480 minute summer	MHS04	328	105.386	0.029	1.7	0.0000	0.0000	OK
960 minute summer	GR2	1155	107.508	0.008	0.1	0.4473	0.0000	OK
480 minute summer	MHS03B	328	106.411	0.711	2.5	0.8037	0.0000	SURCHARGED
480 minute summer	MHS03A	336	106.412	0.412	1.6	0.4658	0.0000	SURCHARGED
480 minute summer	ICS05	336	106.412	0.282	1.0	0.3188	0.0000	SURCHARGED
15 minute summer	ICS01	10	106.437	0.037	2.4	0.0418	0.0000	OK
15 minute summer	private perm 2	10	107.288	0.018	2.1	0.0171	0.0000	OK
15 minute summer	PrivBRRG2	10	106.423	0.023	2.1	0.1323	0.0000	OK
15 minute summer	GR1	1	107.500	0.000	0.0	0.0000	0.0000	OK
15 minute summer	private perm 1	10	107.070	0.020	2.4	0.0228	0.0000	OK
15 minute summer	PrivBRRG1	10	106.458	0.058	2.4	0.0851	0.0000	OK
15 minute summer	PP1	10	106.984	0.034	5.0	0.0166	0.0000	OK
15 minute summer	PP3	10	106.565	0.015	1.3	0.0246	0.0000	OK
480 minute summer	BRTP	328	106.411	0.511	4.0	11.5516	0.0000	SURCHARGED
15 minute summer	PRIVATE PERM 3	10	106.665	0.015	1.0	0.0104	0.0000	OK
15 minute summer	PP5	10	107.075	0.025	4.2	0.0136	0.0000	OK
15 minute summer	PRIVATE PERM 4	10	106.966	0.016	1.3	0.0123	0.0000	OK
15 minute summer	PRIVATE PERM 5	10	107.062	0.012	0.5	0.0066	0.0000	OK
720 minute summer	GR4	885	107.510	0.009	0.2	1.1958	0.0000	OK
15 minute summer	GR3	1	107.500	0.000	0.0	0.0000	0.0000	OK
15 minute summer	NEW PP	1	107.500	0.000	0.0	0.0000	0.0000	OK
480 minute summer	BRRG2	328	106.410	0.110	1.2	1.4579	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
480 minute summer	MHS01	1	MHS02	-2.1	0.381	-0.043	0.6897	
480 minute summer	MHS02	1.003	MHS03	-2.1	0.266	-0.044	1.1955	
480 minute summer	MHS03	1.004	MHS04	1.7	0.546	0.034	0.0129	57.7
960 minute summer	GR2	5.000	private perm 2	0.1	0.528	0.011	0.0023	
480 minute summer	MHS03B	4.007	MHS03	2.8	0.218	0.065	0.0933	
480 minute summer	MHS03A	4.005	BRTP	1.4	0.472	0.071	0.1440	
480 minute summer	ICS05	4.004	MHS03A	0.8	0.463	0.024	0.0705	
15 minute summer	ICS01	4.003	ICS05	2.3	0.687	0.129	0.0899	
15 minute summer	private perm 2	4.001	PrivBRRG2	2.1	1.924	0.067	0.0038	
15 minute summer	PrivBRRG2	4.002	ICS05	2.0	1.027	0.118	0.0068	
15 minute summer	GR1	4.000	private perm 1	0.0	0.000	0.000	0.0000	
15 minute summer	private perm 1	3.001	PrivBRRG1	2.4	1.360	0.091	0.0102	
15 minute summer	PrivBRRG1	3.002	ICS01	2.4	0.652	0.302	0.0073	
15 minute summer	PP1	6.000	MHS03A	5.0	1.245	0.252	0.0405	
15 minute summer	PP3	8.000	BRTP	1.3	0.973	0.046	0.0130	
480 minute summer	BRTP	4.006	MHS03B	2.5	0.856	0.106	0.2077	
15 minute summer	PRIVATE PERM 3	7.000	BRTP	1.0	0.608	0.046	0.0255	
15 minute summer	PP5	12.000	MHS03	4.2	1.323	0.138	0.0319	
15 minute summer	PRIVATE PERM 4	10.000	MHS03	1.3	0.250	0.055	0.0458	
15 minute summer	PRIVATE PERM 5	8.000_1	MHS03	0.5	0.100	0.028	0.0813	
720 minute summer	GR4	1.000	BRRG1	0.2	0.848	0.078	0.0186	
15 minute summer	GR3	9.000	MHS03	0.0	0.000	0.000	0.0708	
15 minute summer	NEW PP	2.000	BRRG2	0.0	0.000	0.000	0.0016	
480 minute summer	BRRG2	2.001	MHS01	1.0	0.157	0.005	0.0972	

