BARRETT MAHONY
CIVIL & STRUCTURAL
CONSULTING ENGINEERS

Civil Engineering & Transport Infrastructure Report

Project: 20.170

Dundrum Central Development

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1. INTRODUCTION

1.1 General Description

A Part 10 Planning Application to An Bord Pleanála is to be made for a development on lands at the former Central Mental Hospital, Dundrum Road, Dundrum, Dublin 14, a site of circa.9.7 ha. Tom Phillips + Associates, Town Planning Consultants, is instructed by Dún Laoghaire Rathdown County Council (referred to from hereon as the 'Applicant'), in partnership with The Land Development Agency (LDA), to submit this Part 10 Application to An Bord Pleanála. This application, taken on jointly by the LDA & DLRCC, forms part of DLRCC's goals under their 2022-2028 Development Plan.

Barrett Mahony Consulting Engineers (BMCE) are the civil and structural design engineers for the project and have been commissioned to prepare a Civil Engineering & Transport Infrastructure Report as part of the planning application package.

Figure 1.1 – Site Location (note: the red line boundary shown here is approximate only)

<u>Project Description:</u>
The development will consist of the construction of a residential scheme of 934 no. dwellings on an overall site of c. 9.7 ha.
The development will consist of the demolition of existing structures associated with the existing use (3,677 sq m), including:

- Single storey former swimming pool / sports hall and admissions unit (2,750 sq m);
- Two storey redbrick building (305 sq m);
- Single storey ancillary and temporary structures including portacabins (618sq m);

- Removal of existing internal sub-divisions/ fencing, including removal of security fence at Dundrum Road entrance;
- Demolition of section of porch and glazed screens at Gate Lodge building (4 sq m);
- Removal of walls adjacent to Main Hospital Building;
- Alterations and removal of section of wall to Walled Garden.

The development will also consist of alterations and partial demolition of the perimeter wall, including:

- Alterations and removal of section of perimeter wall adjacent to Rosemount Green (south);
- Formation of a new opening in perimeter wall at Annaville Grove to provide a pedestrian and cyclist access;
- Alterations and removal of sections of wall adjacent to Dundrum Road (including removal of existing gates and entrance canopy), including reduction in height of section, widening of existing vehicular access, and provision of a new vehicle, cyclist and pedestrian access;
- Alterations and removal of section of perimeter wall adjacent to Mulvey Park to provide a pedestrian and cyclist access.

The development with a total gross floor area of c. 94,058 sq m (c. 93,980 sq m excluding retained existing buildings), will consist of 934 no. residential units comprising:

- 926 no. apartments (consisting of 342 no. one bedroom units; 98 no. two bedroom (3 person) units; 352 no. two bedroom (4 person) units; and 134 no. three bedroom units) arranged in 9 blocks (Blocks 02-10) ranging between 2 and 8 storeys in height (with a lower ground floor to Blocks 02 and Block 10 and Basements in Blocks 03 and 04), together with private balconies and private terraces and communal amenity open space provision (including courtyards) and ancillary residential facilities, including an 130 sq m internal residential amenity area at the Ground Floor Level of Block 3;
- 6 no. three bedroom duplex apartments located at Block 02, together with private balconies and terraces.
- 2 no. 5 bedroom assisted living units and private rear gardens located at Block 02.

The development will also consist of 4,380 sq m of non-residential uses, comprising:

- Change of use and renovation of existing single storey Gate Lodge building (former reception/staff area) to provide a café unit (78 sq m);
- 1 no. restaurant unit (266 sq m) located at ground floor level at Block 03;
- 3 no. retail units (1,160 sq m) located at ground floor level at Blocks 03 and 07;
- 1 no. medical unit (288 sq m) located at ground floor level at Block 02;
- A new childcare facility (716 sq m) and associated outdoor play area located at lower ground and ground floor level at Block 10;
- A management suite (123 sq m) located at ground floor level at Block 10; and
- A new community centre facility, including a multi-purpose hall, changing rooms, meeting rooms, storage and associated facilities (1,749 sq m) located at ground and first floor level at Block 06.

Vehicular access to the site will be from a new signalised access off Dundrum Road to the south of the existing access and the existing access of Dundrum Road will be retained for emergency vehicle, pedestrian and cyclist access only. The development will also consist of the provision of public open space and related play areas; hard and soft landscaping including internal roads, cycle and pedestrian routes, active travel routes for cyclists and pedestrians, pathways and boundary treatments, street furniture, wetland features, part-basement, car parking (524 no. spaces in total, including car sharing and accessible spaces); motorcycle parking; electric vehicle charging points; bicycle parking (long and short stay spaces including stands); ESB substations, piped infrastructural services and connections (including connection into existing surface water sewer in St. Columbanus Road); ducting; plant (including external plant for Air Source Heat Pumps and associated internal heating plantrooms); waste management provision; SuDS measures (including green roofs, blue roofs, bio-retention areas); attenuation tanks; sustainability measures (including solar panels); signage; public lighting; any making good works to perimeter wall and all site development and excavation works above and below ground.

