Project

Residential Development at Hacketstown, Skerries, Co. Dublin

Report Title

Engineering Services Report

Document Reference

190170-DBFL-XX-XX-RP-C-0001

INFRASTRUCTURE

MARCH 2022

DBFL CONSULTING ENGINEERS

Project Title:	Residential Development at Hacketstown, Skerries, Co. Dublin		
Document Title:	Engineering Services Report		
File Ref:	190170-DBFL-XX-XX-RP-C-0001	rev:	P02

Rev.	Status	Date	Description	Prepared	Reviewed	Approved
P01	S2 - For Information	08/10/2020	Issued for Pre-Planning	Ryan Parkes	Ben Mong	Sarah Curran
P02	S2 - For Information	21/03/2022	Issued for Final Review	Ryan Parkes	Laura McLoughlin	Sarah Curran

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1 Introduction

DBFL Consulting Engineers were commissioned by the Applicant to prepare an Engineering Services Report (ESR) for the proposed Strategic Housing Development (SHD) at Hacketstown, Skerries, Co. Dublin. The application site comprises approximately 6.7 hectares – see **Error! Reference source not found.** below.

The subject lands are accessed via Golf Links Road to the south and Ballygossan Park to the north. The site is bound by the Dublin – Belfast trainline to the west, the Golf Links Road to the east and south, and by individual houses to the east and south. The site slopes at an approximate gradient of 1:20 from south to north.

Figure 1: Site Location with approximate SHD site outlined in red and approximate Advanced infrastructure application outlined in Blue (Source: Google Maps, 2022).

The development entails 345 no. residential units comprising of 84 no. 1-bed units, 93 no. 2-bed units (66 no. 2-bed apartments and 27 no. 2-bed duplexes), 167 no. 3-bed units (128 no. 3-bed duplexes and 39 no. 3 - bed houses) ranging in height from 2 no. – 4 no. storeys on a site of 6.7 ha. located at Hacketstown in the townlands of Milverton, Townparks and Hacketstown, Skerries, Co. Dublin.

The proposed development is set out in 8 blocks which comprise the following:

- Block A1 comprises 36 No. units at 4 storeys in height (Comprising a mix of 24 No. apartments & 12 No. Duplexes)
- Block A2 comprises 36 No. units at 4 storeys in height (Comprising a mix of 24 No. apartments & 12 No. Duplexes)
- Block B1 comprises 16 No. units at 3 storeys in height (Comprising all 3 bed Duplexes)
- Block B2 comprises 16 No. units at 3 storeys in height (Comprising all 3 bed Duplexes)
- Block C comprises 42 No. units at 2-3 storeys in height (Comprising 15 No. apartments & 27 No. Duplexes)
- Block D comprises 32 No. units at 2-3 storeys in height (Comprising 12 No. apartments, 2 No. Duplexes and 20 No. houses)
- Block E comprises 61 No. units at 2-3 storeys in height (Comprising 36 No. apartments & 25 No. Duplexes)
- Block F comprises 66 No. units at 2-3 storeys in height (Comprising 39 No. apartments & 27 No. Duplexes)
- Block G comprises 25 No units at 2-3 storeys in height. (Comprising 20 No. Duplexes and 5 No. houses)
- Block H comprises 14 No units at 2-3 storeys in height. (Comprising 14 No. houses)
- Public Open Space of c.16,670 sqm (25% of net developable area) is proposed including the parkland and main public square, in addition to the linear park of c.2,427 sqm;
- c.2,272 sqm communal open space is proposed to serve the apartments;
- 414 car parking spaces in total are proposed including 70 visitor spaces, creche set down and 3 for creche staff parking within undercroft and at surface level.
- 802 No. bicycle parking spaces comprising including 128 No. visitor spaces and 10 No. to serve the creche;
- Childcare and community facility of c.377 sqm. located in Block C;
- Upgrades to the Golf Links Road including new pedestrian and cycle infrastructure with frontage on Golf Links Road;
- Vehicular access off the Golf Links Road is to be provided to the southeast of the subject site;

In addition the proposal will provide a new internal link road which will connect to the adjacent lands to the north, for which a separate planning application has been made to Fingal County Council under Reg. Ref. F21A/0287. This application is currently under appeal to An Bord Pleanala (ABP Reg. Ref. 312189-21);

All associated site development and infrastructural works including amenity spaces, landscaping, open space, boundary treatments, vehicular parking, bicycle parking, utilities, internal roads, footpaths and shared surfaces, playground, site clearance and temporary construction development.

The project will be facilitated by advance infrastructural works. These works were the subject of a Section 34 application to Fingal County Council (FCC F21A/0287) as required. They are currently on appeal to An Bord Pleanala (ABP Reg. Ref. 312189). They consist of a connecting road to the north, drainage infrastructure, cycle and pedestrian facilities, and associated landscaping (the "AI Works").

The following terms are used throughout the ESR and explained below for clarity:

- 'The Proposed SHD' relates to the current application which has been submitted to ABP and is set out in detail above.
- The 'advanced infrastructure works' (AI) is subject of a Section 34 application, and that which is currently under consideration by ABP (Ref. ABP-312189-21).
- 'Ballygossan Phase 2' refers to the lands to the north in the ownership of Noonan Construction which has been the subject of an SHD pre-application to the Board (Ref. ABP 308583-20).
- Off-site road improvements which were granted by ABP and FCC (ABP Reg. Ref. 309409; FCC Reg. Ref. F20A/0324) to provide the necessary upgrades to local road network.

To the north of the site the AI development consists of a number of elements that will facilitate the construction of this proposed SHD including, but not limited to, a new Link Road crossing the Regional Drainage Facility which will provide access to the SHD from the existing Ballygossan Phase 2; Construction of Regional Drainage Facility (RDF) for the surface water management of the (now expired) Hacketstown LAP Lands; Services to facilitate this SHD including new surface water outlet structures; a new foul sewer to connect to the existing foul sewer network and a new watermain pipeline to connect to the existing water network.

The objective of this report is to provide information on the calculations, estimates and assumptions used to design the foul sewers, surface water sewers, surface water attenuation and Sustainable Drainage Systems (SuDS), watermains and road access for the proposed development.

2 Foul Sewers

2.1 Existing Services

As noted above, an Advanced Infrastructure Application (AI) was recently submitted to Fingal County Council under planning reference number F21A/0287. This application made provision for the foul sewer network infrastructure, located within the AI development boundary, required to facilitate this proposed development and its connection to the existing foul sewer infrastructure constructed as part of Ballygossan Phase 1 (a portion of which – external to the AI boundary - has now been taken in charge). See Appendix A for Irish Water records.

The existing 225mm diameter foul infrastructure will connect to an existing 375mm diameter foul sewer located approximately 265m to the east of the site in the Downside Park neighbourhood, before discharging to a 450mm diameter foul sewer in Holmpatrick. These sewers drain southwards along Holmpatrick/Rush Road, increasing to a 600mm diameter before discharging to the municipal pumping station. The foul sewage is then pumped to the Barnageeragh Wastewater Treatment Works.

O'Connor Sutton Cronin Multidisciplinary Consulting Engineers (OCSC) was previously involved with the planning application (ref. F11A/0309) for the adjacent Ballygossan Park development. In pre-planning consultation, Fingal County Council requested that OCSC conduct an assessment of the receiving sewer to Holmpatrick. OCSC assessed the foul contribution from the catchment in accordance with the Environmental Protection Agency's Wastewater Treatment Manuals and with the recommendations of the Greater Dublin Strategic Drainage Study Regional Drainage Policy Volume 2 – New Development (GDSDS-RDP Volume 2).

The results of the assessment concluded that the receiving sewer has sufficient capacity for the existing catchment and for the proposed Hacketstown Lands development.

Please refer to Appendix A for the Existing Irish Water Services Layout.

2.2 Proposed Services

A pre-connection enquiry has been made to Irish water to confirm there is adequate capacity in the public network to accommodate the proposed development (Ref no. CDS 20001995). Irish Water has confirmed that this proposed wastewater connection is feasible without upgrade. The number of residential units proposed within the development has since been reduced, from the 380 units applied for, to 345 units.

This SHD is proposed to connect to the 225mm dia foul sewer to be installed as part of the AI submission. It is proposed that this development will be serviced internally by 150mm and 225mm diameter foul sewers and will include the provision of services connections, inspection chambers etc. throughout the site.

Irish water has noted that the existing foul sewer infrastructure to which the proposed foul infrastructure is planned to connect to has not been taken in charge by Irish Water (Third Party Infrastructure). As

stated above only the infrastructure constructed as part of Phase 1 external to the AI site boundary has been taken in charge at this time. At connection application stage and prior to the commencement of self-lay works the applicant will ensure and demonstrate;

- that the wastewater infrastructure within the Third Party Infrastructure is identified and transferred to Irish Water,
- that the arterial infrastructure is in compliance with requirements of Irish water Code of Practice and Standard Details and in adequate condition and capacity to cater for additional load from the development.

The applicant can confirm that the Third Party Infrastructure, as noted by Irish Water, is in the process of being transferred to Irish Water.

The proposed foul sewer network layout for the development is shown on DBFL drawing 190170-DBFL-FW-SP-DR-C-1021. Infrastructure included as part of the AI submission has been clearly delineated on the aforementioned layout.

See appendix B for a copy of the Irish Water Confirmation of Feasibility.

Foul sewers have been designed and will be constructed in accordance with the Irish Water's 'Standard Details for wastewater infrastructure' and 'Code of practice for wastewater infrastructure'. In addition, foul sewers have been designed to Building Regulations and specifically in accordance with the principles and methods set out in EN 752:2008 and DOE *'Recommendations for Site Development Works'.* In addition, HR Wallingford 'Tables for the hydraulic design of pipes, sewers and channels' and Water UK/WRc 'Sewers for Adoption – 6th Edition' have been applied. Values for roughness of uPVC pipes were obtained from Wallingford "Tables for the Hydraulic Design of Pipes, Sewers and Channels" and Wavinsewer systems catalogue.

Foul sewers were sized using the EN752:2008 method in MICRODRAINAGE software, where:

$$Q = kDU\sqrt{\sum DU}$$

The following design criteria have been applied in the design of foul sewers:

i. Discharge units (DU), 3 per housing unit (6 litre cistern)
ii. EN 752 Frequency, Factor (kDU) 0.5
iii. Pipe Ks
    a. 1.5 mm (concrete)
    b. 0.6mm (uPVC for flow>0.5D)
    c. 0.15mm (uPVC for flow<0.5D)
iv. Minimum velocity, 0.75 m/s (self-cleansing vel.)
v. Maximum velocity, 3 m/s

vi. Minimum gradients:

No. of Houses	Minimum Pipe Gradient
1	100mm dia. @ 1:60 or self cleansing gradient (private connection)
2-9	150mm dia. @ 1:60 or self cleansing gradient
>10	Min 150mm dia. or self cleansing gradient

Using Irish Water parameters, the peak flow from the site is calculated as 8.2 l/s, however using the EN752 method in MICRODRAINAGE software the peak flow is calculated as 16.1 l/s.

Sewers and drains shall be laid to comply with the requirements of the Building Regulations 1997 in accordance with the recommendations contained in the Technical Guidance Documents, Section H (revised 2005) and the Irish Water Code of Practice and Standard Details for Wastewater Infrastructure. Standard drainage details will be in accordance with the Greater Dublin Regional Code of Practice for Drainage Works and Irish Water Standard Details for Wastewater Infrastructure.

The proposed designs for the foul sewers have been issued to Irish Water's Quality Assurance Team for approval as is required by An Bord Pleanala as part of the Strategic Housing Development process. Irish Water has reviewed the design submission and has confirmed by issue of a 'Statement of Design Acceptance' that the designs are in accordance with the Irish Water Quality Assurance requirements and code of practice.

Please refer to Appendix B for a copy of Irish Water Confirmation of Feasibility and Statement of Design Acceptance letters.

Please refer to Appendix C for Foul Sewerage calculations.

Please refer to drawing number 190170-DBFL-FW-SP-DR-C-1021 for the proposed foul sewer layout.

3 Surface Water

3.1 Existing Services

The Hacketstown Lands (undeveloped portions) shed surface water run off to an existing small open watercourse located on the northern boundary of the subject lands. This watercourse comprises an open agricultural ditch that varies in depth to a maximum of approximately 1.8m. Please refer to 2 below for the location of the minor watercourse.

Figure 2: Minor Watercourse on Site

The watercourse drains eastwards to an existing stream which in turn drains northwards to the Downside Park neighbourhood. The stream is in culvert (1050mm diameter) through Downside and the adjacent public open space. From Rush Road (R128), the stream passes through a 1500mm diameter culvert before discharging to the Irish Sea approximately 700m to the east of the subject lands.

The northern boundary of the subject lands forms the northern catchment boundary of the minor watercourse. The railway embankment fence line forms the western catchment boundary. A topographical survey identified an existing culvert passing underneath the railway. The survey confirmed the railway culvert as being flat with a 2m drop westward to the Brook Stream. The function of this culvert, as confirmed by the topographical survey, is to drain the railway embankment only. This survey confirms that there is no upstream catchment to the minor watercourse.

As part of the previous planning application (ref. F11A/0309) for the adjacent Ballygossan Phase 1, OCSC submitted a Surface Water Management Report which set out the masterplan surface water strategy for the Hacketstown Lands. The strategy included for the provision of a Regional Drainage Facility (RDF) in a detention basin comprising the linear open space located to the north of the subject lands, along the route of the minor watercourse. A swale in the middle of the detention basin acts as a

low-flow and a drain-down channel to ensure adequate drainage of the basin following rainfall events. This RDF has been designed to accommodate run off from development of the Hacketstown lands. i.e this SHD, Ballygossan Phase 1 and 2 and the AI works. The RDF has been partially constructed to service the existing Ballygossan Phase 1 development. The surface water management masterplan concludes that the RDF is to be extended to follow the course of the minor watercourse, up to the western boundary of the lands in order to service all of the Hacketstown lands.

Figure 3: Partially Constructed RDF

A headwall fitted with a trash screen and manhole fitted with a vortex flow control device has been installed to the outfall of the RDF.

During the planning application (ref. F11A/0309) for the adjacent Ballygossan Phase 1 development, the surface water drainage along the Golf Links Road was improved and upgraded. The improvement works included the provision of road gullies and piped drainage discharging to the small watercourse east of the subject site. OCSC assessed the performance of the improved roads drainage system for both the 30- and 100-year return period storm events within their Engineering Services Report submitted as part of the aforementioned planning application. The report confirmed that no flooding will occur during these storm events.

3.2 Proposed Services

In order to facilitate the surface water run off generated by the future development of the Hacketstown Lands (noted above), as well suitably intercept, treat and attenuate surface water in accordance with the relevant guidelines and legislation, partial provision of surface water networks and connections to facilitate this development, an Advanced Infrastructure Works application (AI) was recently submitted

under planning reference number F21A/0287. ABP Ref. ABP-312189-21. This includes the complete construction of the Regional Drainage Facility (RDF).