Results for 5 year Critical Storm Duration. Lowest mass balance: 95.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute summer	BRRG1	336	106.411	0.111	2.6	5.5376	0.0000	OK
15 minute summer	PP4	10	106.424	0.024	3.7	0.0207	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
480 minute summer	BRRG1	1.001	MHS01	-2.4	0.345	-0.135	0.0973	
15 minute summer	PP4	11.000	MHS03	3.7	0.944	0.053	0.0666	

Results for 10 year Critical Storm Duration. Lowest mass balance: 95.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute summer	MHS01	420	106.466	0.591	3.1	0.6686	0.0000	SURCHARGED
600 minute summer	MHS02	420	106.466	0.766	2.5	0.8665	0.0000	SURCHARGED
600 minute summer	MHS03	420	106.466	1.095	4.3	1.2386	0.0000	SURCHARGED
600 minute summer	MHS04	420	105.386	0.029	1.7	0.0000	0.0000	OK
960 minute summer	GR2	1170	107.508	0.008	0.1	0.4473	0.0000	OK
600 minute summer	MHS03B	420	106.466	0.766	2.6	0.8668	0.0000	SURCHARGED
600 minute summer	MHS03A	420	106.467	0.467	1.7	0.5281	0.0000	SURCHARGED
600 minute summer	ICS05	420	106.467	0.337	0.9	0.3811	0.0000	SURCHARGED
600 minute summer	ICS01	420	106.467	0.067	0.4	0.0757	0.0000	OK
15 minute summer	private perm 2	10	107.289	0.019	2.4	0.0193	0.0000	OK
600 minute summer	PrivBRRG2	420	106.467	0.067	0.5	0.3804	0.0000	OK
15 minute summer	GR1	1	107.500	0.000	0.0	0.0000	0.0000	OK
15 minute summer	private perm 1	10	107.072	0.022	2.7	0.0255	0.0000	OK
600 minute summer	PrivBRRG1	420	106.467	0.067	0.4	0.0991	0.0000	OK
15 minute summer	PP1	10	106.987	0.037	5.8	0.0191	0.0000	OK
15 minute summer	PP3	10	106.566	0.016	1.6	0.0299	0.0000	OK
600 minute summer	BRTP	420	106.467	0.567	4.1	12.8102	0.0000	SURCHARGED
15 minute summer	PRIVATE PERM 3	10	106.665	0.015	1.1	0.0114	0.0000	OK
15 minute summer	PP5	10	107.077	0.027	4.8	0.0154	0.0000	OK
15 minute summer	PRIVATE PERM 4	10	106.967	0.017	1.5	0.0140	0.0000	OK
30 minute summer	PRIVATE PERM 5	18	107.062	0.012	0.5	0.0066	0.0000	OK
720 minute summer	GR4	885	107.510	0.009	0.2	1.1958	0.0000	OK
15 minute summer	GR3	1	107.500	0.000	0.0	0.0000	0.0000	OK
15 minute summer	NEW PP	1	107.500	0.000	0.0	0.0000	0.0000	OK
600 minute summer	BRRG2	420	106.466	0.166	0.8	2.1938	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute summer	MHS01	1	MHS02	-2.4	0.387	-0.050	0.6897	
600 minute summer	MHS02	1.003	MHS03	-2.5	0.072	-0.051	1.1955	
600 minute summer	MHS03	1.004	MHS04	1.7	0.550	0.035	0.0132	69.2
960 minute summer	GR2	5.000	private perm 2	0.1	0.528	0.011	0.0023	
600 minute summer	MHS03B	4.007	MHS03	2.5	0.143	0.059	0.0933	
600 minute summer	MHS03A	4.005	BRTP	1.6	0.458	0.080	0.1440	
600 minute summer	ICS05	4.004	MHS03A	0.8	0.437	0.023	0.0705	
600 minute summer	ICS01	4.003	ICS05	0.4	0.359	0.022	0.3377	
15 minute summer	private perm 2	4.001	PrivBRRG2	2.4	1.994	0.077	0.0042	
600 minute summer	PrivBRRG2	4.002	ICS05	0.5	0.668	0.029	0.0227	
15 minute summer	GR1	4.000	private perm 1	0.0	0.000	0.000	0.0000	
15 minute summer	private perm 1	3.001	PrivBRRG1	2.7	1.360	0.102	0.0110	
600 minute summer	PrivBRRG1	3.002	ICS01	0.4	0.340	0.051	0.0112	
15 minute summer	PP1	6.000	MHS03A	5.8	1.260	0.292	0.0441	
15 minute summer	PP3	8.000	BRTP	1.6	1.029	0.057	0.0132	
600 minute summer	BRTP	4.006	MHS03B	2.6	0.832	0.111	0.2077	
15 minute summer	PRIVATE PERM 3	7.000	BRTP	1.1	0.534	0.051	0.0256	
15 minute summer	PP5	12.000	MHS03	4.8	1.253	0.158	0.0325	
15 minute summer	PRIVATE PERM 4	10.000	MHS03	1.5	0.335	0.064	0.0463	
30 minute summer	PRIVATE PERM 5	8.000_1	MHS03	0.5	0.100	0.028	0.0813	
720 minute summer	GR4	1.000	BRRG1	0.2	0.848	0.078	0.0186	
15 minute summer	GR3	9.000	MHS03	0.0	0.000	0.000	0.0708	
15 minute summer	NEW PP	2.000	BRRG2	0.0	0.000	0.000	0.0018	
600 minute summer	BRRG2	2.001	MHS01	-0.6	0.155	-0.003	0.1171	