Please note that the subject site is in the immediate setting and curtilage of a number of protected structures, namely the 'Asylum' (RPS No. 2072), the 'Catholic Chapel' (RPS No. 2071) and the 'Hospital Building' (RPS No. 2073).

Construction of the development involves the following principal elements:

- Demolition of the existing buildings, excluding structures to be retained.
- Removal of sections of the perimeter wall.
- Site strip. Earthworks associated with the construction of the buildings and roads in the development.
- Construction of new buildings – apartments, the community facility & ancillary buildings.
- Construction of roads, footpaths & hard/soft landscaping.
- Buried site services installation. New foul pumping stations. Connection to public services.
- Works to the Dundrum Road along the site boundary, including modifying the existing site entrance and construction a new road entrance.

Figure 1.2 Site Layout Plan

1.2 Purpose of this Report

This report considers the proposed development's main infrastructural elements and how they will connect to the public infrastructure in the area.

In particular, foul and surface water drainage, water supply and roads engineering aspects are addressed. This report should be read in conjunction with the engineering drawings submitted with the planning application.

The impact of the proposed phasing of the development on the site infrastructure is addressed in Section 6 of this report.

1.3 Previously Granted SHD

An SHD Planning Application was lodged with An Bord Pleanála in 2022. This application was for 977 no. units and ancillary facilities. Planning was granted by the Bord, ABP reference ABP-313176-22, subject to a number of conditions.

The overall site layout and layout of the residential blocks for the new Part 10 application is very similar to the layout submitted as part of the SHD. Ground floor levels are generally unchanged.

The buried foul drainage, surface water drainage and watermain layout are similar to those proposed for the SHD scheme. The SuDS layout is also very similar to that prepared for the SHD application.

1.4 References

- DLRCC Development Plan 2022-2028 in particular Appendix 7
- Greater Dublin Strategic Drainage Study (GDSDS) Regional Drainage Policies Technical Document – Volume 2, New Developments, 2005'
- Greater Dublin Regional Code of Practice for Drainage Works, V6.0 2005.
- CIRIA Design Manuals C753, C697 and C609
- BRE Digest 365

1.5 Engagement with the Local Authority

Extensive meetings and email correspondence was carried out during the previous SHD process between Barret Mahony & DLR Drainage Planning, Municipal Services Department. Queries raised during the SHD process were addressed. The proposed new development is very similar in terms of surface water drainage/SuDS to the granted SHD scheme, incorporating DLR comments from that scheme. Further engagement between DLR Drainage Department & Barrett Mahony has taken place via a phone discussion and email correspondence to ensure that the proposed Part 10 scheme meets the requirements of the department.

As set out in Section 1.6 below, a Stage 1 Stormwater Audit was completed and forwarded to DLR Drainage Department.

The text below in italics is taken from an email from DLR Drainage to Barrett Mahony on the 6th of September 2024 following a review by them of the final pack of surface water drainage and SuDS information from Barrett Mahony.

The report/drawings provide an appropriate level of detail for the planning design stage of the proposed development. In order to satisfy the requirements of the local authority, the application will be subject to a number of standard conditions.

In their correspondence of the 6th of September DLR Drainage Department set out a number of standard requirements. These are shown in Appendix 9 of this report. They will be addressed at detailed design stage prior to construction commencement and prior to the Stage 2 Stormwater Audit (ref Section 1.6 below).

1.6 STORMWATER AUDIT

In accordance with the requirements of Appendix 7 Section 7.1.5 of the DLRCC Development Plan, a Stage 1 (Pre-Application Stage) Stormwater Audit of the project is to be prepared by an independent consulting engineer. JBA Consulting engineers have been engaged on the Dundrum project to carry out this audit. Extract from Section 7.1.5 shown below.

Scope of Audit: The scope of the Stormwater Audit process is to ensure the drainage proposals for the subject development is assessed for conformity with the recommendations of the following:

- *Greater Dublin Strategic Drainage Strategy (GDSDS)*
- *The SuDS Manual (CIRIA C753)*
- *Green Roof Policy document*
- *Stormwater Management Policy*
- *Greater Dublin Regional Code of Practice for Drainage Works*
- *BRE Digest 365*

The Part 10 planning application is in partnership with DLRCC (applicant) and LDA (agent). The audit has been prepared specifically as a technical review for the DLR Drainage Planning, Municipal Services Department in the standard manner applicable to all planning applications. The audit has been carried out by JBA and the JBA report is contained in Appendix 8 of this report. The report includes a table of queries from JBA and responses to these queries by BM. Please note that the Green Roof Policy document referred to above is now incorporated into the DLRCC DP Appendix 7.2.

DLR Drainage Planning, Municipal Services Department reviewed the completed audit and noted that they were satisfied with it. Refer to Appendix 9 for the text of the email. There are a number of items that will be examined again at detailed design stage prior to the Stage 2 Stormwater Audit.