Surface water management for the proposed development is designed to comply with the 'Greater Dublin Strategic Drainage Study (GDSDS) Regional Drainage Policies Technical Document – Volume 2, New Developments, 2005' and the 'Greater Dublin Regional Code of Practice for Drainage Works, V6.0 2005'. CIRIA Design Manuals C753, C697 and C609 have also been used to design the surface water drainage system within the site.

The GDSDS guidelines require the following 4 main criteria to be provided by the development's surface water design;

- Criterion 1: River Water Quality Protection - satisfied by providing interception storage and treatment of run-off within the SuDS features e.g. permeable paving, tree pits, swales and detention basins.
- Criterion 2: River Regime Protection – satisfied by attenuating run-off with flow control device prior to discharge to the outfall.
- Criterion 3: Level of Service (flooding) for the site – satisfied by the site being outside the 1000 year coastal and fluvial flood levels. Pluvial flood risk addressed by development designed to accommodate a 100-year storm as per GDSDS. Planned flood routing for storms greater than 100-year level considered in design and development run-off contained within site.
- Criterion 4: River flood protection – attenuation provided within the SuDS features e.g. permeable paving construction, swales, tree pits and detention basin.

3.3 Sustainable Drainage Systems (SuDS)

The AI (under planning reference F21A/0287) included for the provision of the complete construction of the Regional Drainage Facility (RDF), previously discussed and further described and elaborated on below, as well as all surface water infrastructure required to facilitate this proposed development and its connection to the existing surface water infrastructure. As per the OCSC Surface Water Management Report submitted as part of the previous planning application (ref. F11A/0309) for Ballygossan Phase 1, the proposal to extend the RDF to follow the minor watercourse, up to the western boundary of the lands, in order to service all of the Hacketstown lands was included as part of the AI submission.

This RDF comprising swale, interception storage and detention basin is currently servicing the surface water runoff from the existing Ballygossan Phase 1 development.

In addition to the RDF, it is proposed to use a sustainable urban drainage systems (SuDS) approach to stormwater management throughout the site, the overall strategy aims to provide an effective system to mitigate the adverse effects of urban stormwater runoff on the environment by reducing runoff rates, volumes and frequency, reducing pollutant concentrations in stormwater, contributing to amenity, aesthetics and biodiversity enhancement and allow for the maximum collection of rainwater for re-use

where possible. In addition, SuDS features aim to replicate the natural characteristics of rainfall runoff for any site by providing control of run-off at source and this has been achieved by the current proposals.

SuDS are a requirement of 'The Greater Dublin Strategic Drainage Study' and are recommended under the 2009 guidelines, 'The Planning System and Flood Risk Management'.

There are a number of SuDS features proposed which have been designed in accordance with CIRIA documents C753, C697 and C609 as follows:

- Filter Strips: Wide, gently sloping areas of grass which treat runoff from adjacent impermeable areas and roofs, at source, running over its surface. Filter strips also have an attenuating effect on runoff and can allow some infiltration to the ground where the subgrade is suitable. These are located adjacent to hard-standing areas and swales.
- Swales (wet): Broad, shallow drainage channels covered in grass which can treat, convey and attenuate runoff, at source, and can infiltrate to the ground where the subgrade is suitable. Swales also can promote biodiversity. These are located adjacent to roads and shared surfaces
- Filter Drains: Trenches filled with permeable stone material and a perforated collection pipe at the invert with an optional permeable 'sandy' topsoil at surface. These can treat, convey and attenuate runoff, at source, and can infiltrate to the ground where the subgrade is suitable. These systems will allow some form of storage for small rainfall events and can result in water evaporation and adsorption in small quantities, therefore there will be less runoff from these areas in small rainfall events thus mimicking the natural response for this catchment. These will be located in the rear gardens of each unit and will result in an improvement in the quality of surface water draining from roofs of houses and paved areas in rear gardens and will also allow groundwater to recharge to its natural state.
- Tree Pits: Trees can be planted within a range of infiltration SuDS components to improve their performance, as root growth and decomposition increase soil infiltration capacity. Alternatively, they can be used as standalone within soil-filled tree pits, tree planters or structural soils, collecting and storing runoff and providing treatment via filtration and phytoremediation. Tree pits and planters will be designed to collect and attenuate runoff by providing additional storage within the underlying structure. The soils around trees can also be used to filter out pollutants from runoff directly. Tree pits are proposed to be included adjacent to car parks in required green space provision to treat and control runoff, while at the same time providing amenity value to car park users and adjacent pedestrian, commercial and residential zones.
- Petrol Interceptor: A proprietary oil/water separator which prevents hazardous chemical and petroleum products from entering watercourses and public sewers. This is proposed at the outfall from the site and has been included as part of the previously submitted AI (under planning reference F21A/0287).
- Permeable Pavers: Porous surfacing (paving block or open graded material) which can treat rainwater, at source, and allow infiltration through to an underlying porous subbase where water

can be stored within the voids of the subbase before being slowly released to the drainage collection system through natural flow via the porous medium. Partial infiltration systems are proposed to be used as existing subgrade (ground) is not capable of absorbing all the water through infiltration. This type of permeable paving system includes a permeable geotextile at its base as well as an outlet to the surface water system. These systems will allow some form of storage for small rainfall events and will result in infiltration, water evaporation and adsorption in small quantities, therefore there will be less runoff from these areas in small rainfall events thus mimicking the natural response for this catchment. As well as reducing the amount of runoff from the surface, permeable paving will slow down the rate of runoff from the pavement in extreme rainfall events contributing to attenuation flows. In addition, permeable paving will increase the quality of water which is intercepted by the system through filtration, biodegradation, pollutant adsorption and settlement and retention of solids, also the reduction in peak flows to the outfall will enhance settlement and biodegradation of pollutants. It is proposed to use these systems in private driveways and surface water storage within these systems will be further mobilised by providing a 100mm diameter pipe at outlet to the site drainage system. This pipe outlet will restrict flow to its capacity of 7.1 l/s (Ks=0.15 and gradient at 1 in 100) thereby reducing the runoff rate from the permeable paving even further.

Refer to Appendix D for the SuDS calculations and SuDS summary.

Refer to drawing number 190170-DBFL-SW-SP-DR-C-1031 for the proposed surface water layout.

Refer to drawing number 190170-DBFL-SW-SP-DR-C-5014 and 5016 for the standard SuDS details.

3.3.1 Long Term Storage

In addition to limiting the runoff rate through attenuation (see below), the GDSDS requires that runoff volume from the site is limited in extreme events. The objective is to match the runoff volume discharged to the downstream receiving watercourse after development to that which occurred prior to development. This volume is calculated by comparing the 100-year 6 hour event for ‘pre’ and ‘post’ development and is referred to as “Long-Term Storage”.

Where long-term storage is provided, this has a direct effect on the permissible site discharge rate from the site, as explained further forward.

Due to the large extent of development within the site it is not proposed to provide long-term storage, this effects the permissible site discharge and resulting attenuation volumes required.

3.3.2 Site Investigation

A site investigation on the whole of the Hacketstown lands was carried out by Ground Investigations Ireland and concluded in April 2020. The site investigation comprised 26 number trial pits which included infiltration tests in 8 pits, 34 number dynamic probes, 15 number cable percussion boreholes, 6 number rotary core boreholes and 14 number California Bearing Ratio tests.

The topsoil in the investigation locations on the subject site was present to a maximum depth of 0.5m below ground level.

The cohesive deposits were encountered beneath the topsoil and were described as brown sandy gravelly Clay or silty Clay with occasional cobbles and boulders. The secondary sand and gravel constituents varied across the site and with depth, with granular lenses occasionally present in the glacial till matrix. The strength of the cohesive deposits varied across the site but generally increased with depth and was typically soft to depth of 1.7m and 3.4m below ground level overlaying firm, firm to stiff or stiff in the majority of the exploratory holes.

The granular deposits were encountered within the cohesive deposits and were typically described as grey or brown clayey sandy sub rounded to sub angular fine to coarse Gravel with occasional cobbles or gravelly fine to coarse Sand. Based on the SPT N values, the deposits are typically medium dense and become dense with depth although loose deposits were recorded in places.

The site investigation noted groundwater levels to vary between 1m and 1.5m below ground level.

The geotechnical testing carried out on soil samples recovered generally confirm the descriptions on the logs with the primary constituent of the cohesive deposits found to be a CLAY of low to intermediate plasticity. The Particle Size Distribution tests confirm that generally the cohesive deposits are well-graded with percentages of sands and gravels ranging between 15% and 45% generally with fines contents of 30 to 40%.

The Particle Size Distribution tests confirm that generally the granular deposits are well-graded with percentages of sands/gravels and silt/clay typically between 20% and 30% with a gravel/sand content of typically 60% to 75%.

The CBR testing on remoulded samples from the subject site gave results ranging between 2% and 23% and generally undertaken on fill deposits.

Soil infiltration rates were assessed as part of the site investigation, the assessment was undertaken by excavating trial pits based on the requirements of BRE Digest 365 and CIRIA SuDS Manual C753. The FSR (Winter Rain Acceptance) SOIL value determined was used to calculate the pre-development characteristics of the in-situ soil and the corresponding greenfield run-off of the site, mentioned previously.

The infiltration tests were used to determine the infiltration rate applicable to SuDS features for the calculation of interception storage (see 3.3.6 further forward). An infiltration rate of 29.52 mm/hr were calculated for the soakaway location TPI16, on the subject site. For all other soakaway locations, the infiltration rate could not be calculated due to the water level drop being too slow. It is therefore recommended to allow for partial infiltration design on all SuDS features.

Refer to the site investigation report by Ground Investigations Ireland included as part of this planning application under separate cover.

3.3.3 Permissible Site Discharge

According to the GDSDS, the method used for determining peak flow rates for small greenfield catchments is the UK 'Institute of Hydrology Report 124, Flood Estimation for Small Catchments'. This method calculates $QBAR_{rural}$ which is the mean annual flood flow from a rural catchment.

Where long-term storage can be provided or is not necessary, surface water can be discharged at a higher value than $QBAR_{rural}$, this discharge rate ($QBAR_{growth}$) is dependent on the design return period and the corresponding growth factor from the GDSDS Table 6.6. However, if long-term storage cannot be provided on-site the discharge rate from the site should be kept to $QBAR_{rural}$ or 2 l/s/ha, which is the case for this development.

The IH124 method calculates $QBAR_{rural}$ which is the mean annual flood flow from a rural catchment. As the subject site area is less than 50 hectares, the calculated QBAR is to be linearly interpolated from the calculated value to produce a reduced allowable outflow based on the actual site area, as per GDSDS section 6.6.1.

$$QBAR_{rural} = 0.00108 \times (Area)^{0.89}(SAAR)^{1.17}(SOIL)^{2.17}$$

where:-

$QBAR_{rural}$ = Mean Annual Flood (m3/s)
Area = Catchment Area (km2)
SAAR = Standard Average Annual Rainfall (mm)
SOIL = SOIL index from Flood Studies Report

Using data received from Met Eireann for Irish Grid co-ordinates E 324000, N 259000 (site co-ordinates are: E 324991, N 259352), the SAAR is determined as 735mm.

The soil value can be determined from the Flood Studies Report - Winter Rainfall Acceptance Maps (WRAP). A more accurate approach is to use the 'The Classification of Soils from Winter Rainfall Acceptance Rate, Flood Studies Report Table 4.5' to determine soil type and determine the soil value from from Table 6.7 from the GDSD. The latter method is adopted for this site.

Permissible site discharge for the site has been determined as follows:

Total Site Area used for calculations = 6.94 ha
Actual Catchment Area used for calculations = 3.14 ha
SAAR = 735mm
SOIL Value= 0.40 (for soil type 3 from Table 6.7 from the GDSD)

Therefore the permissible site discharge for the development (QBARrural) is 25 l/s. The Permissible site discharge as calculated for the whole of the Hacketstown Lands (as described above) is 45 l/s. The existing flow control device, installed as part of the Ballygossan Phase 1 development, is set at this discharge rate.

Refer to Appendix E for the Permissible Site Discharge calculations.

3.3.4 Surface Water Runoff Coefficients

As a large proportion of runoff is routed through SuDS features these will have an attenuating effect which reduce the rate of stormwater runoff for every rainfall event. Also, SuDS features would reduce the runoff volume through evaporation, transpiration, infiltration and depression storage of the water within each system.

Runoff coefficients have been agreed with Fingal County Council. These coefficients have been utilised for this site and have been applied as follows:

Roofs - Type 1 (Draining to traditional gullies) = 1.0
Roofs – Type 2 (Draining to SuDS features) = 0.70
Paved Garden Areas Hardstanding =1.0
Roads and Footpaths - Type 1 (Draining to traditional gullies) = 1.00
Roads and Footpaths - Type 2 (Draining to SuDS features) = 0.75
Permeable Paving = 0.50
Bioretention Areas – Type 1 (Filter Drains) = 0.70
Bioretention Areas – Type 2 (Tree Pits and Swales) = 0.70
Public Open Space – Considered to drain to Surface Water Network = 0.30
Public Open Space - Considered to not drain to Surface Water Network = 0.30

3.3.5 Regional Drainage Facility Design

GDSDS requires flood waters for a 100-year return period to be managed on-site, therefore this return period is adopted for attenuation calculations.

O'Connor Sutton Cronin Multidisciplinary Consulting Engineers (OCSC) was previously involved with the planning application (ref. F11A/0309) for the adjacent Ballygossan Phase 1. The OCSC Surface Water Management report confirmed the provision of a Regional Drainage Facility (RDF), comprising swale, interception storage and detention basin in the linear open space on the northern boundary, designed to accommodate run off from development of the whole of the Hacketstown Lands (as noted above).

As mentioned previously in this report, this RDF will be fully completed/constructed as part of the Advanced Infrastructure works submitted under planning reference F21A/0287.

An ecological corridor will be provided on both sides of the swale. This corridor will be at least 10m wide as required by Fingal County Council.

The outlet from the existing portion of RDF already constructed and operational for the Ballygossan Phase 1 development is 450mm above the invert level of the swale. This allows for the interception and retention of small rainfall events and the first flush runoff of larger events. The swale thus provides interception storage as discussed in section 3.3.6 of this report.

This RDF can be described simply as a swale with a high-level outflow, hence a 'mini-retention basin', in accordance with the GDSDS.

The RDF swale has been designed as a wet swale (Type 3 to CIRIA C697). CIRIA C697, Section 104, states that *"there is no minimum [longitudinal] slope requirement for wet swales"*. The flat slope proposed will encourage infiltration along the full length of the swale by ensuring an even distribution of surface water. Local minor variations in invert level will not adversely impede the functioning of the swale and would encourage variation in flora and fauna by providing small pools. The base of the swale will be seeded with native wetland species to the Landscape Architect's specification.