Results for 10 year Critical Storm Duration. Lowest mass balance: 95.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute summer	BRRG1	420	106.466	0.166	2.6	8.3122	0.0000	SURCHARGED
600 minute summer	PP4	420	106.466	0.066	0.7	0.1510	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute summer	BRRG1	1.001	MHS01	-2.4	0.347	-0.137	0.1086	
600 minute summer	PP4	11.000	MHS03	0.7	0.065	0.010	0.0862	

Results for 30 year Critical Storm Duration. Lowest mass balance: 95.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute summer	MHS01	435	106.569	0.694	4.6	0.7853	0.0000	SURCHARGED
600 minute summer	MHS02	435	106.569	0.869	3.8	0.9832	0.0000	SURCHARGED
600 minute summer	MHS03	435	106.569	1.198	5.6	1.3553	0.0000	SURCHARGED
600 minute summer	MHS04	435	105.387	0.029	1.8	0.0000	0.0000	OK
1440 minute summer	GR2	1500	107.508	0.008	0.1	0.4473	0.0000	OK
600 minute summer	MHS03B	435	106.570	0.870	3.6	0.9835	0.0000	SURCHARGED
600 minute summer	MHS03A	435	106.570	0.570	2.0	0.6448	0.0000	SURCHARGED
600 minute summer	ICS05	435	106.570	0.440	1.1	0.4978	0.0000	SURCHARGED
600 minute summer	ICS01	435	106.570	0.170	0.5	0.1925	0.0000	SURCHARGED
15 minute summer	private perm 2	10	107.291	0.021	3.0	0.0238	0.0000	OK
600 minute summer	PrivBRRG2	435	106.570	0.170	0.6	0.9668	0.0000	SURCHARGED
15 minute summer	GR1	1	107.500	0.000	0.0	0.0000	0.0000	OK
15 minute summer	private perm 1	10	107.074	0.024	3.4	0.0318	0.0000	OK
600 minute summer	PrivBRRG1	435	106.570	0.170	0.5	0.2519	0.0000	SURCHARGED
15 minute summer	PP1	10	106.992	0.042	7.4	0.0243	0.0000	OK
600 minute summer	PP3	435	106.570	0.020	0.3	0.0453	0.0000	OK
600 minute summer	BRTP	435	106.570	0.670	4.9	14.7013	0.0000	SURCHARGED
15 minute summer	PRIVATE PERM 3	10	106.667	0.017	1.4	0.0142	0.0000	OK
15 minute summer	PP5	10	107.080	0.030	6.1	0.0193	0.0000	OK
15 minute summer	PRIVATE PERM 4	10	106.969	0.019	1.8	0.0166	0.0000	OK
15 minute summer	PRIVATE PERM 5	10	107.064	0.014	0.7	0.0088	0.0000	OK
720 minute summer	GR4	885	107.510	0.009	0.2	1.1958	0.0000	OK
15 minute summer	GR3	1	107.500	0.000	0.0	0.0000	0.0000	OK
15 minute summer	NEW PP	1	107.500	0.000	0.0	0.0000	0.0000	OK
600 minute summer	BRRG2	435	106.569	0.269	1.1	3.5556	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute summer	MHS01	1	MHS02	-3.7	0.386	-0.076	0.6897	
600 minute summer	MHS02	1.003	MHS03	-3.8	-0.095	-0.078	1.1955	
600 minute summer	MHS03	1.004	MHS04	1.8	0.556	0.036	0.0136	74.0
1440 minute summer	GR2	5.000	private perm 2	0.1	0.528	0.011	0.0023	
600 minute summer	MHS03B	4.007	MHS03	3.5	0.199	0.082	0.0933	
600 minute summer	MHS03A	4.005	BRTP	1.8	0.440	0.093	0.1440	
600 minute summer	ICS05	4.004	MHS03A	0.9	0.438	0.027	0.0705	
600 minute summer	ICS01	4.003	ICS05	0.5	0.359	0.027	0.4717	
15 minute summer	private perm 2	4.001	PrivBRRG2	3.0	2.099	0.096	0.0050	
600 minute summer	PrivBRRG2	4.002	ICS05	0.6	0.668	0.034	0.0265	
15 minute summer	GR1	4.000	private perm 1	0.0	0.000	0.000	0.0000	
15 minute summer	private perm 1	3.001	PrivBRRG1	3.4	1.494	0.129	0.0127	
600 minute summer	PrivBRRG1	3.002	ICS01	0.5	0.374	0.063	0.0157	
15 minute summer	PP1	6.000	MHS03A	7.4	1.327	0.372	0.0493	
600 minute summer	PP3	8.000	BRTP	0.3	0.161	0.011	0.0137	
600 minute summer	BRTP	4.006	MHS03B	3.6	0.832	0.154	0.2077	
15 minute summer	PRIVATE PERM 3	7.000	BRTP	1.4	0.755	0.065	0.0261	
15 minute summer	PP5	12.000	MHS03	6.1	1.291	0.201	0.0335	
15 minute summer	PRIVATE PERM 4	10.000	MHS03	1.8	0.338	0.076	0.0469	
15 minute summer	PRIVATE PERM 5	8.000_1	MHS03	0.7	0.138	0.039	0.0826	
720 minute summer	GR4	1.000	BRRG1	0.2	0.848	0.078	0.0186	
15 minute summer	GR3	9.000	MHS03	0.0	0.000	0.000	0.0708	
15 minute summer	NEW PP	2.000	BRRG2	0.0	0.000	0.000	0.0076	
600 minute summer	BRRG2	2.001	MHS01	-0.8	0.156	-0.004	0.1308	