2. SITE TOPOGRAPHY

A detailed topographical survey of the existing site has been prepared. There is considerable variation in ground levels across the site. In broad terms the main part of the site slopes down gradually from the southwest corner towards the northeast corner, from +45.21m OD down to +39.76m OD. The western portion of the site slopes down towards the Dundrum Road entrance at +38.44m OD. These low points are the furthest locations from the high topography in the south corner at a distance of 410m and 430m away respectively. Figure 2.1 shows typical spot levels across the site. Refer to the topographical survey plan for further information,

In the proposed new development, the site levels typically follow the existing site topography.

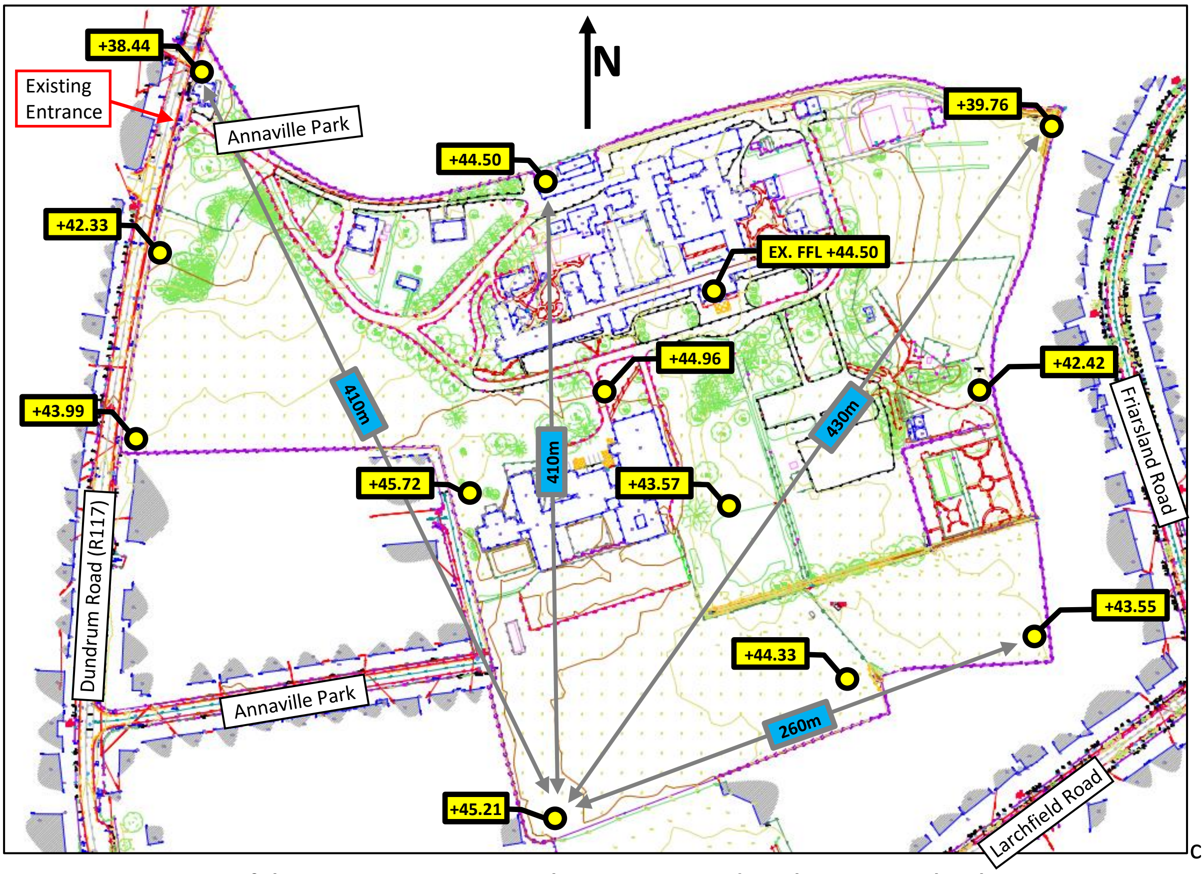


Fig 2.2. Summary of the Existing Site Topography Superimposed on the Topographical Survey Drawing. (Ordnance Datum Levels).

3. SURFACE WATER DRAINAGE SYSTEM

3.1 Introduction

This chapter follows the guidelines set out in the documents referenced in Section 1.4 above.

The aim of any SuDS strategy is to ensure that a new development does not negatively affect surrounding watercourse systems, existing surface water networks and groundwater systems. This SuDS strategy will achieve these aims by using a variety of SuDS measures within the site. These measures include water interception, treatment, infiltration and attenuation.