CIRIA C697, Section 10.4, requires that the wet swale design follow safety-design guidance for ponds and wetlands (CIRIA C697 Chapter 17). The proposed wet swale is considered as an aquatic bench with normal depth of water of 450mm in accordance with CIRIA 697. As there will be no deep water (permanent pool), the side slopes of the swale will be at a maximum of 1 in 3 in accordance with Section 17.4 of CIRIA C697. The ground immediately adjacent to the swale will provide a safety bench meeting the requirements of CIRIA C697.

The outlet from the existing portion of RDF already constructed and operational is via a pipe to a flow control manhole fitted with a vortex flow control device. The headwall to the pipe has been fitted with a trash screen in accordance with the specifications of the Greater Dublin Region code of Practice for Drainage Works.

During extreme rainfall storm events, discharge from the site will be limited to greenfield runoff rates. Attenuation storage volume for the 100-year return period storm event has been provided in the swale and adjacent corridor of open space. The open space will therefore function as a detention basin, filling to a maximum depth of 800mm as a result of the 100-year return period storm event. An overflow facility has been provided at a height 100mm above the maximum design water level. All buildings within the development will be at least 500mm above the maximum design water level.

As required under the GDSDS, a climate change allowance of 20% has been applied to the surface water drainage design.

This surface water system has been hydraulically modelled in MICRODRAINAGE to ensure that the overall discharge at the end of the hydraulic system (i.e. the outlets to the Regional Drainage Facility and subsequent surface water network) is at, or below, the greenfield rate that discharges to the stream, as mentioned in section 3.3.3. A MICRODRAINAGE simulation model has been created for the entire site which includes the RDF.

The MICRODRAINAGE simulation uses the Wallingford Procedure, time/area full hydrograph methodology, including energy and momentum equations for dynamic analysis of surface water networks. The site drainage network is modelled as one system where all flows, capacities, water levels, surcharged manholes etc are determined throughout the network for each critical storm duration. Therefore, the final combined discharge rate to the stream from the outlet will be kept at (or below) the total permissible discharge rate defined above.

Maximum rainfall data from Extreme Rainfall Return Period values produced by Met Eireann was used to input into MICRODRAINAGE to determine maximum flood volumes. Rainfall data for the site was

sourced from an Annual Average Rainfall (AAR) Grid (1981-2010) and a Depth Duration Frequency model produced by Met Éireann (Available from: http://www.met.ie/climate/products03.asp). This data was input into MICRODRAINAGE to determine the maximum flood volume for the 1 in 100-year rainfall event.

SAAR	=	735 mm
Ratio M560/M52d	=	0.272
M560	=	15.20 mm

The volume of attenuation required within the RDF on the northern boundary of the site, to service the Hacketstown Lands (as shown below in figure 5) in its entirety is 2550 m3.

The RDF design provides for an attenuation volume of 4483 m^3, which is far greater than the calculated requirement.

The Hacketstown Lands is effectively divided into 3 individual developments; Ballygossan Phase 1 development which is completed, Ballygossan Phase 2 development by others and the Hacketstown LDA Lands, the subject site. Figure 4 below illustrates the 3 individual developments on the Hacketstown Lands.

Figure 4: Hacketstown Lands Developments

The attenuation volume required for each of the portions that make up the Hacketstown Lands are summarised in Table 1.

Table 1: Attenuation Volume for Hacketstown Lands (LAP)

Portion/Site	Attenuation Volume Required (m^3)
Ballygossan – Phase 1	1180
Ballygossan – Phase 2	370
Hacketstown LDA Lands	1000

It should be noted that attenuation volumes required are based on the results of the MICRODRAINAGE hydraulic simulation summary of Critical Results by Maximum Level. Hydrobrake maximum head and discharges are based on results of MICRODRAINAGE hydraulic simulation summary of Critical Results by Maximum Outflow as designed by OCSC during the construction of the Ballygossan Phase 1 Development.

A minimum freeboard of 500mm has been provided above the 1 in 100-year flood levels to all building finished floor levels.

Refer to Appendix D for the SuDS calculations and SuDS summary.

Refer to drawing number 190170-DBFL-SW-SP-DR-C-1031 for the proposed surface water layout.

Refer to drawing numbers 190170-DBFL-SW-SP-DR-C-5011 to 5016 for the standard surface water details.

3.3.6 Interception Volume

The GDSDS requires that no run-off should directly pass to the receiving watercourse for rainfall depths of up to 5mm, therefore interception should be provided at source where practicable. The volume of interception required is based on 5mm of rainfall depth from 80% of the runoff from impermeable areas as defined in the GDSDS (Appendix E section E2.1.1).

The interception volume attributable to each SuDS feature (swales, regional drainage facility etc.) consists of the volume of water that can infiltrate to the ground, what will evaporate into the atmosphere and what can transpirate through plants and vegetation. Additionally, there will some losses of water due to absorption and wetting of stone and soil media.

Not all SuDS features will be able to achieve infiltration, evaporation, transpiration and losses due to absorption/wetting. The limits for each SuDS feature type are considered when calculating interception volumes.

The interception storage attributable to the losses in stone and soil media, such as the stone media used in filter drains was not included in the calculations.

The total interception volume required (as calculated) for the site is 51.89 m^3. The volume provided for the site by means of swales, tree pits and bioretention areas, permeable paving, filter drains and the Regional Drainage Facility 1309.9 m^3.

The volume provided for within the site by means of swales, tree pits and bioretention areas, permeable paving and filter drains, excluding the Regional Drainage Facility, is 964.4 m^3 which is still more than the required interception volume as calculated above.

Refer to Appendix F for the Interception Volume Calculations.

Refer to drawing number 190170-DBFL-SW-SP-DR-C-1031 for the proposed surface water layout.

3.3.7 Treatment Volume

The GDSDS requires that a "treatment volume" (Vt) be provided in order to prevent any pollutants or sediments discharging into river systems, additionally a 'treatment train' stormwater runoff management system is required. According to CIRIA document C697 the following treatment train approach is necessary:

Roofs – 1 Treatment Stage

Road Areas – 2 Treatment Stages

Paved Areas excluding Roads - 1 Treatment Stage

The treatment volume is based on treatment of 15mm of rainfall depth from 80% of the runoff from impermeable areas as defined in the GDSDS (Appendix E section E2.1.2).

All run-off areas will pass through the required number of treatment stages prior to discharging to the downstream outfall.

The total treatment volume required (as calculated) for the site is 155.68 m^3. The volume provided by means of swales, tree pits and bioretention areas, permeable paving, filter drains and the Regional Drainage Facility 2290.4 m^3.

The volume provided for within the site by means of swales, tree pits and bioretention areas, permeable paving and filter drains, excluding the Regional Drainage Facility, is 461.8m^3 which is still more than the required treatment volume as calculated above.

Refer to Appendix F for the Treatment Volumes Calculations.

Refer to drawing number 190170-DBFL-SW-SP-DR-C-1011 for the proposed surface water layout.

3.3.8 Surface Water Sewers

Surface water from the proposed development will be discharged after attenuation, within the Regional Drainage Facility, to the existing surface water network to the east of the Hacketstown Lands via the headwall structure and outlet constructed as part of the Ballygossan Phase 1 development.

Surface water sewers are designed in MICRODRAINAGE using the Modified Rational Method. The return period for sizing pipes is based on the following;

- Department of Environment – Recommendations for Site Development Works for Housing Areas (1998), Table 3.1;
- GDSDS – Regional Drainage Policies – Volume 2 – New Development (2005), Section 6.5;
- IS EN 752:2008 - Drain and Sewer Systems Outside Buildings, Table 2;
- Building Regulations (2005) – Section H - Drainage and Wastewater Disposal, Section 1.5.7.

The surface water network was assessed for the 5, 30- and 100-year return period where no flooding from manholes was encountered. The surface water network has been designed for the 5-year return period and assessed for the critical storm to minimise the risk of flooding.

The following parameters applied:

Return period	5 year
Time of entry	4 minutes
Pipe Ks	0.6mm (concrete); 0.15mm (uPVC)
Minimum velocity	0.75 m/s
Maximum velocity	3.0 m/s

Effective runoff coefficients for each pipe catchment have been determined based on the runoff characteristics for each surface contributing to flows within the catchment.

The minimum pipe diameter for public surface water sewers is 225mm.

Values for roughness of uPVC pipes were obtained from Wallingford “Tables for the Hydraulic Design of Pipes, Sewers and Channels” and Wavinsewer systems catalogue.

Refer to Appendix G for the Surface Water Network Calculations.

Refer to Appendix H for the Surface Water Critical Storm Calculations.

Refer to drawing number 190170-DBFL-SW-SP-DR-C-1011 for the proposed surface water layout.

4 Watermains

4.1 Existing Services

There is an existing 1-inch diameter galvanised steel watermain located in the Golf Links Road. Irish Water records indicate this watermain terminates along the eastern boundary of the site. The records also show an existing 100mm dia uPVC watermain located along the southern boundary of the subject site, terminating in close proximity to the second proposed entrance to the proposed development.

The Ballygossan Phase1 is connected via a 150mm diameter uPVC pipeline to an existing 150mm dia uPVC watermain at the junction of Shenick Road and Miller's Lane.

During the planning application (ref. F11A/0309) for Ballygossan Phase 1, Fingal County Council confirmed a working pressure of 3.7 bar in the aforementioned watermain.

Please refer to Appendix A for the Existing Irish Water Services Layout.

4.2 Proposed Services

During the construction of the adjacent Ballygossan Phase 1 development, a 150mm diameter watermain was installed close to the boundary of the subject site to accommodate future connection.

In order to facilitate the water connection for the development of the subject site, partial provision of water networks was included as part of the AI approved development made under planning reference number F21A/0287.

The subject development will utilise this connection as a watermain supply.

A pre-connection enquiry was made to Irish Water to confirm there is adequate capacity in the public network to accommodate the proposed SHD (Ref no. 20001995). Irish Water has confirmed that the proposed water connection is feasible without upgrade. The number of residential units proposed within the development has since been reduced, from the 380 units applied for, to 345 units.

The proposed designs for the water supply have been issued to Irish Water's Quality Assurance Team for approval as is required by An Bord Pleanala as part of the Strategic Housing Development process. Irish Water has reviewed the design submission and has confirmed by issue of a 'Statement of Design Acceptance' that the designs are in accordance with the Irish Water Quality Assurance requirements and code of practice.

150mm and 100mm diameter watermains and new fire hydrants will be provided throughout the site. The estimated peak demand from the development will be 9.28 l/s with the average daily demand being 1.63 l/s.

A bulk water meter will be provided at the connection to the site. The supply arrangements will be carried out to the requirements of Irish Water.

Please refer to Appendix B for the Irish Water Confirmation of Feasibility and Statement of Design acceptance letters.

Refer to Appendix H for the Water Demand Calculations.

Refer to drawing number 190170-DBFL-WM-SP-DR-C-1031 for the proposed water main layout.

5 Flood Risk

The Site Specific Flood Risk Assessment 190170-DBFL-XX-XX-RP-C-002 has been included with this planning application under separate cover.

6 Traffic and Transportation

The Mobility Management Plan 190170-DBFL-TR-SP-RP-C-002 MMP has been included with this planning application under separate cover.

The DMURS Compliance Statement 190170-DBFL-TR-XX-RP-C-003 has been included with this planning application under separate cover.

The Traffic and Transport Assessment 190170-DBFL-TR-SP-RP-C-005 has been included with this planning application under separate cover.

7 Items Raised by Fingal at Pre-planning Stage

The items below, raised during the pre-planning stage by Fingal County Council Water Services Department (report reference PPSHD/008/20) were discussed in meetings and correspondence between DBFL and Fingal County Council and addressed as follows:

Recommendation 12:

Address the issues raised in the report of Water Services section.

Foul Sewer:

1. *Prior to lodgement of the SHD application, the applicant is required to review the submission with IW and to receive a Statement of Design Acceptance.*

Response:

The Foul Sewer design was submitted to Irish Water, and a Statement of Design acceptance received which confirms the design to be in accordance with the Irish Water Wastewater Code of Practice, Standard Details and Quality Assurance Requirements. The Statement of Design acceptance has been included within Appendix B of this report.

Water Supply:

1. *Prior to the submission of the full SHD application to ABP, the applicant is required to review the submission with IW and to receive a Statement of Design Acceptance.*

Response:

Similarly to the Foul Sewer discussed above, the Water Supply design was submitted to Irish Water, and a Statement of Design acceptance received which confirms the design to be in accordance with the Irish Water, Water Code of Practice, Standard Details and Quality Assurance Requirements. The Statement of Design acceptance has been included within Appendix B of this report.

Surface Water:

1. *In accordance with FCC's de-culverting policy, the potential for substituting the proposed 450mm ND outfall pipe to the west with a swale.*

Response:

DBFL have reviewed the possibility of providing a swale at the proposed location along with the landscape architects. A swale would however not suit the landscaping proposals and design intent within this open space area.

2. *Details of the headwall structures and the proposed 1200mm Nd culvert between western and eastern parts of the RDF.*

Response:

Please refer to DBFL drawing 190170-DBFL-SW-SP-DR-C-5016 for cross-section through the new Regional Drainage Facility, illustrating the link between the western and eastern parts. Please refer to DBFL drawing 190170-DBFL-SW-SP-DR-C-5014 for the typical surface water headwall details. These details have been approved under planning ref F21A/ 0287.

3. *Location in terms of the light liquid interceptors in terms of vehicular access for routine maintenance, in consultation with FCC Parks and Operations.*

Response:

The footpath provision, levels and grades within the open space area, where the light liquid interceptors will be located, are such that they are accessible by vehicle should they require routine maintenance.

4. *Flow Control device location*

Response:

The Flow Control Device is located at the eastern boundary of the partially constructed Regional Drainage Facility and was installed as part of the Ballygossan Phase 1 development. The device is set at 45 l/s and will service all of the Hacketstown Lands (as noted in this report).

5. *Clarification on how the water levels within the RDF will be managed. The proposal in its current format indicates two linked basins with different invert and water levels, but with identical water depths.*

Response:

Please refer to DBFL drawing 190170-DBFL-SW-SP-DR-C-5016 for cross section details through the new Regional Drainage Facility, illustrating the link between the western and eastern parts. This cross section illustrates the invert and water levels, addressing this enquiry. The RDF proposals have been agreed under AI application, planning ref F21A/0287.

8 Specific Information Requested by An Bord Pleanala

The items below are items raised during the pre-planning stage by An Bord Pleanala (case reference ABP-308478-20) that are related to the civil services. The responses to these items are summarised below and have been included within this report under the relevant headings and sections.

Item 15:

Address each of the 15 no. recommendations outlined in the Planning Authority opinion.