Results for 30 year Critical Storm Duration. Lowest mass balance: 95.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute summer	BRRG1	435	106.569	0.269	4.1	13.4701	0.0000	SURCHARGED
600 minute summer	PP4	435	106.569	0.169	0.8	0.9636	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute summer	BRRG1	1.001	MHS01	-3.9	-0.341	-0.220	0.1086	
600 minute summer	PP4	11.000	MHS03	0.8	0.074	0.012	0.1211	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 95.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute summer	MHS01	495	106.851	0.976	6.4	1.1034	0.0000	SURCHARGED
600 minute summer	MHS02	495	106.851	1.151	5.2	1.3013	0.0000	SURCHARGED
600 minute summer	MHS03	495	106.851	1.480	7.4	1.6734	0.0000	FLOOD RISK
600 minute summer	MHS04	495	105.388	0.031	2.0	0.0000	0.0000	OK
1440 minute summer	GR2	1620	107.508	0.008	0.1	0.4473	0.0000	OK
600 minute summer	MHS03B	495	106.851	1.151	5.5	1.3017	0.0000	FLOOD RISK
600 minute summer	MHS03A	495	106.852	0.851	2.4	0.9630	0.0000	FLOOD RISK
600 minute summer	ICS05	495	106.852	0.722	1.0	0.8160	0.0000	SURCHARGED
600 minute summer	ICS01	495	106.852	0.452	0.7	0.5107	0.0000	SURCHARGED
15 minute summer	private perm 2	10	107.296	0.026	4.7	0.0366	0.0000	OK
600 minute summer	PrivBRRG2	495	106.852	0.452	0.8	2.5648	0.0000	SURCHARGED
15 minute summer	GR1	1	107.500	0.000	0.0	0.0000	0.0000	OK
15 minute summer	private perm 1	10	107.081	0.031	5.4	0.0502	0.0000	OK
600 minute summer	PrivBRRG1	495	106.852	0.452	0.8	0.6683	0.0000	SURCHARGED
30 minute summer	PP1	18	107.005	0.055	10.6	0.0394	0.0000	OK
600 minute summer	PP3	495	106.851	0.301	1.3	3.6595	0.0000	FLOOD RISK
600 minute summer	BRTP	495	106.851	0.951	6.6	14.7013	0.0000	FLOOD RISK
600 minute summer	PRIVATE PERM 3	495	106.851	0.201	0.4	1.4677	0.0000	FLOOD RISK
15 minute summer	PP5	10	107.092	0.042	9.5	0.0355	0.0000	OK
15 minute summer	PRIVATE PERM 4	10	106.974	0.024	2.9	0.0259	0.0000	OK
15 minute summer	PRIVATE PERM 5	10	107.067	0.017	1.1	0.0133	0.0000	OK
720 minute summer	GR4	885	107.510	0.009	0.2	1.1958	0.0000	OK
15 minute summer	GR3	1	107.500	0.000	0.0	0.0000	0.0000	OK