The SuDS strategy will be developed with the following steps:

1. The existing greenfield run-off of the development site is calculated in Section 3.3.3 of this report in the standard manner and this is used as the minimum benchmark for the SuDS design. This run-off calculation is based on the drained area of the new development. The post development run-off will not exceed the greenfield run-off.
2. A set of SuDS measures will be chosen based on their applicability and usage for the site.
3. A “FLOW” model will be created to analyse the rainfall on the site and the effectiveness of the proposed SuDS measures.
4. If effective, these SuDS measures will be incorporated into the proposed design.

3.2 Existing Surface Water Infrastructure

The lands/roads surrounding the site contain a number of surface water sewers and a combined sewer. The River Slang runs south to north, approximately 70m to the west of the site and a drainage ditch runs through the site and northwards along the eastern boundary as shown in Figure 3.1.

3.2.1 Existing Site Drainage

Existing site drainage confirmed by CCTV and dye testing have shown the existing buildings on site discharging to a combined drainage system on site. This system discharges to the Ø300mm combined sewer in the Dundrum Road, connecting at the current site entrance.

3.2.2 Existing Surface Water Drainage in The Vicinity of The Site:

a) The River Slang: The River Slang runs from south of Dundrum Village northwards down to the River Dodder and passes approximately 70 metres west of the western site boundary on the Dundrum Road. The estimated 100-year storm level in the river is approximately 1.5metres lower than the lowest point of the site, at the existing Dundrum Road entrance. Predicted floods, for storms with 1 in 10, 1 in 100 & 1 in 1000-year return periods are shown on the OPW CFRAMS Flood Maps. This flooding does not encroach on the subject site. Refer to the Site-Specific Flood Risk Assessment for further information.

b) Public Sewer and drainage ditch on the south and east boundary: A 525mm diameter surface water sewer enters the south side of the site from Rosemount Green. Refer to Figure 3.1 below. This connects into an open drainage ditch which runs west to east across the site along the southern edge of the walled garden and discharges through a grated opening in the boundary wall (Location 'B1' in Figure 2.1 below) where it continues as a drainage ditch running northwards just along and outside of the east boundary wall. Tailte Éireann maps indicate that the drainage ditch is in third party ownership along the outside of the wall. There are no records of flooding in this watercourse. Flow monitoring in the ditch by LowFlo Ltd was carried out close to Location 'B1'. Refer to the report in Appendix 3. The report indicates that there is a correlation between the flow in the channel and rainfall events.

3.2.3 Drainage Ditch flood level

The Lowflo flow logger results showed that the depth of water in the drainage ditch varied between 25mm and 180mm during the two and a half months of recordings. The drainage ditch is approximately 1m deep. In the case that the level in the ditch rises, the head of water in the pipe network discharging to it, will be sufficient to push the water through and out into the ditch. At no point, during various site visits between 2020 & 2024 have we, Barrett Mahony, observed more that a 200mm depth of flow in the channel.

Fig 3.1. Aerial View of the Approximate Natural Catchment Areas and surface water drainage outfalls on the Existing Site. Catchment 1 shaded yellow. Catchment 2 is in the unshaded area.

Photos 3.1 & 3.2. Existing drainage openings through the eastern perimeter wall. B1 on the right. B2 on the left (ref Fig 3.1)

3.3 Proposed Surface Water Drainage System

The proposed surface water drainage system is designed to comply with the documents listed in Section 1.4 of this report.

3.3.1 Catchment strategy

The site is split into three catchments for design purposes. The catchments will be attenuated separately by means of blue roofs and attenuation tanks. The catchments follow approximately the existing site topography and natural drainage routes on site set out in the preceding section. Catchment A drains to the River Slang, via an existing surface water sewer. Catchments B & C drain to an existing open drainage ditch. Connection points 'A', 'B1' and 'B2' shown in Figure 3.1. B1 takes Catchment B, while B2 takes Catchment C.

3.3.2 Catchment Area

The total site area is c9.6ha inside the boundary wall.
The positively drained area on site is approximately 6.4ha, comprising of Catchment A (1.41ha), Catchment B (4.01ha) and Catchment C (0.98ha). The drainage system involves a robust suite of SuDS measures in the treatment train, which will influence on the runoff coefficients. The more porous the material, the lower the runoff coefficient. Surface materials will consist of, but not limited to, permeable paving, intensive and extensive green/blue roofs and podiums, impermeable roofs, bio-retention areas, filter strips, a detention basin, impermeable hardstanding, tree pits and landscaped areas. Please refer to the BM SuDS layout drawing C11030 for further information.

The runoff coefficients used in the calculations are as requested by DLR:

Table 3.1: Runoff Coefficients

Type of areas	CV
Landscaping (Grass / Soft)	0.3
Intensive Green Roof / Podium	0.8
Extensive Green Roof	0.8
Permeable Paving	0.8
Impermeable Surface (incl tree pits)	0.9
Standard Roof (impermeable)	0.95

Please refer to Appendix 7 for a tabulated schedule of all the contributing areas.