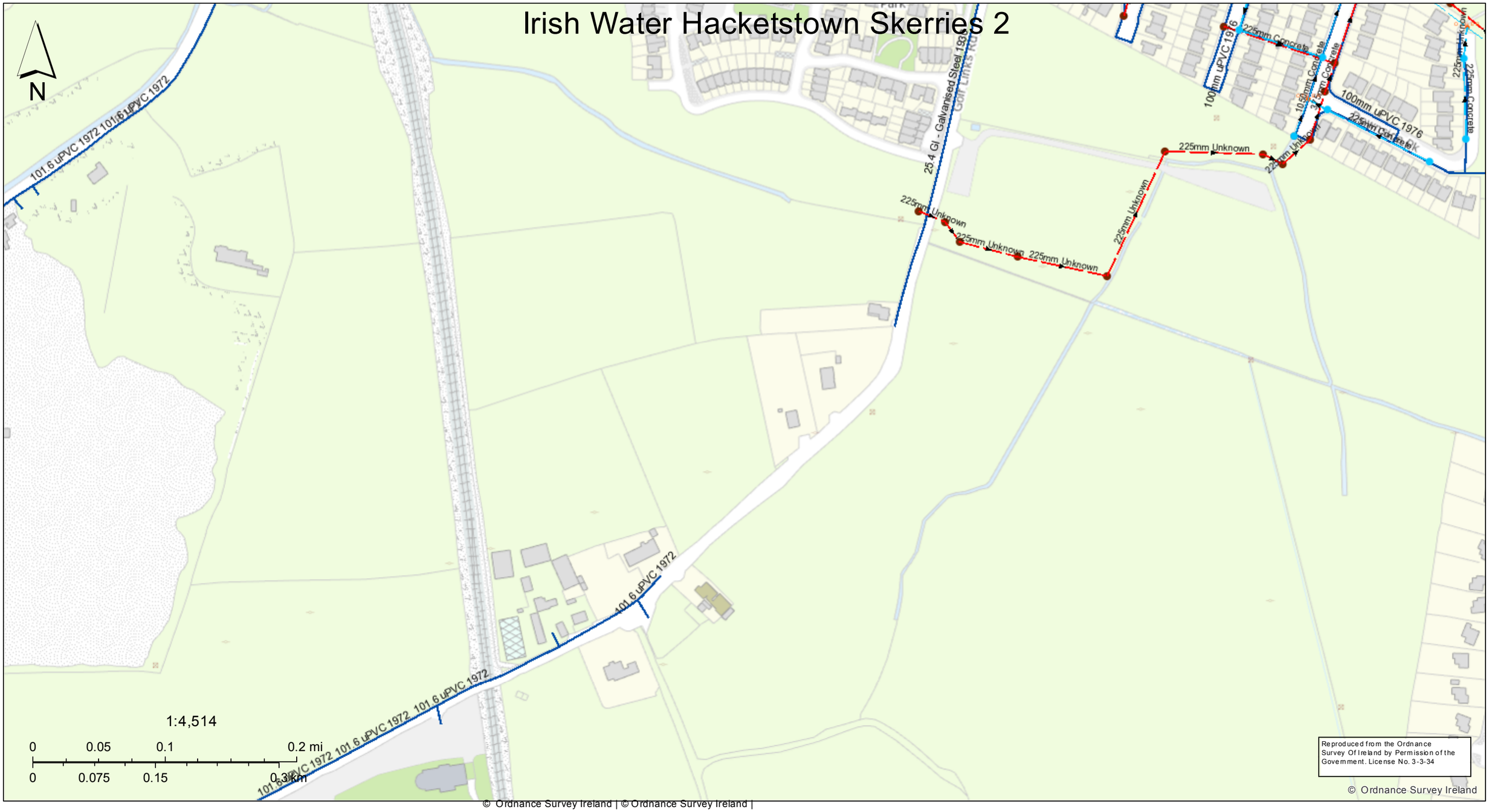
Response:

The recommendations outlined in the Planning Authority opinion has been addressed accordingly under heading 7 in this report.

APPENDIX A

Existing Services

Irish Water Hacketstown Skerries 2



9/30/2019, 5:12:48 PM

Legend

Stormwater Gravity Mains (Irish Water Owned)

- Surface

Stormwater Gravity Mains (Non-Irish Water Owned)

- Surface

Storm Manholes

- Cascade
- Catchpit
- Hatchbox

Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland. It should not be relied upon in the event of excavations or other works being carried out in the vicinity of the network. The onus is on the parties carrying out the works to ensure the exact location of the network is identified prior to mechanical works being carried out. Service pipes are not generally shown but their presence should be anticipated. © Irish Water

"Gas Networks Ireland (GNI), their affiliates and assigns, accept no responsibility for any information contained in this document concerning location and technical designation of the gas distribution and transmission network ("the Information"). Any representations and warranties express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect, special, incidental, punitive or consequential loss including loss of profits, arising out of or in connection with the use of the Information (including maps or mapping data). NOTE: DIAL BEFORE YOU DIG Phone 1850 427 747 or e-mail dig@gasnetworks.ie – The actual position of the gas/electricity distribution and transmission network must be verified on site before any mechanical excavating takes place. If any mechanical excavation is proposed, hard copy maps must be requested from GNI re gas. All work in the vicinity of the gas distribution and transmission network must be completed in accordance with the current edition of the Health & Safety Authority publication, 'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (1890 28 93 89) or can be downloaded free of charge at www.hsa.ie."

APPENDIX B

Irish Water Confirmation of Feasibility and Statement of Design Acceptance

Ben Mong
DBFL
Ormond House
Upper Ormond Quay
Dublin 7
D07W704

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

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

www.water.ie

2 April 2020

Dear Ben Mong,

Re: Connection Reference No CDS20001995 pre-connection enquiry -
Subject to contract | Contract denied

Connection for Multi/Mixed Use Development of 380 domestic units and 1 no, crèche unit at Golf Links Road, Hacketstown, Skerries, Co. Dublin

Irish Water has reviewed your pre-connection enquiry in relation to a water and wastewater connection at Golf Links Road, Hacketstown, Skerries, Co Dublin.

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

Water:

New connection to the existing network is feasible without upgrade (through the 160 mm third party watermain as proposed).

If the connection through the third party infrastructure is not possible, approx. 450 m of 150 mm ID new main to replace the existing 3" Cast Iron and 25.4 mm Galvanised Steel watermain is required, as shown by red dashed-line in the figure below. Irish Water currently does not have any plans to extend its network in this area. Should you wish to progress with the connection you will be required to fund this network extension.

This Confirmation of Feasibility to connect to the Irish Water infrastructure also does not extend to your fire flow requirements. Please note that Irish Water cannot guarantee a flow rate to meet fire flow requirements and in order to guarantee a flow to meet the Fire Authority requirements, you may need to provide adequate fire storage capacity within your development.

In order to determine the potential flow that could be delivered during normal operational conditions, an onsite assessment of the existing network is required.

Wastewater:

New connection to the existing network is feasible without upgrade.

The proposed water and wastewater connections for this development connect to the Irish Water network via infrastructure that has not been taken in charge by Irish Water (Third Party Infrastructure). Please be advised that at connection application stage and prior to the commencement of any Self-Lay Works, you have to:

- identify and procure transfer to Irish Water of the arterial water and wastewater Infrastructure within the Third Party Infrastructure;
- demonstrate that the arterial infrastructure are in compliance with requirements of Irish Water Code of Practice and Standard Details and in adequate condition and capacity to cater for additional load from the Development.

Strategic Housing Development:

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

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

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

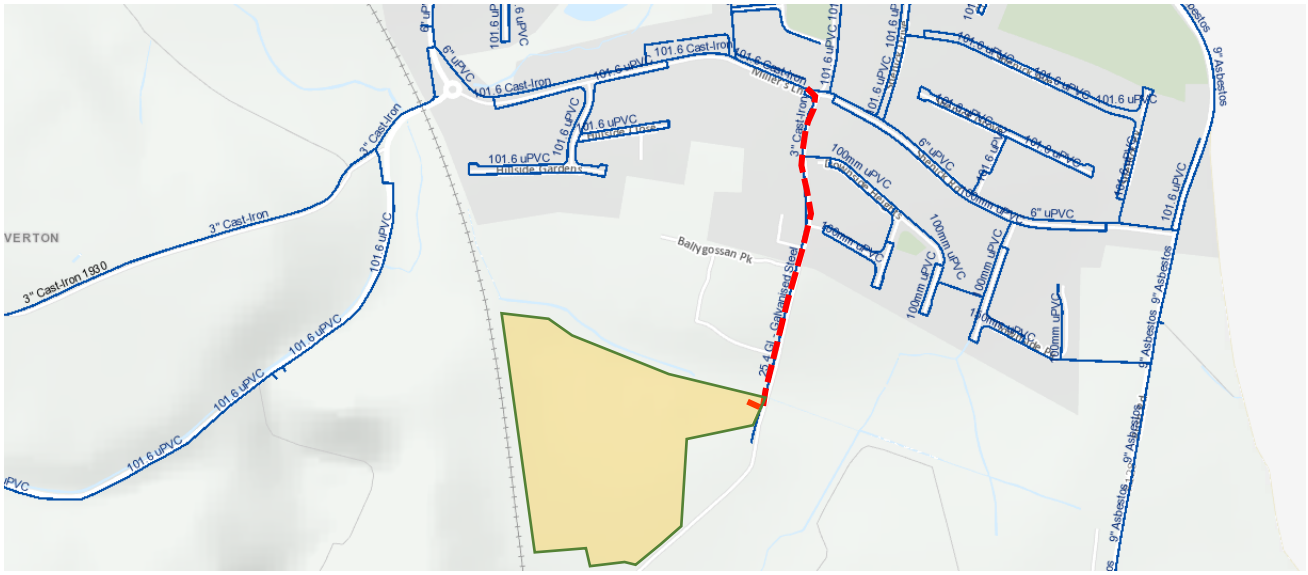
A connection agreement can be applied for by completing the connection application form available at **www.water.ie/connections**. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Regulation of Utilities.

If you have any further questions, please contact Deirdre Ryan from the design team on 022 54620 or email deiryan@water.ie. For further information, visit **www.water.ie/connections.**

Yours sincerely,

Maria O'Dwyer

Connections and Developer Services


VERTON
3" Cast-Iron
3" Cast-Iron 1930
101.6 uPVC
101.6 Cast-Iron
6" uPVC
Ballygossan Pk
25.4 GI - Galvanised Steel
100mm uPVC
6" uPVC
9" Asbestos

Ben Mong
DBFL
Ormond House
Upper Ormond Quay
Dublin 7
D07W704

16 February 2021

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

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

www.water.ie

Re: Design Submission for Golf Links Road, Hacketstown, Dublin (the "Development") (the "Design Submission") / Connection Reference No: CDS20001995

Dear Ben Mong,

Many thanks for your recent Design Submission.

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

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

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

If you have any further questions, please contact your Irish Water representative:
Name: Alvaro Garcia
Email: agarcia@water.ie

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

APPENDIX C

Foul Sewerage Calculations

TITLE	Job Reference
Proposed Residential Development Hackettstown, Skerries, Co Dublin	190170
SUBJECT	**Calc. Sheet No.**
Wastewater Hydraulic Load -Post Development Residential	1

DRAWING NUMBER	Calculations by	Checked by	Date
190170-DBFL-FW-SP-C-1021	RSP	LMcL	08.03.22

Foul Drainage

Housing Units	345	no.
Dry Weather Flow (DWF)[1]	150	litres/person/day
Average Occupancy Ratio[2]	2.7	person/unit
Total Site Occupancy (i.e. population)	932	person
Total Daily Wastewater Discharge + 10% Unit Consumption Allowance[3]	153,698	l/day
Peak Flow Factor[4]	4.5	

Post Development Average Discharge	**1.8**	l/s	Note: This value may be lower than value calculated using MICRODRAINAGE EN752 method for pipe sizing
Post Development Peak Discharge[5]	**8.0**	l/s	

Foul Sewer Organic Loading

	Average Concentration[6]	Maximum Concentration[7]
BOD (mg/l)	168	422
SS (mg/l)	163	435
N (mg/l)	40.6	78.6
P (mg/l)	7.1	15.5
COD (mg/l)	389	1000

Notes:

1. Dry Weather Flow (DWF) is 150 litres/person/day from the Irish Water Code of Practice for Wastewater Infrastructure.
2. Occupancy ratio of 2.7 persons per dwelling from Irish Water Code of Practice for Wastewater Infrastructure.
3. The unit consumption allowance is 10% in accordance with the Irish Water Code of Practice for Wastewater Infrastructure.
4. The Peak Flow factor is taken as 6 times Dry Weather Flow (0 to 750 population), 4.5 DWF for 751 to 1000 and 3.0 DWF for 1001 to 5000
5. The peak discharge is equal to the Total Wastewater Discharge multiplied by the peak flow factor, expressed in litres/second.
6. The average concentrations of wastewater parameters taken from EPA "Wastewater Treatment Manuals, Treatment Systems for Small Communities, Business, Leisure Centres and Hotels".
7. Assumed Maximum concentration is equal to the average concentration plus 2 times the standard deviation (for the 95%ile) taken from EPA "Wastewater Treatment Manuals, Treatment Systems for Small Communities, Business, Leisure Centres and Hotels".

TITLE	Job Reference
Proposed Residential Development Hackettstown, Skerries, Co Dublin	190170
SUBJECT	**Calc. Sheet No.**
Wastewater Hydraulic Load - Post Development Creche	2

DRAWING NUMBER	Calculations by	Checked by	Date
190170-DBFL-FW-SP-DR-C-1021	RSP	LMcL	08.03.22

Foul Drainage

Day Staff	10	no.
Dry Weather Flow (DWF)[1]	50	litres/person/day
Children	40	no.
Dry Weather Flow (DWF)[1]	50	litres/person/day
Total Daily Wastewater Discharge + 10% Unit Consumption Allowance[2]	2,750	l/day
Peak Flow Factor[3]	6.0	
Post Development Average Discharge	**0.032**	l/s
Post Development Peak Discharge[4]	**0.191**	l/s

Foul Sewer Organic Loading

	Average Concentration[5]	Maximum Concentration[6]
BOD (mg/l)	168	422
SS (mg/l)	163	435
N (mg/l)	40.6	78.6
P (mg/l)	7.1	15.5
COD (mg/l)	389	1000

Notes:

1. Dry Weather Flow (DWF) is 50 litres/person/day for Staff and Patrons taken from Irish Water "Code of Practice for Wasterwater Infrastructure".
2. The unit consumption allowance is 10% in accordance with the Irish Water "Code of Practice for Wastewater Infrastructure".
3. The Peak Flow factor is taken from Irish Water "Code of Practice for Wasterwater Infrastructure" Appendix C Section 1.2.7
4. The peak discharge is equal to the Total Wastewater Discharge multiplied by the peak flow factor, expressed in litres/second.
5. The average concentrations of wastewater parameters taken from EPA "Wastewater Treatment Manuals, Treatment Systems for Small Communities, Business, Leisure Centres and Hotels".
6. Assumed Maximum concentration is equal to the average concentration plus 2 times the standard deviation (for the 95%ile) taken from EPA "Wastewater Treatment Manuals, Treatment Systems for Small Communities, Business, Leisure Centres and Hotels".