15 minute summer	NEW PP	1	107.500	0.000	0.0	0.0000	0.0000	OK
600 minute summer	BRRG2	495	106.851	0.551	1.4	7.2680	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute summer	MHS01	1	MHS02	-5.1	0.370	-0.105	0.6897	
600 minute summer	MHS02	1.003	MHS03	-5.2	-0.132	-0.108	1.1955	
600 minute summer	MHS03	1.004	MHS04	2.0	0.571	0.040	0.0146	84.0
1440 minute summer	GR2	5.000	private perm 2	0.1	0.528	0.011	0.0025	
600 minute summer	MHS03B	4.007	MHS03	5.4	0.307	0.127	0.0933	
600 minute summer	MHS03A	4.005	BRTP	2.3	0.414	0.115	0.1440	
600 minute summer	ICS05	4.004	MHS03A	0.8	0.434	0.024	0.0705	
600 minute summer	ICS01	4.003	ICS05	0.6	0.341	0.032	0.4717	
15 minute summer	private perm 2	4.001	PrivBRRG2	4.7	2.352	0.150	0.0142	
600 minute summer	PrivBRRG2	4.002	ICS05	0.5	0.674	0.029	0.0265	
15 minute summer	GR1	4.000	private perm 1	0.0	0.000	0.000	0.0000	
15 minute summer	private perm 1	3.001	PrivBRRG1	5.4	1.464	0.205	0.0168	
600 minute summer	PrivBRRG1	3.002	ICS01	0.7	0.374	0.085	0.0157	
30 minute summer	PP1	6.000	MHS03A	10.4	1.509	0.522	0.0549	
600 minute summer	PP3	8.000	BRTP	-0.8	0.163	-0.029	0.0239	
600 minute summer	BRTP	4.006	MHS03B	5.5	0.787	0.238	0.2077	
600 minute summer	PRIVATE PERM 3	7.000	BRTP	0.3	0.130	0.014	0.0467	
15 minute summer	PP5	12.000	MHS03	9.4	1.509	0.311	0.0374	
15 minute summer	PRIVATE PERM 4	10.000	MHS03	2.9	0.521	0.123	0.0491	
15 minute summer	PRIVATE PERM 5	8.000_1	MHS03	1.1	0.210	0.061	0.0850	
720 minute summer	GR4	1.000	BRRG1	0.2	0.848	0.078	0.0186	
15 minute summer	GR3	9.000	MHS03	0.0	0.000	0.000	0.0708	
15 minute summer	NEW PP	2.000	BRRG2	0.0	0.000	0.000	0.0086	
600 minute summer	BRRG2	2.001	MHS01	-1.0	0.170	-0.005	0.1308	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 95.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute summer	BRRG1	495	106.851	0.551	5.5	27.5310	0.0000	SURCHARGED
600 minute summer	PP4	495	106.851	0.451	1.3	6.6083	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute summer	BRRG1	1.001	MHS01	-5.3	-0.331	-0.297	0.1086	
600 minute summer	PP4	11.000	MHS03	0.8	0.077	0.012	0.1211	