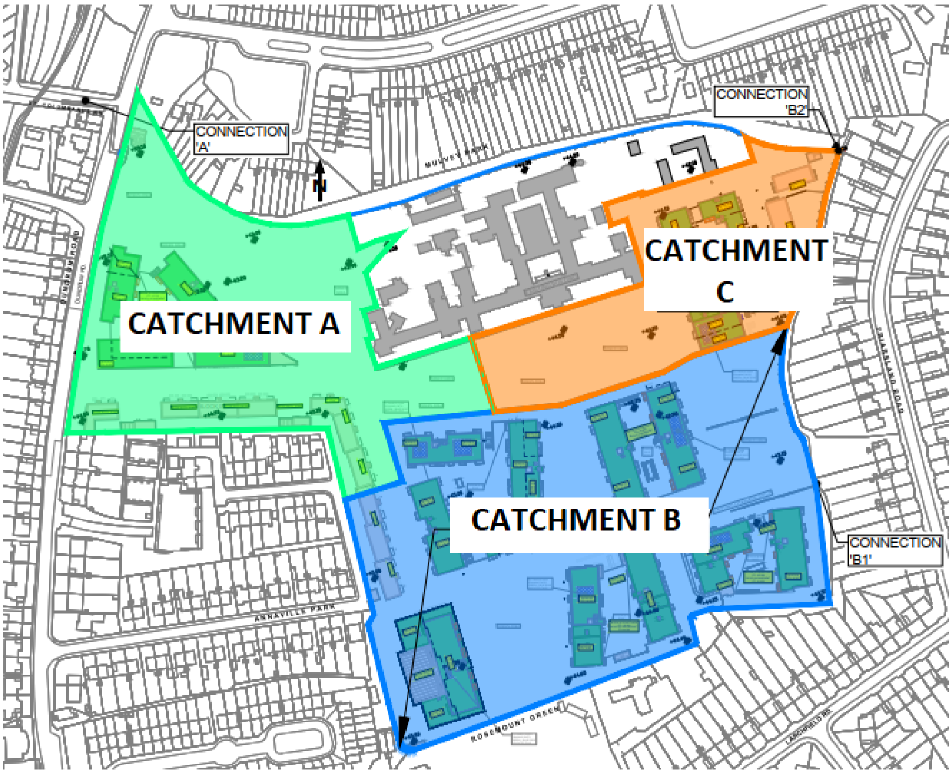


Figure 3.2 – Catchment Strategy. Note that existing retained green areas within each catchment are positively drained and are not included in the drained area calculations in this report (Table 3.2).

3.3.3 Estimation of greenfield runoff rate

In accordance with the standard UK Institute of Hydrology method, the IH124 method, the greenfield runoff for existing undeveloped sites measuring less than 50ha can be estimated using the following formula:

$Qbar_{rural}$ (in m^3 /s) = $0.00108 \times (0.01 \times AREA)^{0.89} \times SAAR^{1.17} \times SPR^{2.17}$

where:

- $Qbar_{rural}$ is the mean annual flood flow from a catchment
- AREA is the area of the catchment in ha.
- SAAR is the standard average annual rainfall for the period 1981-2010 Annual Average Rainfall Grid produced by Met Éireann.
- SPR is Standard Percentage Runoff coefficient for the SOIL category – geotechnical site investigations indicate generally impermeable underlying clays on site. SOIL type of 4 (SPR = 0.47) is therefore considered appropriate for the site.

Rainfall data for the site was sourced from an Annual Average Rainfall (AAR) Grid (1991-2020) produced by Met Éireann. The rainfall data for the Irish Grid Coordinates closest to the site indicates a SAAR value of **800mm** is appropriate.

Therefore, $Qbar_{rural}$ for a 50ha site has been calculated as follows:

$Qbar_{rural}$ (for a 50ha site) = $0.00108 \times (0.01 \times 50)^{0.89} \times 800^{1.17} \times 0.47^{2.17}$

$Qbar_{rural}$ (for a 50ha site) = 0.28221 m^3 /s

= 282.211 l/s

Interpolating linearly, this corresponds with a Qbar figure for the drained area (6.4ha) of 36.1l/s. The discharge limit to the site has been taken as a conservative 32.4 l/s. The runoff rate for each catchment is set out in the table below:

Table 3.2 Runoff rate per catchment

Catchment	Area (m^2)	Positively Drained Area (m^2)	Calculated Qbar (l/s)	Proposed Qbar (l/s)
Catchment A	29 747	14 079	7.95	7.9
Catchment B	47 961	40 089	22.63	20.5
Catchment C	17 788	9831	5.55	4.0
Total	95 496*	63999	36.1l/s	32.4l/s

**Please note, the red line has an area outside of the drained catchment area upgrade works on the Dundrum Road and for the surface water drainage connection in the public road to the surface water sewer in St Columbanus Road. These areas are not included in the drained areas in Table 3.2.*