FOUL SEWERAGE DESIGN

Design Criteria for FS_1

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.000
Calculation Method	EN 752	Maximum Backdrop Height (m)	0.000
Frequency Factor	0.50	Min Design Depth for Optimisation (m)	0.000
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	1.00
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Inverts

Network Design Table for FS_1

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.000	29.983	0.600	50.0	0.000	21.0	0.0	0.600	o	150	Pipe/Conduit	
F2.000	28.472	0.949	30.0	0.000	24.0	0.0	0.600	o	150	Pipe/Conduit	
F1.001	21.223	0.212	100.0	0.000	0.0	0.0	0.600	o	150	Pipe/Conduit	
F3.000	69.866	0.466	150.0	0.000	144.0	0.0	0.600	o	225	Pipe/Conduit	
F1.002	13.504	0.068	200.0	0.000	3.0	0.0	0.600	o	225	Pipe/Conduit	
F1.003	22.219	0.111	200.0	0.000	15.0	0.0	0.600	o	225	Pipe/Conduit	
F1.004	20.774	0.104	200.0	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F1.005	23.337	0.117	200.0	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F4.000	30.256	0.504	60.0	0.000	18.0	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Units	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.000	23.601	0.000	0.0	21.0	0.0	30	0.89	1.43	25.2	2.3
F2.000	24.095	0.000	0.0	24.0	0.0	28	1.09	1.84	32.6	2.4
F1.001	23.001	0.000	0.0	45.0	0.0	44	0.77	1.00	17.8	3.4
F3.000	23.260	0.000	0.0	144.0	0.0	57	0.76	1.07	42.4	6.0
F1.002	22.789	0.000	0.0	192.0	0.0	66	0.71	0.92	36.6	6.9
F1.003	22.722	0.000	0.0	207.0	0.0	67	0.72	0.92	36.6	7.2
F1.004	22.610	0.000	0.0	207.0	0.0	67	0.72	0.92	36.6	7.2
F1.005	22.507	0.000	0.0	207.0	0.0	67	0.72	0.92	36.6	7.2
F4.000	23.963	0.000	0.0	18.0	0.0	31	0.81	1.30	23.0	2.1

Network Design Table for FS_1

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F4.001	13.270	0.221	60.0	0.000	0.0	0.0	0.600	o	150	Pipe/Conduit	
F4.002	42.660	0.533	80.0	0.000	162.0	0.0	0.600	o	225	Pipe/Conduit	
F4.003	36.691	0.245	150.0	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F1.006	71.358	1.151	62.0	0.000	6.0	0.0	0.600	o	225	Pipe/Conduit	
F1.007	10.501	0.175	60.0	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F5.000	32.788	0.546	60.0	0.000	18.0	0.0	0.600	o	150	Pipe/Conduit	
F5.001	13.937	0.557	25.0	0.000	78.0	0.0	0.600	o	225	Pipe/Conduit	
F5.002	71.467	1.191	60.0	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F1.008	10.247	0.516	19.9	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F1.009	19.413	0.777	25.0	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F1.010	8.077	0.269	30.0	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F6.000	24.624	0.410	60.0	0.000	6.0	0.0	0.600	o	150	Pipe/Conduit	
F6.001	10.051	0.168	60.0	0.000	0.0	0.0	0.600	o	150	Pipe/Conduit	
F6.002	30.983	0.310	100.0	0.000	24.0	0.0	0.600	o	150	Pipe/Conduit	
F7.000	45.777	1.831	25.0	0.000	48.0	0.0	0.600	o	150	Pipe/Conduit	
F6.003	77.379	1.208	64.1	0.000	57.0	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Units	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F4.001	23.459	0.000	0.0	18.0	0.0	31	0.81	1.30	23.0	2.1
F4.002	23.238	0.000	0.0	180.0	0.0	51	0.98	1.46	58.2	6.7
F4.003	22.704	0.000	0.0	180.0	0.0	60	0.78	1.07	42.4	6.7
F1.006	22.390	0.000	0.0	393.0	0.0	58	1.20	1.66	66.2	9.9
F1.007	21.239	0.000	0.0	393.0	0.0	58	1.22	1.69	67.3	9.9
F5.000	22.572	0.000	0.0	18.0	0.0	31	0.81	1.30	23.0	2.1
F5.001	22.026	0.000	0.0	96.0	0.0	33	1.36	2.63	104.5	4.9
F5.002	21.468	0.000	0.0	96.0	0.0	41	0.99	1.69	67.3	4.9
F1.008	20.277	0.000	0.0	489.0	0.0	46	1.87	2.95	117.3	11.1
F1.009	18.786	0.000	0.0	489.0	0.0	49	1.72	2.63	104.5	11.1
F1.010	18.009	0.000	0.0	489.0	0.0	52	1.61	2.40	95.3	11.1
F6.000	23.171	0.000	0.0	6.0	0.0	24	0.69	1.30	23.0	1.2
F6.001	22.761	0.000	0.0	6.0	0.0	24	0.69	1.30	23.0	1.2
F6.002	22.593	0.000	0.0	30.0	0.0	40	0.73	1.00	17.8	2.7
F7.000	24.088	0.000	0.0	48.0	0.0	32	1.29	2.02	35.7	3.5
F6.003	22.257	0.000	0.0	135.0	0.0	45	1.02	1.64	65.1	5.8

Network Design Table for FS_1

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F8.000	59.667	2.983	20.0	0.000	111.0	0.0	0.600	o	225	Pipe/Conduit	
F8.001	11.120	0.445	25.0	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F6.004	43.150	1.027	42.0	0.000	27.0	0.0	0.600	o	225	Pipe/Conduit	
F6.005	60.747	1.593	38.1	0.000	54.0	0.0	0.600	o	225	Pipe/Conduit	
F6.006	14.403	0.714	20.2	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F1.011	36.582	1.464	25.0	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F9.000	16.469	0.274	60.0	0.000	36.0	0.0	0.600	o	225	Pipe/Conduit	
F9.001	63.174	1.049	60.2	0.000	72.0	0.0	0.600	o	225	Pipe/Conduit	
F9.002	15.417	0.257	60.0	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F10.000	52.541	0.876	60.0	0.000	72.0	0.0	0.600	o	225	Pipe/Conduit	
F10.001	36.672	0.611	60.0	0.000	36.0	0.0	0.600	o	225	Pipe/Conduit	
F10.002	27.245	0.454	60.0	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F1.012	11.700	0.234	50.0	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F1.013	22.684	0.227	99.9	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Units	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F8.000	24.539	0.000	0.0	111.0	0.0	32	1.50	2.94	116.9	5.3
F8.001	21.556	0.000	0.0	111.0	0.0	34	1.39	2.63	104.5	5.3
F6.004	21.049	0.000	0.0	273.0	0.0	48	1.32	2.02	80.5	8.3
F6.005	20.022	0.000	0.0	327.0	0.0	49	1.40	2.13	84.5	9.0
F6.006	18.429	0.000	0.0	327.0	0.0	42	1.75	2.93	116.4	9.0
F1.011	17.715	0.000	0.0	816.0	0.0	56	1.85	2.63	104.5	14.3
F9.000	17.197	0.000	0.0	36.0	0.0	32	0.86	1.69	67.3	3.0
F9.001	16.923	0.000	0.0	108.0	0.0	42	1.01	1.69	67.1	5.2
F9.002	15.874	0.000	0.0	108.0	0.0	42	1.01	1.69	67.3	5.2
F10.000	18.241	0.000	0.0	72.0	0.0	38	0.95	1.69	67.3	4.2
F10.001	17.365	0.000	0.0	108.0	0.0	42	1.01	1.69	67.3	5.2
F10.002	16.754	0.000	0.0	108.0	0.0	42	1.01	1.69	67.3	5.2
F1.012	15.617	0.000	0.0	1032.0	0.0	71	1.49	1.85	73.7	16.1
F1.013	13.670	0.000	0.0	1032.0	0.0	86	1.16	1.31	52.0	16.1

PIPELINE SCHEDULES for FS_1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	o	150	FF14	24.995	23.601	1.244	Open Manhole	1200
F2.000	o	150	FF13.1	25.626	24.095	1.381	Open Manhole	1200
F1.001	o	150	FF13	25.184	23.001	2.033	Open Manhole	1200
F3.000	o	225	FF12.1	24.688	23.260	1.203	Open Manhole	1200
F1.002	o	225	FF12	25.298	22.789	2.284	Open Manhole	1200
F1.003	o	225	FF11	25.468	22.722	2.521	Open Manhole	1200
F1.004	o	225	FF10	25.584	22.610	2.749	Open Manhole	1200
F1.005	o	225	FF9	25.567	22.507	2.835	Open Manhole	1200
F4.000	o	150	FF8.4	25.000	23.963	0.887	Open Manhole	1200
F4.001	o	150	FF8.3	24.691	23.459	1.082	Open Manhole	1200
F4.002	o	225	FF8.2	24.528	23.238	1.065	Open Manhole	1200
F4.003	o	225	FF8.1	24.543	22.704	1.614	Open Manhole	1200
F1.006	o	225	FF8	24.956	22.390	2.341	Open Manhole	1200
F1.007	o	225	FF7	23.132	21.239	1.668	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	29.983	50.0	FF13	25.184	23.001	2.033	Open Manhole	1200
F2.000	28.472	30.0	FF13	25.184	23.146	1.888	Open Manhole	1200
F1.001	21.223	100.0	FF12	25.298	22.789	2.359	Open Manhole	1200
F3.000	69.866	150.0	FF12	25.298	22.794	2.279	Open Manhole	1200
F1.002	13.504	200.0	FF11	25.468	22.722	2.521	Open Manhole	1200
F1.003	22.219	200.0	FF10	25.584	22.610	2.749	Open Manhole	1200
F1.004	20.774	200.0	FF9	25.567	22.507	2.835	Open Manhole	1200
F1.005	23.337	200.0	FF8	24.956	22.390	2.341	Open Manhole	1200
F4.000	30.256	60.0	FF8.3	24.691	23.459	1.082	Open Manhole	1200
F4.001	13.270	60.0	FF8.2	24.528	23.238	1.140	Open Manhole	1200
F4.002	42.660	80.0	FF8.1	24.543	22.704	1.614	Open Manhole	1200
F4.003	36.691	150.0	FF8	24.956	22.460	2.271	Open Manhole	1200
F1.006	71.358	62.0	FF7	23.132	21.239	1.668	Open Manhole	1200
F1.007	10.501	60.0	FF6	22.768	21.064	1.479	Open Manhole	1200

PIPELINE SCHEDULES for FS_1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F5.000	o	150	FF6.3	23.948	22.572	1.226	Open Manhole	1200
F5.001	o	225	FF6.2	23.943	22.026	1.692	Open Manhole	1200
F5.002	o	225	FF6.1	23.672	21.468	1.979	Open Manhole	1200
F1.008	o	225	FF6	22.768	20.277	2.266	Open Manhole	1200
F1.009	o	225	FF5	22.407	18.786	3.396	Open Manhole	1200
F1.010	o	225	FF4	19.823	18.009	1.589	Open Manhole	1200
F6.000	o	150	FF3.7	24.564	23.171	1.243	Open Manhole	1200
F6.001	o	150	FF3.6	23.661	22.761	0.750	Open Manhole	1200
F6.002	o	150	FF3.5	23.823	22.593	1.080	Open Manhole	1200
F7.000	o	150	FF3.4.1	25.628	24.088	1.390	Open Manhole	1200
F6.003	o	225	FF3.4	24.259	22.257	1.777	Open Manhole	1200
F8.000	o	225	FF3.3.2	25.788	24.539	1.024	Open Manhole	1200
F8.001	o	225	FF3.3.1	23.597	21.556	1.816	Open Manhole	1200
F6.004	o	225	FF3.3	23.088	21.049	1.814	Open Manhole	1200
F6.005	o	225	FF3.2	21.297	20.022	1.050	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F5.000	32.788	60.0	FF6.2	23.943	22.026	1.767	Open Manhole	1200
F5.001	13.937	25.0	FF6.1	23.672	21.468	1.979	Open Manhole	1200
F5.002	71.467	60.0	FF6	22.768	20.277	2.266	Open Manhole	1200
F1.008	10.247	19.9	FF5	22.407	19.761	2.421	Open Manhole	1200
F1.009	19.413	25.0	FF4	19.823	18.009	1.589	Open Manhole	1200
F1.010	8.077	30.0	FF3	19.770	17.740	1.805	Open Manhole	1200
F6.000	24.624	60.0	FF3.6	23.661	22.761	0.750	Open Manhole	1200
F6.001	10.051	60.0	FF3.5	23.823	22.593	1.080	Open Manhole	1200
F6.002	30.983	100.0	FF3.4	24.259	22.283	1.826	Open Manhole	1200
F7.000	45.777	25.0	FF3.4	24.259	22.257	1.852	Open Manhole	1200
F6.003	77.379	64.1	FF3.3	23.088	21.049	1.814	Open Manhole	1200
F8.000	59.667	20.0	FF3.3.1	23.597	21.556	1.816	Open Manhole	1200
F8.001	11.120	25.0	FF3.3	23.088	21.111	1.752	Open Manhole	1200
F6.004	43.150	42.0	FF3.2	21.297	20.022	1.050	Open Manhole	1200
F6.005	60.747	38.1	FF3.1	20.398	18.429	1.744	Open Manhole	1200

PIPELINE SCHEDULES for FS_1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F6.006	o	225	FF3.1	20.398	18.429	1.744	Open Manhole	1200
F1.011	o	225	FF3	19.770	17.715	1.830	Open Manhole	1200
F9.000	o	225	FF2.6	18.596	17.197	1.174	Open Manhole	1200
F9.001	o	225	FF2.5	18.238	16.923	1.090	Open Manhole	1200
F9.002	o	225	FF2.4	18.363	15.874	2.264	Open Manhole	1200
F10.000	o	225	FF2.3	19.641	18.241	1.175	Open Manhole	1200
F10.001	o	225	FF2.2	19.201	17.365	1.611	Open Manhole	1200
F10.002	o	225	FF2.1	18.859	16.754	1.880	Open Manhole	1200
F1.012	o	225	FF2	18.076	15.617	2.234	Open Manhole	1200
F1.013	o	225	FF1	17.765	13.670	3.870	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F6.006	14.403	20.2	FF3	19.770	17.715	1.830	Open Manhole	1200
F1.011	36.582	25.0	FF2	18.076	16.250	1.600	Open Manhole	1200
F9.000	16.469	60.0	FF2.5	18.238	16.923	1.090	Open Manhole	1200
F9.001	63.174	60.2	FF2.4	18.363	15.874	2.264	Open Manhole	1200
F9.002	15.417	60.0	FF2	18.076	15.617	2.234	Open Manhole	1200
F10.000	52.541	60.0	FF2.2	19.201	17.365	1.611	Open Manhole	1200
F10.001	36.672	60.0	FF2.1	18.859	16.754	1.880	Open Manhole	1200
F10.002	27.245	60.0	FF2	18.076	16.300	1.551	Open Manhole	1200
F1.012	11.700	50.0	FF1	17.765	15.383	2.157	Open Manhole	1200
F1.013	22.684	99.9	FEX F1	17.318	13.443	3.650	Open Manhole	1200