F. Estimated Attenuation Volume – (Causeway FLOW)

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	16.600	Minimum Backdrop Height (m)	0.200
Ratio-R	0.270	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
1	0.220	4.00	107.000	1900	1.629
MHS04			106.850	1900	2.105

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	MHS04	4.000	0.600	105.371	104.745	0.626	6.4	1000	4.01	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	13.267	10419.8	29.8	0.629	1.105	0.220	0.0	38	3.048

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	4.000	6.4	1000	Circular	107.000	105.371	0.629	106.850	104.745	1.105

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1900	Manhole	Adoptable	MHS04	1900	Manhole	Adoptable

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1	107.000	1.629	1900	0	1.000	105.371	1000
MHS04	106.850	2.105	1900	1	1.000	104.745	1000

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	16.600	Drain Down Time (mins)	240
Ratio-R	0.270	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
5	0	0	0
10	0	0	0
30	0	0	0
100	20	0	0

Node 1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	105.371	Product Number	CTL-SHE-0061-2000-1500-2000
Design Depth (m)	1.500	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	105.371
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	70.0	0.0	1.500	70.0	0.0	1.510	0.0	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	1	256	105.650	0.279	4.7	21.0830	0.0000	OK
240 minute winter	MHS04	168	104.753	0.008	1.6	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
240 minute winter	1	1.000	MHS04	1.6	1.296	0.000	0.0048	31.7

Results for 5 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	1	288	105.870	0.499	7.1	37.6928	0.0000	OK
30 minute winter	MHS04	26	104.753	0.008	1.6	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute winter	1	1.000	MHS04	1.6	1.296	0.000	0.0048	20.5

Results for 10 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	1	384	105.986	0.615	6.7	46.4263	0.0000	OK
30 minute summer	MHS04	24	104.753	0.008	1.6	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute winter	1	1.000	MHS04	1.6	1.296	0.000	0.0048	22.6

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	1	400	106.208	0.837	8.5	63.2186	0.0000	OK
15 minute summer	MHS04	15	104.753	0.008	1.6	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	MHS04	1.6	1.296	0.000	0.0048	19.2

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute winter	1	540	106.810	1.439	11.1	108.6609	0.0000	FLOOD RISK
600 minute winter	MHS04	540	104.754	0.009	2.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute winter	1	1.000	MHS04	2.0	1.386	0.000	0.0057	79.4

G. SuDS Volume Calculations

Drainage Calculations - Rossfield Avenue

BY: L. Mugo Date: 05.12.2023

Site Catchment Area = 2487 m^2

Pre-development/Current-Brownfield				
	C -factor	Area (m^2)	Factored Area (m^2)	
Hardstanding	0.95	1392	1322.4	
Landscape	0.2	1095	219	
		2487	**1541.4**	**62% Hardstanding coverage**

Post-development				
	C -factor	Area (m^2)	Factored Area (m^2)	
Hardstanding	0.95	2270	2156.5	
Landscape	0.2	217	43.4	
		2487	**2199.9**	**88% Hardstanding coverage**
				26% Increase in hardstanding

The proportional area of the post-development hardstanding covered by SuDS features as follows.