3.3.4 Compliance with the Principles of SuDS

3.3.4.1 Compliance with the principles of the GDSDS

The proposed development will be designed in accordance with the principles of Sustainable Drainage Systems (SuDS) as embodied in the recommendations of the Greater Dublin Strategic Drainage Study (GDSDS) and will significantly reduce run-off rates and improve storm water quality discharging to the public storm water system. The GDSDS addresses the issue of sustainability by requiring designs to comply with a set of drainage criteria which aim to minimize the impact of urbanization by replicating the run-off characteristics of the greenfield site, as per the catchment strategy/areas set out in Section 3.3.1/3.3.2 and greenfield run-off rates calculations set out in Section 3.3.3. The criteria provide a consistent approach to addressing the increase in both rate and volume of run-off, as well as ensuring the environment is protected from any pollution from roads and buildings. These drainage design criteria are as follows:

- Criterion 1 – River Water Quality Protection
- Criterion 2 – River Regime Protection
- Criterion 3 – Flood Risk Assessment
- Criterion 4 – River Flood Protection

The requirements of SuDS are typically addressed by provision of the following:

- Interception storage
- Treatment storage (commonly addressed in interception storage)
- Attenuation storage
- Long term storage (not applicable if growth factors are not applied to Qbar when designing attenuation storage)

3.3.4.2 Compliance with the principles of the CIRIA C573 SuDS Manual

The C753 SuDS Manual explains that the primary function of SuDS measures is to protect watercourses from any impact due to the new development. However, SuDS can also improve the quality of life in a new development and urban spaces by making them more vibrant, visually attractive, sustainable and more resilient to change. This document explains the wider social context of SuDS and how SuDS can deliver high quality drainage while supporting urban areas to cope better with sever rainfall both in present and future.

There are four main categories of benefits that can be achieved by SuDS:

1. Water Quantity (mitigate flood risk & protect natural water cycle)
2. Water Quality (manage the quality of the runoff to prevent pollution)
3. Amenity (create and sustain better places for people)
4. Biodiversity (create and sustain better places for nature)

3.3.5 SuDS Measure Selection

Below are the applicable SuDS measures which have been chosen for the site. The proposed site has been divided into 3no sub-catchment areas. Sub catchment A is the north-western part of the site, connecting into the public surface water sewer network at Dundrum Road, adjacent to the discharge point into the River Slang. Sub catchment B1 and B2 will drain the remainder of the site, connecting to the existing drainage ditch on the eastern side of the site.

The runoff generated from the catchments will be attenuated in storage structures below ground and in the blue roof attenuation systems. The proposed attenuation systems are explained in section 3.4.4.

A wide range of SuDS measures are proposed across the site to maximise interception and treatment.

3.3.5.1 Green Roofs – General

Green roofs are areas of living vegetation, installed on the top of buildings. They provide water quality, water quantity, amenity and provide biodiversity benefits. Green roofs also intercept rainfall at source reducing the reliance on attenuation storage structures. Blue roofs are roof level rainwater storage systems with a controlled outflow rate to the receiving system.

Refer to the Barrett Mahony SuDS detail drawing no. 11205 for typical roof details.

3.3.5.2 Green Roof/Podium – Extensive:

Extensive roofs have low substrate depths and therefore low loadings on the building structure, they are lightweight and have a low cost to maintain. These systems cover the entire roof area with hardy, slow growing, drought resistance, low maintenance plants and vegetation, such as sedums. The planting usually matures slowly, with the long-term biodiverse benefits being the sought-after results. These roofs are typically only accessed for maintenance and are usually comprised of between 20mm – 150mm overall total depth.

Extensive green roofs have the effect of providing some initial storage of rainwater, while also reducing the rate at which rainwater from heavier rainfall events will discharge to the main attenuation tank. It can also help to filter the run-off, removing any pollutants and resulting in a higher quality of water discharging to the drainage system. A typical extensive green roof system can intercept and retain over 30 litres/m² (i.e. 30 mm) depending on the build-up. Since these roofs are exposed to the Irish climate, there is a high probability that the roof will not be completely dry, and the storage capacity will be compromised on any given rainfall event. Thus, the more conservative estimate of 12 litres/m² (12mm) interception storage will be assumed.