Free Flowing Outfall Details for FS_1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F1.013	FEX F1	17.318	13.443	0.000	1200	0

APPENDIX D

SuDS calculations

TITLE		Job Reference	
Residential Development, Hackettstown, Skerries, Co. Dublin		190170	
SUBJECT		**Calc. Sheet No.**	
BIORETENTION DESIGN		1	
DRAWING NUMBER	**Calculations by**	**Checked by**	**Date**
190170-DBFL-SW-SP-DR-C-1011	RSP	LMCL	14/02/2022

BIORETENTION AREA

Surface Area of Bioretention Area (A_f)	69.8	m^2

TREATMENT VOLUME

[1]**Treatment Volume (V_T)**	**25.1**	m^3

CATCHMENT AREA

Effective Impermeable Area Covered for Treatment (A)	**2092.5**	m^2

INPUT DATA

[2]Filter Bed Depth (L)	1.200	m
Coefficient of Permeability of Filter Medium (k)	0.000002	m/s
[3]Average Height of Water above Filter Bed (h)	0.050	m
[4]Time Required for Percolation (t)	48.0	hr

INFILTRATION VOLUME

Subgrade Infiltration Rate per hour	29.5	mm/hr
Subgrade Infiltration Rate (f)	0.008	mm/s
[5]**Subgrade Infiltration Volume**	**83.4**	m^3

Notes:

1 Treatment Volume Vt (m^3) = Impermeable Area (ha) x 15mm x 10 x 80% (GDSDS Section 6.3.1.2.1).

2 Filter Bed depth typically between 0.9 and 1.5m

3 h = Half maximum height, where hmax <=2m

4 Typically between 24 and 48 hours

5 Volume calculated using 6 hour storm event.

$$\text{Area of Bioretention Filter Bed} = \frac{V_T \cdot L}{k(h+L)t}$$

Table: 1 Coefficient of Permeability of Filter Medium

Soil Type/Texture	Infiltration Rate (m/s)
Source: SUDS Manual Table 25-1	
Gravel	0.0003 - 0.03
Sand	0.00001 - 0.00005
Loamy Sand	0.0001 - 0.00003
Sandy Loam	0.0000001 - 0.00001
Loam	0.0000001 - 0.00005
Silt Loam	0.0000001 - 0.00001
Chalk	0.00000003 - 0.000003
Sandy Clay Loam	0.0000000003 - 0.0000003
Silty Clay Loam	0.0000001 - 0.000001
Clay	< 0.00000003
Till	0.000000003 - 0.000003

TITLE		Job Reference	
Hacketstowns		190170	
SUBJECT		**Calc. Sheet No.**	
FILTER TRENCH DESIGN		1	
DRAWING NUMBER	**Calculations by**	**Checked by**	**Date**
190170-DBFL-SW-SP-DR-C-1011	RSP	LMCL	14/02/2022

INPUT DATA

Pipe Diameter (∅)	0.150	m
Average Width (W)	0.600	m
Average Depth to Invert (D)	0.600	m
Length (L)	854.2	m
Slope (S)	150	1 in ….
[1]Trench Backfill Voids Ratio (η)	0.30	
Trench Backfill Infiltration Rate per hour	3600.0	mm/hr
Trench Backfill Infiltration Rate (k)	1.000	mm/s
Subgrade Infiltration Rate per hour	10.0	mm/hr
Subgrade Infiltration Rate (f)	0.003	mm/s

VOLUME (STORAGE AND TREATMENT)

Filter Trench Storage Volume per metre	0.123	m^3/m	
Total Filter Trench Storage Volume (V)	105.1	m^3	Provided Treatment Volume

INFILTRATION/ INTERCEPTION VOLUME

[2]Filter Trench Infiltration per metre	0.002	l/s/m	
Total Filter Trench Infiltration Rate (I)	**1.424**	l/s/m	
[3]Total Filter Trench Infiltration Volume	30.7	m^3	Provided Interception Volume

FLOW

Filter Trench Cross-Sectional Area (A)	0.24	m^2
Total Filter Trench Flow (Q)	**14.434**	l/s
Trench Retention Time	**4.0**	hr

Notes:

1 Trench backfill material has a void ratio of approximately 30%, source 'BRE Digest 365'.

2 Wetted perimeter assuming 50% of trench depth, source 'BRE Digest 365'.

3 Volume calculated using 6 hour storm event.

Table: 1

Material	void Ratio, η
Clean stone	0.40 - 050
Uniform gravel	0.30 - 0.40
Graded sand or gravel	0.20 - 0.30

Total Trench Flow:

$= A \cdot k \cdot i$ + Pipe Flow

where:

A = Cross Sectional Area of Backfill

k = Trench Backfill Infiltration Rate

i = Hydraulic Gradient

Hydraulic gradient has been assumed as the trench gradient with an additional 250mm fall per 100m length.

Pipe Flow calculated using Colebrook White Eqn.

Table: 2

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr	
Source: Microdrainage	

Total Trench Infiltration:

$= 1/2 \cdot D \cdot L \cdot f$

where:

L = Length

D = Depth to Invert

f = Subgrade infiltration rate

TITLE		Job Reference	
Residential Development, Hackettstown, Skerries, Co. Dublin		190170	
SUBJECT		**Calc. Sheet No.**	
Permeable Paving Design		1	
DRAWING NUMBER	**Calculations by**	**Checked by**	**Date**
190170-DBFL-SW-SP-DR-C-1011	RSP	LMCL	14/02/2022

FLAT SITES

INPUT DATA

Pavement Area (A)	4135.7	m^2
Pavement Perimeter (P)	2506.0	m
Sub-base Depth (d)	0.250	m
[1]Sub-base Voids Ratio (η)	0.30	
Sub-base Infiltration Rate per hour	1000	mm/hr
Sub-base Infiltration Rate (k)	0.278	mm/s
Subgrade Infiltration Rate per hour	29.5	mm/hr
Subgrade Infiltration Rate (f)	0.008	mm/s

VOLUME (STORAGE AND TREATMENT)

Permeable Paving Storage Volume per m^2	0.075	m^3/m^2	
Total Permeable Paving Storage Volume	310.2	m^3	Provided Treatment Volume

INFILTRATION / INTERCEPTION VOLUME

Approx. Permeable Paving Infiltration per m^2	0.009	l/s/m^2	
[2]**Total Permeable Paving Infiltration Rate**	**39.050**	l/s	
[3]**Total Permeable Paving Infiltration Volume**	843.5	m^3	Provided Interception Volume

FLOW

Average Distance between Outlet Drains	6.0	m	Assumed one outlet per house
Flow Velocity through Permeable Paving	**0.000024**	m/s	
Trench Retention Time	**69.9**	hr	

TITLE
Residential Development, Hackettstown, Skerries, Co. Dublin

Job Reference
190170

SUBJECT
Permeable Paving Design

Calc. Sheet No.
1

DRAWING NUMBER	Calculations by	Checked by	Date
190170-DBFL-SW-SP-DR-C-1011	RSP	LMCL	14/02/2022

Notes:

1 Sub-base material has a void ratio of approximately 30%, source 'BRE Digest 365'.

2 Wetted perimeter assuming 50% of trench depth, source 'BRE Digest 365'.

3 Volume calculated using 6 hour storm event.

4 For Paving on slopes includes infiltration, provide 500mmx500mm trenches at 10m centres along slope with 1000mmx500mm at base of slope. source 'Formpave - Aquaflow Permeable Paving System'.

Table: 1

Material	void Ratio, η
Clean stone	0.40 - 0.50
Uniform gravel	0.30 - 0.40
Graded sand or gravel	0.20 - 0.30
Source: The SUDS manual, Published by CIRIA.	

Table: 2

Pavement Type	Effective Depth (m)
Car-Parking	0.40
Footpath	0.20
Effective Depths are provided from source 'Formpave - Aquaflow Permeable Paving System' and may subject to change as per site requirement.	

Total Permeable Paving Outflow:

$= A \cdot k \cdot i$

where:

A = Cross Sectional Area of Subbase
k = Subbase Infiltration Rate
i = Hydraulic Gradient

Hydraulic gradient has been assumed as the pavement gradient with an additional 250mm fall per 100m length.

Table: 3

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

Total Trench Infiltration:

$= 1/2 \cdot D \cdot L \cdot f$

where:

L = Length
D = Depth to Invert
f = Subgrade infiltration rate

TITLE		Job Reference	
Residential Development, Hackettstown, Skerries, Co. Dublin		190170	
SUBJECT		**Calc. Sheet No.**	
Swale Channel No.1		3	
DRAWING NUMBER	**Calculations by**	**Checked by**	**Date**
190170-DBFL-SW-SP-DR-C-1011	RSP	LMCL	14/02/2022

INPUT DATA

Side Slopes	4.0	1 in ….
Bottom width (W)	1.00	m
Depth to Invert (D)	0.15	m
Length (L)	7.3	m
Slope (S)	50	1 in ….
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	29.520	mm/hr
Subgrade Infiltration Rate (f)	0.008200000	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	16.3	m^2
[1]Depth of Subgrade Treatment	0.20	m
Total Swale Treatment Volume (V_T)	3.266	m^3

STORAGE VOLUME

Max. Length of Storage within Swale	7.3	m
Swale Storage Volume per 7m Length	**0.55**	m^3
Swale Storage Volume (V)	**0.55**	m^3

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	**0.07**	l/s
[3]Total Swale Infiltration Volume	1.459	m^3

FLOW

Maximum Swale Flow at Outlet	**255.5**	l/s
Maximum Swale Velocity at Outlet	**1.06**	m/s
[3]Typical Swale Retention Time	**0.002**	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (mm/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1

Cutoff point for most infiltration drainage systems = 0.001 mm/hr
Source: Microdrainage

TITLE		Job Reference	
Residential Development, Hackettstown, Skerries, Co. Dublin		190170	
SUBJECT		**Calc. Sheet No.**	
Swale Channel No.2		5	
DRAWING NUMBER	**Calculations by**	**Checked by**	**Date**
190170-DBFL-SW-SP-DR-C-1011	RSP	LMCL	14/02/2022

INPUT DATA

Side Slopes	4.0	1 in ….
Bottom width (W)	1.00	m
Depth to Invert (D)	0.15	m
Length (L)	18.6	m
Slope (S)	30	1 in ….
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	29.520	mm/hr
Subgrade Infiltration Rate (f)	0.008200000	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	41.6	m^2
[1]Depth of Subgrade Treatment	0.20	m
Total Swale Treatment Volume (V_T)	8.321	m^3

STORAGE VOLUME

Max. Length of Storage within Swale	4.5	m
Swale Storage Volume per 5m Length	**0.79**	m^3
Swale Storage Volume (V)	**3.15**	m^3

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	**0.10**	l/s
[3]Total Swale Infiltration Volume	2.058	m^3

FLOW

Maximum Swale Flow at Outlet	**329.8**	l/s
Maximum Swale Velocity at Outlet	**1.37**	m/s
[3]Typical Swale Retention Time	**0.004**	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (mm/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1

Cutoff point for most infiltration drainage systems = 0.001 mm/hr
Source: Microdrainage

TITLE		Job Reference	
Residential Development, Hackettstown, Skerries, Co. Dublin		190170	
SUBJECT		**Calc. Sheet No.**	
Swale Channel No.3		6	
DRAWING NUMBER	**Calculations by**	**Checked by**	**Date**
190170-DBFL-SW-SP-DR-C-1011	RSP	LMCL	14/02/2022

INPUT DATA

Side Slopes	4.0	1 in ….
Bottom width (W)	1.00	m
Depth to Invert (D)	0.15	m
Length (L)	10.5	m
Slope (S)	30	1 in ….
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	29.520	mm/hr
Subgrade Infiltration Rate (f)	0.008200000	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	23.5	m^2
[1]Depth of Subgrade Treatment	0.20	m
Total Swale Treatment Volume (V_T)	4.698	m^3

STORAGE VOLUME

Max. Length of Storage within Swale	4.5	m
Swale Storage Volume per 5m Length	**0.29**	m^3
Swale Storage Volume (V)	**0.58**	m^3

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	**0.03**	l/s
[3]Total Swale Infiltration Volume	0.646	m^3

FLOW

Maximum Swale Flow at Outlet	**329.8**	l/s
Maximum Swale Velocity at Outlet	**1.37**	m/s
[3]Typical Swale Retention Time	**0.002**	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (mm/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1

Cutoff point for most infiltration drainage systems = 0.001 mm/hr
Source: Microdrainage

TITLE		Job Reference	
Residential Development, Hackettstown, Skerries, Co. Dublin		190170	
SUBJECT		**Calc. Sheet No.**	
Swale Channel No.4		8	
DRAWING NUMBER	**Calculations by**	**Checked by**	**Date**
190170-DBFL-SW-SP-DR-C-1011	RSP	LMCL	14/02/2022

INPUT DATA

Side Slopes	4.0	1 in ….
Bottom width (W)	1.00	m
Depth to Invert (D)	0.15	m
Length (L)	11.5	m
Slope (S)	200	1 in ….
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	29.520	mm/hr
Subgrade Infiltration Rate (f)	0.008200000	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	25.7	m^2
[1]Depth of Subgrade Treatment	0.20	m
Total Swale Treatment Volume (V_T)	5.145	m^3

STORAGE VOLUME

Max. Length of Storage within Swale	11.5	m
Swale Storage Volume per 12m Length	**1.02**	m^3
Swale Storage Volume (V)	**1.02**	m^3

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	**0.12**	l/s
[3]Total Swale Infiltration Volume	2.656	m^3

FLOW

Maximum Swale Flow at Outlet	**127.7**	l/s
Maximum Swale Velocity at Outlet	**0.53**	m/s
[3]Typical Swale Retention Time	**0.006**	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (mm/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1

Cutoff point for most infiltration drainage systems = 0.001 mm/hr
Source: Microdrainage

TITLE		**Job Reference**	
Residential Development, Hackettstown, Skerries, Co. Dublin		190170	
SUBJECT		**Calc. Sheet No.**	
REGIONAL DRAINAGE FACILITY		1	
DRAWING NUMBER	**Calculations by**	**Checked by**	**Date**
190170-DBFL-SW-SP-DR-C-1011	RSP	LMCL	14/02/2022

BIORETENTION AREA

Surface Area of Bioretention Area (A_f)	1,628.0	m^2

TREATMENT VOLUME

[1]**Treatment Volume (V_T)**	**1828.6**	m^3

CATCHMENT AREA

Effective Impermeable Area Covered for Treatment (A)	**152380.8**	m^2	**15.2**	ha

INPUT DATA

[2]Filter Bed Depth (L)	0.200	m
Coefficient of Permeability of Filter Medium (k)	0.000002	m/s
[3]Average Height of Water above Filter Bed (h)	0.450	m
[4]Time Required for Percolation (t)	48.0	hr