	Area (m^2)	% of proposed hardstanding	% of proposed total site area
Private Permeable Paving (300mm thick)	200	8.8%	8.0%
Public Permeable Paving (450mm thick)	230	10.1%	9.2%
Proposed green roof for construction	40	1.8%	1.6%
Bioretention tree pit	43	1.9%	1.7%
Private Bioretention tree Pit	22.2	1.0%	0.9%
Rain garden	38	1.7%	1.5%
23% Total proposed proportion of SUDS within Post development area - excluding potential green roof			
Future Potential green roof for construction	510	22.5%	20.5%
44% Total proposed proportion of SUDS within Post development area-including potential green roof			

SuDS Volumes

	Area (m^2)	Depth (m)	Porosity (%)	Volume (m^3)
Private Permeable Paving (300mm thick)	200	0.35	40%	28.0
Public Permeable Paving (450mm thick)	230	0.45	40%	41.4
Proposed green roof trial portion	40			
Soil Component		0.2	40%	3.2
Drainage Core Component		0.04	95%	1.5
Private Bioretention Rain gardens	22.2	0.5	40%	4.4
Bioretention tree Pit	43	0.5	40%	8.6
Propopriety Cellular Storage	20.5	0.66	96%	13.0
Drainage Core Component	43	0.1	40%	1.7
Rain garden	38	0.6	40%	9.1

Proposed SUDS Volumes - excluding Potential Green Roofs

Total Volume =	111.0	m^3
(m3 of runoff stored)/(m2 of development)	0.045	m^3
(mm depth of runoff stored)/(m2 of development)	44.63	mm

Potential SUDS Volumes - Including Potential Green Roofs

	Area (m^2)	Depth (m)	Porosity (%)	Volume (m^3)
Potential Green Roofs	510			
Soil Component		0.2	40%	40.8
Drainage Core Component		0.04	95%	19.38

Total Volume =	171.2	m^3
(m3 of runoff stored)/(m2 of development)	0.069	m^3
(mm depth of runoff stored)/(m2 of development)	68.83	mm

Drainage Calculations - Rossfield Avenue

BY: L. Mugo Date: 05.12.2023

Retun Period		Surface Water Discharge Rate (l/s) (A) Greenfields *	(B) Current - Brownfields	(C) Post-Development without SuDS	(D) Post-Development with SuDS
1:	1	0.46	16.7	23.9	1.6
1:	10	-	32.2	46.1	1.7
1:	30	1.14	40.4	57.7	1.8
1:	100+20%	1.4	51.7	88.7**	2.0**

*Qbar = 2.17l/s/ha - as per greenfield runoff rate estimation for sites - www.uksuds.com

**100+20%Climate Change

(A) The catchment area in Greenfields condition
(B) The current brownfields site as it stands
(C) The proposed site without consideration for any SUDS measures
(D) The proposed site with the full compliment of the proposed SUDS and Flow Control (75mm diameter

Notes: In line with GDSDS Clause 6.3.3.1 and the Institute of Hydrology report No 124 "Flood Estimation for Small Catchments", where the Greenfields discharge rates are less than 5l/s, the flow control device has been set to a reasonably practical discharge rate of 2l/s for the 1:100+20% year return period with a minimum orifice size of 75mm diameter.

GDSDS

6.3.3.1 Size of Development

To limit discharge to greenfield runoff rates usually requires a pipe or other form of throttle. These throttle sizes theoretically need to be quite small to achieve the required maximum rate of flow, especially for small developments. For operational purposes, it is recommended that the minimum throttle size for a pipe should be 150mm minimum diameter and any other orifice unit other than a pipe should be a minimum of 200mm diameter. This means that flows much below 10 l/s are rarely achievable. Thus small sites, by default, are often allowed a more generous discharge limit than larger developments. This can be partially re-dressed in three ways.

The first is to ensure the development area is planned on a catchment basis so that any development fits within a drainage strategy for a catchment.

Secondly building storage tanks and ponds in series can help in minimising peak flow rates.

Thirdly certain SuDS systems can result in significantly greater attenuation than just using a tank and orifice arrangement. Thus small sites should place particular emphasis on the use of unlined pervious pavements and infiltration units. Where the permeability of a soil is low and the use of infiltration is marginal, it should still be used, but systems should be designed with overflows to ensure against a level of service failure.

Institute of Hydrology report No 124 "Flood Estimation for Small Catchments"

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

Retun Period		Attenuation Volumes (m^3) (A) Current - Brownfield	(B) Estimated required Volume for 2l/s disharge	(C) Post-Development excluding potenential green roofs	(D) Post-Development including potenential green roofs
1:	1	0	21	111.0	171.2
1:	10	0	46.42	111.0	171.2
1:	30	0	63.21	111.0	171.2
1:	100+20%	0	108.66*	111.0	171.2

*1:100+20% Critical storm event 600 minute

UK and Ireland Office Locations