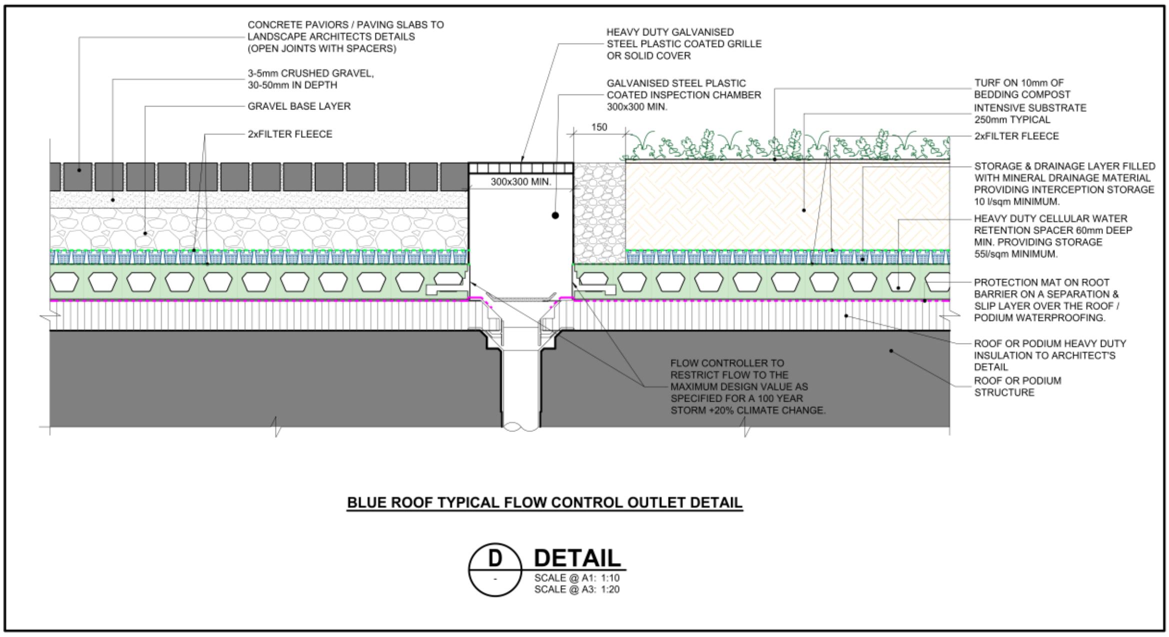


Figure 3.3 – Intensive Green Roof Detail with blue roof storage & outflow control

3.3.5.3 Green Roof – Intensive

Intensive green roofs are designed to sustain more complex landscaped environments that can provide high amenity and biodiverse benefits. They are planted with a range of plants, including grasses, shrubs, trees and may also include water features, as well as hard landscape paved areas. They are designed to be accessible and normally require regular maintenance.

Intensive paved soft landscaped roofs will be proposed on some of the apartment blocks roofs in the public amenity areas and in some courtyard podium areas over the basement car parking. The use of intensive green roofs will also allow the planting of large shrubs, small trees, and small water features within the podium area. These features improve the amenity value for the residents. The build-up selected for the Intensive Green Roof on the top of the roofs will include an interception tray to capture the first 12mm of rainfall falling on each roof, providing an intercept and retain capacity of 12 litres/m^2 (minimum). Refer to BM drawing C11205 for details.

3.3.5.4 Permeable Paving

Permeable paving provides a surface suitable for pedestrian and/or vehicular traffic, while also allowing rainwater to infiltrate through the surface and into the underlying structural layers. The water is temporarily stored beneath the overlying surface before slowly infiltrating. Permeable paving systems are an effective way of managing surface water runoff close to its source.

The car parking spaces, podium courtyards and footpaths throughout the site will be made up of permeable paving. The larger open spaces and car parking in Catchment A and B will be linked with the overall management train used in each respective catchment.

By providing a raised drainage outlet above the base of the coarse graded gravel bed it is possible to achieve interception storage. Raising the invert of the drainage pipe to 100mm above the gravel bed gives 30mm interception storage @ 30% voids in the gravel. Refer to BM drawing C11206 for details.

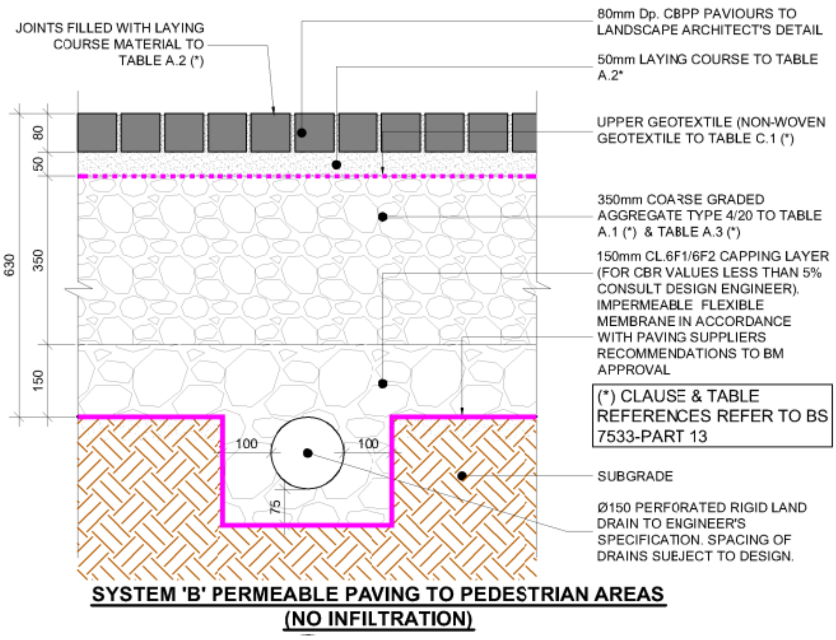


Figure 3.5 – Permeable Paving Build-up

3.3.6 Attenuation Devices

a) Buried Attenuation Storage Devices

Attenuation storage devices on this project are used to create below-ground void space for the temporary storage of surface water before infiltration and/or controlled release. An attenuation storage device can be constructed up using Stormtech arch type systems, which offer flexibility in size, shape and constructability of the tank. Detailed design of the tanks are by the tank supplier. Refer to BM drawing C11208 for typical details. Concrete tanks have also been used on site where the available space is constrained. Infiltration into the ground is not available with this type of storage device.