INFILTRATION VOLUME

Subgrade Infiltration Rate per hour	29.5	mm/hr
Subgrade Infiltration Rate (f)	0.008	mm/s
[5]**Subgrade Infiltration Volume**	**345.5**	m^3

Notes:

1 Treatment Volume Vt (m^3) = Impermeable Area (ha) x 15mm x 10 x 80% (GDSDS Section 6.3.1.2.1).

2 Filter Bed depth typically between 0.9 and 1.5m

3 h = Half maximum height, where hmax <=2m

4 Typically between 24 and 48 hours

5 Volume calculated using 6 hour storm event.

$$\textit{Area of Bioretention Filter Bed} = \frac{V_T \cdot L}{k(h+L)t}$$

Table: 1 Coefficient of Permeability of Filter Medium

Soil Type/Texture	Infiltration Rate (m/s)
Source: SUDS Manual Table 25-1	
Gravel	0.0003 - 0.03
Sand	0.00001 - 0.00005
Loamy Sand	0.0001 - 0.00003
Sandy Loam	0.0000001 - 0.00001
Loam	0.0000001 - 0.00005
Silt Loam	0.0000001 - 0.00001
Chalk	0.00000003 - 0.000003
Sandy Clay Loam	0.0000000003 - 0.0000003
Silty Clay Loam	0.0000001 - 0.000001
Clay	< 0.00000003
Till	0.000000003 - 0.000003

TITLE		Job Reference	
Residential Development at Hackettstown, Skerries, Co. Dublin		190170	
SUBJECT		**Calc. Sheet No.**	
Interception/Treatment Volume Summary		1	
DRAWING NUMBER	**Calculations by**	**Checked by**	**Date**
190170-DBFL-SW-SP-DR-C-1011	RSP	LMCL	14/02/2022

INPUT DATA

Interception Volume Required	51.892	m^3
Treatment Volume Required	155.676	m^3

Catchment	**Interception Volumes**		**Treatment Volumes**	
Swales	6.8	m^3	21.4	m^3
Bio-Retention/ Tree Pits	83.4	m^3	25.1	m^3
Permeable Paving	843.5	m^3	310.2	m^3
Filter Drain	30.7	m^3	105.1	m^3
Regional Drainage Facility	345.5	m^3	1828.6	m^3
-				
Total Volumes Provided	1309.9	m^3	2290.4	m^3
Check Provided Volumes are greater than Required Volumes	PASS		PASS	

Not considering Regional Drainage Facility:

Total Volumes Provided	964.4	m^3	461.8	m^3
Check Provided Volumes are greater than Required Volumes	PASS		PASS	

APPENDIX E

Permissible Site Discharge Calculations

PROJECT			JOB REF.
Residential Development at Hackettstown, Skerries, Co. Dublin			190170
SUBJECT			**Calc. Sheet No.**
Surface Water Calculations - Permissible Site Discharge			1
Drawing ref.	**Calculations by**	**Checked by**	**Date**
190170-DBFL-SW-SP-DR-C-1011	RSP	BJM	26/09/2020

PERMISSIBLE SURFACE WATER DISCHARGE CALCULATIONS

Site Area

What is the overall site area? **6.94** Hectares (ha) Site is Less than 50 Hectares

Pre-Development Catchment Soil Characteristics

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

Catchment (This refers to the entire site area)	1	
Area	6.94	Hectares (ha)
Drainage Group	1	Class
Depth to Impermeable Layers	2	Class
Permeability Group above Impermeable Layers	3	Class
Slope [6]	2	Class
SOIL Type	3	From FSR Table
[1]SOIL Index	0.40	

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

Site SOIL Index Value **0.40**

Site SPR Value **0.37**

Post-Development Catchment Characteristics

Is the development divided into sub-catchments? No

What is the overall site area for catchment? 6.94 Hectares (ha)

Catchment 1	Area (m^2)	Runoff Coeff.	Effective Area (m^2)
Roofs - Type 1 (Draining to traditional gullies)	488	1.00	488.0
Roofs - Type 2 (Draining to SUDS features)	14216	0.70	9951.2
Roofs - Type 3 (Extensive Green Roofs, 2-4cm depth)	0	0.70	0.0
Paved Garden Areas - Hardstanding	1776	1.00	1776.0
Roads and Footpaths - Type 1 (Draining to traditional gullies)	5745	1.00	5745.0
Roads and Footpaths - Type 2 (Draining to Suds features)	6801	0.75	5100.8
Permeable Paving	4635	0.50	2317.5
Bioretention Areas - Type 1 (Filter Drains)	3228	0.70	2259.6
Bioretention Areas - Type 2 (Tree Pits and Swales)	329	0.70	230.3
Public Open Space - Considered to drain to Surface Water	11929	0.30	3578.7
Public Open Space - Considered to not drain to Surface Water	20143	0.30	6042.9

Include All Public Open Space in Effective Catchment Area? No — Assumed open space area does not drain to surface water network

Effective Catchment Area **31447.1** m^2

Effective Catchment Runoff Coefficient **0.64**

Long-Term Storage

Is long-term Storage provided? No

Permissible Site Discharge

What is the Standard Average Annual Rainfall (SAAR)? 735.0 mm — From Met Eireann, Co-ordinates xxxxxxxx, xxxxxxxxx

Is the overall site area less than 50 hectares? Yes

[5]$QBAR_{Rural}$ calculated for 50 ha and linearly interpolated for area of site 25.0 Litres/sec

[7]Site Discharge = **25.0** Litres/sec

Notes and Formulae

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

PROJECT			JOB REF.
Residential Development at Hackettstown, Skerries, Co. Dublin			190170
SUBJECT			**Calc. Sheet No.**
Surface Water Calculations - Soil Characteristics from FSR			4
Drawing ref.	**Calculations by**	**Checked by**	**Date**
190170-DBFL-SW-SP-DR-C-1011	RSP	BJM	26/09/2020

Table 4.4 Classification of soil factors.

Property		Classes
A	Drainage group	1 Rarely waterlogged within 60 cm at any time (well and moderately well drained) 2 Commonly waterlogged within 60 cm during winter (imperfect and poor) 3 Commonly waterlogged within 60 cm during winter and summer (very poorly drained)
B	Depth to 'impermeable' layers	1 >80 cm 2 80–40 cm 3 <40 cm
C	Permeability group (above 'impermeable' layers or to 80 cm)	1 Rapid 2 Medium 3 Slow
D	Slope	1 0–2° 2 2–8° 3 >8°

Having decided all four parameters, Table 4.5 was used to reach the index of 'winter rain acceptance'.

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

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

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

1. Soil index (SPR) value calculated from Flood Studies Report - The Classification of Soils from Winter Rainfall Acceptance Rate (Table 4.5).

APPENDIX F

Interception and Treatment Volumes Calculations

PROJECT			JOB REF.
Residential Development at Hackettstown, Skerries, Co. Dublin			190170
SUBJECT			**Calc. Sheet No.**
Surface Water Calculations - Interception Volume			3
Drawing ref.	**Calculations by**	**Checked by**	**Date**
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SURFACE WATER CALCULATIONS

Site Area

Total Site Area =	6.94	Hectares (ha)

Interception Volume (Post-Development)

Impermeable Area =	1.297	Hectares (ha)
Rainfall Depth =	5	mm
[1]Infiltration Volume =	51.9	m^3

Notes

1. Infiltration Volume (m^3) = Impermeable Area (ha) x 5mm x 10 (GDSDS Section 6.3.1.2.1). For sites where a pond is applicable.

80% runoff from impermeable areas assumed.

PROJECT			JOB REF.
Residential Development at Hackettstown, Skerries, Co. Dublin			190170
SUBJECT			**Calc. Sheet No.**
Surface Water Calculations - Treatment Volume			2
Drawing ref.	**Calculations by**	**Checked by**	**Date**
190170-DBFL-SW-SP-DR-C-1011	RSP	BJM	26/09/2020

SURFACE WATER CALCULATIONS

Site Area

Total Site Area =	6.94	Hectares (ha)

Pond Treatment Volume (Post-Development)

Impermeable Area =	1.297	Hectares (ha)
Rainfall Depth =	15	mm
'Treatment Volume (Vt) =	155.7	m^3

Notes

1. Treatment Volume Vt (m^3) = Impermeable Area (ha) x 15mm x 10 (GDSDS Section 6.3.1.2.1). For sites where a pond is applicable.

80% runoff from impermeable areas assumed.

APPENDIX G

Surface Water Network Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SW_1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	100	PIMP (%)	64
M5-60 (mm)	15.600	Add Flow / Climate Change (%)	20
Ratio R	0.272	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	150	Maximum Backdrop Height (m)	2.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.000
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Inverts

Network Design Table for SW_1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	34.677	0.229	151.4	0.100	4.00	0.0	0.150	o	225	Pipe/Conduit	
2.000	33.538	0.664	50.5	0.120	4.00	0.0	0.150	o	225	Pipe/Conduit	
1.001	21.236	0.260	81.7	0.054	0.00	0.0	0.150	o	300	Pipe/Conduit	
3.000	65.441	0.388	168.7	0.261	4.00	0.0	0.150	o	300	Pipe/Conduit	
1.002	12.051	0.048	250.0	0.019	0.00	0.0	0.150	o	450	Pipe/Conduit	
1.003	22.509	0.075	300.0	0.050	0.00	0.0	0.150	o	450	Pipe/Conduit	
1.004	24.874	0.124	200.0	0.015	0.00	0.0	0.150	o	450	Pipe/Conduit	
1.005	20.374	0.209	97.4	0.042	0.00	0.0	0.150	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	108.66	4.47	23.818	0.100	0.0	0.0	5.9	1.23	49.0	35.5
2.000	110.22	4.26	24.253	0.120	0.0	0.0	7.1	2.17	86.1	42.9
1.001	107.42	4.64	23.589	0.274	0.0	0.0	15.9	2.03	143.4	95.6
3.000	106.47	4.78	23.717	0.261	0.0	0.0	15.1	1.40	98.9	90.4
1.002	105.55	4.92	23.329	0.554	0.0	0.0	31.6	1.47	234.4	189.9
1.003	103.71	5.20	23.281	0.604	0.0	0.0	33.9	1.34	213.4	203.4
1.004	102.13	5.45	23.206	0.619	0.0	0.0	34.2	1.65	262.9	205.4
1.005	101.26	5.59	23.081	0.660	0.0	0.0	36.2	2.39	379.7	217.4

Network Design Table for SW_1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
4.000	33.291	0.166	200.0	0.401	4.00	0.0	0.150	o	375	Pipe/Conduit	
4.001	34.326	0.221	155.1	0.000	0.00	0.0	0.150	o	375	Pipe/Conduit	
1.006	35.558	0.474	75.0	0.168	0.00	0.0	0.150	o	450	Pipe/Conduit	
1.007	36.284	0.484	75.0	0.038	0.00	0.0	0.150	o	450	Pipe/Conduit	
1.008	8.734	0.116	75.0	0.039	0.00	0.0	0.150	o	450	Pipe/Conduit	
1.009	32.267	0.538	60.0	0.351	0.00	0.0	0.150	o	525	Pipe/Conduit	
1.010	34.608	0.173	200.0	0.000	0.00	0.0	0.150	o	600	Pipe/Conduit	
1.011	40.817	0.408	100.0	0.000	0.00	0.0	0.150	o	600	Pipe/Conduit	
1.012	43.555	3.064	14.2	0.000	0.00	0.0	0.150	o	600	Pipe/Conduit	
1.013	30.341	1.214	25.0	0.000	0.00	0.0	0.150	o	600	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
4.000	109.34	4.38	23.260	0.401	0.0	0.0	23.7	1.47	162.9	142.4
4.001	106.91	4.72	23.094	0.401	0.0	0.0	23.7	1.68	185.6	142.4
1.006	99.97	5.81	22.872	1.229	0.0	0.0	66.5	2.73	433.6	399.2
1.007	98.70	6.03	22.098	1.267	0.0	0.0	67.7	2.73	433.6	406.2
1.008	98.39	6.08	21.150	1.306	0.0	0.0	69.6	2.73	433.6	417.5
1.009	97.51	6.24	21.034	1.657	0.0	0.0	87.5	3.36	727.0	525.1
1.010	95.94	6.53	20.496	1.657	0.0	0.0	87.5	1.98	558.5	525.1
1.011	94.68	6.78	20.323	1.657	0.0	0.0	87.5	2.81	795.0	525.1
1.012	94.20	6.87	19.915	1.657	0.0	0.0	87.5	7.54	2131.3	525.1
1.013	93.75	6.96	16.851	1.657	0.0	0.0	87.5	5.67	1603.9	525.1

PIPELINE SCHEDULES for SW_1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	225	S14	24.986	23.818	0.943	Open Manhole	1200
2.000	o	225	S13.1	25.683	24.253	1.205	Open Manhole	1200
1.001	o	300	S13	25.206	23.589	1.317	Open Manhole	1200
3.000	o	300	S12.1	24.682	23.717	0.665	Open Manhole	1200
1.002	o	450	S12	25.263	23.329	1.484	Open Manhole	1350
1.003	o	450	S11	24.415	23.281	0.684	Open Manhole	1350
1.004	o	450	S10	25.538	23.206	1.882	Open Manhole	1350
1.005	o	450	S9	25.438	23.081	1.907	Open Manhole	1350
4.000	o	375	S8.2	24.416	23.260	0.781	Open Manhole	1350
4.001	o	375	S8.1	24.558	23.094	1.089	Open Manhole	1350
1.006	o	450	S8	24.919	22.872	1.597	Open Manhole	1350
1.007	o	450	S7	24.029	22.098	1.481	Open Manhole	1350
1.008	o	450	S6	23.042	21.150	1.442	Open Manhole	1350
1.009	o	525	S5	22.765	21.034	1.206	Open Manhole	1500
1.010	o	600	S4.1	22.477	20.496	1.381	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	34.677	151.4	S13	25.206	23.589	1.392	Open Manhole	1200
2.000	33.538	50.5	S13	25.206	23.589	1.392	Open Manhole	1200
1.001	21.236	81.7	S12	25.263	23.329	1.634	Open Manhole	1350
3.000	65.441	168.7	S12	25.263	23.329	1.634	Open Manhole	1350
1.002	12.051	250.0	S11	24.415	23.281	0.684	Open Manhole	1350
1.003	22.509	300.0	S10	25.538	23.206	1.882	Open Manhole	1350
1.004	24.874	200.0	S9	25.438	23.081	1.907	Open Manhole	1350
1.005	20.374	97.4	S8	24.919	22.872	1.597	Open Manhole	1350
4.000	33.291	200.0	S8.1	24.558	23.094	1.089	Open Manhole	1350
4.001	34.326	155.1	S8	24.919	22.872	1.672	Open Manhole	1350
1.006	35.558	75.0	S7	24.029	22.398	1.181	Open Manhole	1350
1.007	36.284	75.0	S6	23.042	21.614	0.978	Open Manhole	1350
1.008	8.734	75.0	S5	22.765	21.034	1.281	Open Manhole	1500
1.009	32.267	60.0	S4.1	22.477	20.496	1.456	Open Manhole	1500
1.010	34.608	200.0	S4	24.300	20.323	3.377	Open Manhole	1500

PIPELINE SCHEDULES for SW_1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.011	o	600	S4	24.300	20.323	3.377	Open Manhole	1500
1.012	o	600	S3	21.813	19.915	1.298	Open Manhole	1500
1.013	o	600	S2	20.201	16.851	2.750	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.011	40.817	100.0	S3	21.813	19.915	1.298	Open Manhole	1500
1.012	43.555	14.2	S2	20.201	16.851	2.750	Open Manhole	1500
1.013	30.341	25.0	S1	16.673	15.637	0.436	Open Manhole	1200

Free Flowing Outfall Details for SW_1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.013	S1	16.673	15.637	0.000	1200	0

Simulation Criteria for SW_1

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	20.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	15.600	Storm Duration (mins)	30
Ratio R	0.272		

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SW_2

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	100	PIMP (%)	64
M5-60 (mm)	15.600	Add Flow / Climate Change (%)	20
Ratio R	0.272	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	150	Maximum Backdrop Height (m)	2.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.000
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Inverts

Network Design Table for SW_2

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	17.375	0.348	50.0	0.033	4.00	0.0	0.150	o	225	Pipe/Conduit	
1.001	39.104	0.782	50.0	0.050	0.00	0.0	0.150	o	225	Pipe/Conduit	
1.002	14.239	0.071	200.0	0.000	0.00	0.0	0.150	o	225	Pipe/Conduit	
1.003	25.573	0.128	199.8	0.093	0.00	0.0	0.150	o	300	Pipe/Conduit	
2.000	45.784	1.145	40.0	0.147	4.00	0.0	0.150	o	225	Pipe/Conduit	
1.004	79.274	0.793	100.0	0.255	0.00	0.0	0.150	o	375	Pipe/Conduit	
3.000	64.025	2.561	25.0	0.227	4.00	0.0	0.150	o	225	Pipe/Conduit	
3.001	12.998	0.260	50.0	0.000	0.00	0.0	0.150	o	225	Pipe/Conduit	
1.005	43.979	1.759	25.0	0.134	0.00	0.0	0.150	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	111.16	4.13	23.517	0.033	0.0	0.0	2.0	2.18	86.5	12.0
1.001	108.93	4.43	23.170	0.083	0.0	0.0	4.9	2.18	86.5	29.5
1.002	107.34	4.65	22.387	0.083	0.0	0.0	4.9	1.07	42.4	29.5
1.003	105.07	4.99	22.316	0.176	0.0	0.0	10.0	1.28	90.6	60.1
2.000	109.81	4.31	24.139	0.147	0.0	0.0	8.7	2.44	97.0	52.3
1.004	101.10	5.62	22.188	0.577	0.0	0.0	31.6	2.10	232.3	189.7
3.000	109.57	4.34	24.514	0.227	0.0	0.0	13.5	3.10	123.1	80.9
3.001	108.84	4.44	21.953	0.227	0.0	0.0	13.5	2.18	86.5	80.9
1.005	100.08	5.79	21.395	0.939	0.0	0.0	50.9	4.25	469.6	305.4

Network Design Table for SW_2

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.006	61.013	1.525	40.0	0.170	0.00	0.0	0.150	o	375	Pipe/Conduit	
1.007	11.709	0.781	15.0	0.025	0.00	0.0	0.150	o	375	Pipe/Conduit	
1.008	25.252	1.263	20.0	0.424	0.00	0.0	0.150	o	375	Pipe/Conduit	
1.009	22.990	0.858	26.8	0.000	0.00	0.0	0.150	o	450	Pipe/Conduit	
1.010	21.084	0.210	100.4	0.000	0.00	0.0	0.150	o	525	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.006	98.34	6.09	19.636	1.108	0.0	0.0	59.0	3.35	370.2	354.3
1.007	98.14	6.13	18.111	1.133	0.0	0.0	60.3	5.50	607.9	361.5
1.008	97.65	6.21	17.330	1.558	0.0	0.0	82.4	4.76	525.7	494.4
1.009	97.19	6.30	16.068	1.558	0.0	0.0	82.4	4.59	730.5	494.4
1.010	96.46	6.43	15.210	1.558	0.0	0.0	82.4	2.59	559.6	494.4

PIPELINE SCHEDULES for SW_2

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	225	S26	25.030	23.517	1.288	Open Manhole	1200
1.001	o	225	S25	24.626	23.170	1.232	Open Manhole	1200
1.002	o	225	S24	23.649	22.387	1.037	Open Manhole	1200
1.003	o	300	S23	23.861	22.316	1.245	Open Manhole	1200
2.000	o	225	S22.1	25.578	24.139	1.214	Open Manhole	1200
1.004	o	375	S22	24.196	22.188	1.633	Open Manhole	1350
3.000	o	225	S21.2	25.768	24.514	1.029	Open Manhole	1200
3.001	o	225	S21.1	23.578	21.953	1.400	Open Manhole	1200
1.005	o	375	S21	23.063	21.395	1.293	Open Manhole	1350
1.006	o	375	S20	21.250	19.636	1.239	Open Manhole	1350
1.007	o	375	S19	20.429	18.111	1.943	Open Manhole	1350
1.008	o	375	S18	19.861	17.330	2.156	Open Manhole	1350
1.009	o	450	S17	18.625	16.068	2.107	Open Manhole	1350
1.010	o	525	S16	17.758	15.210	2.023	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	17.375	50.0	S25	24.626	23.170	1.232	Open Manhole	1200
1.001	39.104	50.0	S24	23.649	22.387	1.037	Open Manhole	1200
1.002	14.239	200.0	S23	23.861	22.316	1.320	Open Manhole	1200
1.003	25.573	199.8	S22	24.196	22.188	1.708	Open Manhole	1350
2.000	45.784	40.0	S22	24.196	22.994	0.977	Open Manhole	1350
1.004	79.274	100.0	S21	23.063	21.395	1.293	Open Manhole	1350
3.000	64.025	25.0	S21.1	23.578	21.953	1.400	Open Manhole	1200
3.001	12.998	50.0	S21	23.063	21.693	1.145	Open Manhole	1350
1.005	43.979	25.0	S20	21.250	19.636	1.239	Open Manhole	1350
1.006	61.013	40.0	S19	20.429	18.111	1.943	Open Manhole	1350
1.007	11.709	15.0	S18	19.861	17.330	2.156	Open Manhole	1350
1.008	25.252	20.0	S17	18.625	16.068	2.182	Open Manhole	1350
1.009	22.990	26.8	S16	17.758	15.210	2.098	Open Manhole	1500
1.010	21.084	100.4	S15	16.200	15.000	0.675	Open Manhole	1200

Free Flowing Outfall Details for SW_2

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.010	S15	16.200	15.000	0.000	1200	0

Simulation Criteria for SW_2

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	20.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	5	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	15.600	Storm Duration (mins)	30
Ratio R	0.272		

APPENDIX H

Surface Water Network Critical Storm Calculations

Summary of Critical Results by Maximum Level (Rank 1) for SW_1

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	20.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 15.600 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.272 Cv (Winter) 0.750

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	100
Climate Change (%)	20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	S14	15 Summer	100	+20%	100/15 Summer				24.333	0.290	0.000
2.000	S13.1	15 Summer	100	+20%					24.428	-0.050	0.000
1.001	S13	15 Summer	100	+20%	100/15 Summer				24.183	0.294	0.000
3.000	S12.1	15 Summer	100	+20%	100/15 Summer				24.411	0.394	0.000
1.002	S12	15 Summer	100	+20%	100/15 Summer				24.009	0.230	0.000
1.003	S11	15 Summer	100	+20%	100/15 Summer				23.886	0.155	0.000
1.004	S10	15 Summer	100	+20%	100/15 Summer				23.743	0.087	0.000
1.005	S9	15 Summer	100	+20%	100/15 Summer				23.588	0.057	0.000
4.000	S8.2	15 Summer	100	+20%	100/15 Summer				23.813	0.178	0.000
4.001	S8.1	15 Summer	100	+20%	100/15 Summer				23.632	0.164	0.000
1.006	S8	15 Summer	100	+20%	100/15 Summer				23.440	0.118	0.000
1.007	S7	15 Summer	100	+20%	100/15 Summer				22.749	0.201	0.000
1.008	S6	30 Summer	100	+20%	100/15 Summer				22.128	0.528	0.000
1.009	S5	15 Summer	100	+20%	100/15 Summer				21.621	0.063	0.000
1.010	S4.1	15 Summer	100	+20%	100/15 Summer				21.157	0.061	0.000
1.011	S4	30 Summer	100	+20%					20.729	-0.193	0.000
1.012	S3	30 Summer	100	+20%					20.135	-0.380	0.000
1.013	S2	15 Summer	100	+20%					17.137	-0.314	0.000

Summary of Critical Results by Maximum Level (Rank 1) for SW_1

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S14	0.84		37.9	SURCHARGED	
2.000	S13.1	0.70		55.0	OK	
1.001	S13	0.88		106.7	SURCHARGED	
3.000	S12.1	1.06		98.6	FLOOD RISK	
1.002	S12	1.31		208.2	SURCHARGED	
1.003	S11	1.32		219.8	SURCHARGED	
1.004	S10	1.09		217.2	SURCHARGED	
1.005	S9	0.89		230.6	SURCHARGED	
4.000	S8.2	1.26		176.7	SURCHARGED	
4.001	S8.1	0.98		158.2	SURCHARGED	
1.006	S8	1.13		412.8	SURCHARGED	
1.007	S7	1.14		416.5	SURCHARGED	
1.008	S6	2.21		424.2	SURCHARGED	
1.009	S5	0.91		511.3	SURCHARGED	
1.010	S4.1	1.22		508.8	SURCHARGED	
1.011	S4	0.80		510.3	OK	
1.012	S3	0.29		510.2	OK	
1.013	S2	0.46		506.1	OK	

Summary of Critical Results by Maximum Level (Rank 1) for SW_2

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	20.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 15.600	Cv (Summer) 0.750
Region	Scotland and Ireland	Ratio R 0.272	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	100
Climate Change (%)	20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	S26	15 Winter	100	+20%					23.586	-0.156	0.000
1.001	S25	15 Winter	100	+20%					23.280	-0.115	0.000
1.002	S24	15 Winter	100	+20%	100/15 Summer				23.105	0.492	0.000
1.003	S23	15 Winter	100	+20%	100/15 Summer				23.060	0.443	0.000
2.000	S22.1	15 Winter	100	+20%					24.286	-0.078	0.000
1.004	S22	15 Winter	100	+20%	100/15 Summer				22.980	0.417	0.000
3.000	S21.2	15 Winter	100	+20%					24.681	-0.058	0.000
3.001	S21.1	15 Winter	100	+20%	100/15 Summer				22.600	0.422	0.000
1.005	S21	15 Winter	100	+20%	100/15 Summer				22.273	0.502	0.000
1.006	S20	15 Winter	100	+20%	100/15 Summer				21.221	1.210	0.000
1.007	S19	15 Winter	100	+20%	100/15 Summer				19.417	0.931	0.000
1.008	S18	15 Winter	100	+20%	100/15 Summer				18.569	0.863	0.000
1.009	S17	15 Winter	100	+20%	100/15 Summer				16.776	0.258	0.000
1.010	S16	15 Winter	100	+20%	100/15 Summer				15.944	0.209	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S26	0.21		15.6	OK	
1.001	S25	0.48		38.9	OK	
1.002	S24	0.97		34.5	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for SW_2

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.003	S23	0.84		65.6	SURCHARGED	
2.000	S22.1	0.75		68.6	OK	
1.004	S22	1.04		226.6	SURCHARGED	
3.000	S21.2	0.90		106.0	OK	
3.001	S21.1	1.46		103.8	SURCHARGED	
1.005	S21	0.81		337.1	SURCHARGED	
1.006	S20	1.09		371.1	FLOOD RISK	
1.007	S19	1.14		394.4	SURCHARGED	
1.008	S18	1.18		512.3	SURCHARGED	
1.009	S17	0.98		512.3	SURCHARGED	
1.010	S16	1.46		512.6	SURCHARGED	

APPENDIX I

Water Demand Calculations

TITLE		Job Reference
Proposed Residential Development Hackettstown, Skerries, Co Dublin		190170
SUBJECT		**Calc. Sheet No.**
Water Demand - Post Development Residential		1

DRAWING NUMBER	Calculations by	Checked by	Date
190170-DBFL-WM-SP-DR-C-1031	RSP	LMcL	08.03.22

DEMAND

Housing Units	345	no.
Daily Demand per person	150	litres/person/day
Average Occupancy Ratio[1]	2.7	person/unit
Total Site Occupancy	932	people
Average Daily Demand	139,725	l/day
Average Day in Peak Week[2]	174,656	l/day
Normal Length of Day[3]	12	hours
Peak Factor[4]	4.5	

Post Development Peak Water Demand[5]	**9.1**	l/s
Post Development Average Water Demand	**1.6**	l/s
Normal Demand[6]	**3.2**	l/s

Notes:

1. Occupancy ratio of 2.7 persons per dwelling from Irish Water Code of Practice for Water Infrastructure.
2. Average Day in Peak Week is 1.25 times the average daily demand.
3. Assumed normal demand is the total daily demand during the normal length of day.
4. Peak Factor for pipe sizing from Irish Water Code of Practice for Water Infrastructure
5. Peak Factor multiplied by Average Day in Peak Week flow
6. Normal demand is the total daily demand during the normal length of day.
7. Fire flow is required at 25l/s as per B.S. 5306-1:1976.

TITLE		Job Reference
Proposed Residential Development At Hackettstown, Skerries, Co. Dublin		190170
SUBJECT		**Calc. Sheet No.**
Water Demand - Post Development Creche		2

DRAWING NUMBER	Calculations by	Checked by	Date
190170-DBFL-WM-SP-DR-C-1031	RSP	LMcL	08.03.22

DEMAND

			Daily Demand per person[1]	
Day Staff	10	people	50	litres/person/day
Children	40	people	50	litres/person/day

Average Daily Demand	2,500	l/day
Average Day in Peak Week[2]	3,125	l/day
Normal Length of Day[3]	12	hours
Peak Factor[4]	5.0	

Post Development Peak Water Demand[5]	**0.181**	l/s
Post Development Average Water Demand	**0.029**	l/s
Normal Demand[6]	**0.058**	l/s

Notes:

1. Daily Demand per person is 50 litres/person/day for Staff taken from Irish Water "Code of Practice for Wasterwater Infrastructure".
2. Average Day in Peak Week is 1.25 times the average daily demand.
3. Assumed normal demand is the total daily demand during the normal length of day.
4. Peak Factor of 2.1 assumed due to size of development.
5. Peak Factor multiplied by Average Day in Peak Week flow
6. Normal demand is the total daily demand during the normal length of day.
7. Fire flow is required at 25l/s as per B.S. 5306-1:1976.