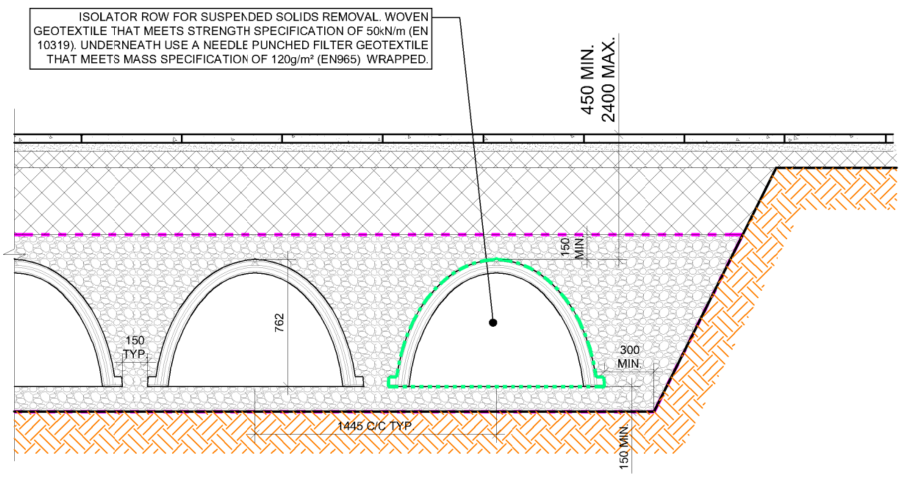


Figure 3.6 – Buried Stormtech type tank detail

b) Blue Roofs

A blue roof is a solution for urban areas where the available space for ground-based attenuation systems is limited. The blue roof will discharge water through an orifice control device to the surface water network. The blue roofs will be combined with the intensive and extensive green roof systems. Refer to Figure 3.3 above and BM drawing number C-11205 for details.

3.3.7 Bio-Retention and Tree Pits

The three catchments contain bio-retention areas and tree pits to treat and intercept runoff from neighbouring road surfaces and to take the rainwater from adjacent rainwater downpipes. These systems also allow some direct infiltration to the ground since they will be lined with permeable geotextile material. In each case there is a slotted drainage pipe above the base which collects and re-directs excess runoff to the stormwater network. For the location of these SuDS measures on BM drawings C11020 and C11030.

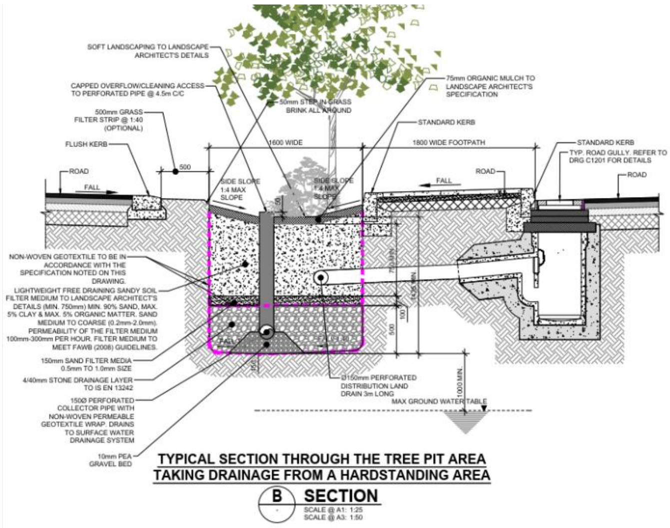


Figure 3.8 – Tree Pit Detail

3.3.8 Detention Basin

Detention systems are primarily designed to reduce runoff rate from a contributing drainage area. A detention basin treats and intercepts runoff. Infiltration can also occur. The detention basin proposed in the eastern part of the site will cater for the adjacent roads. This will allow road runoff to be treated and intercepted in the basin and be discharged in a controlled state. A lined pond feature is included here.

3.3.9 Filter Trenches

Filter Trenches systems are shallow landscaped depressions adjacent to the roadway. The trenches collect, intercepts and treat the road runoff. Filter trenches can reduce the runoff rates and volumes of surface water. They treat pollution using engineered soils and vegetation. They are very effective in delivering interception and treatment storage. By including filter strips within the depression, the effectiveness of the overall system in meeting the requirements of water quality, water quantity, amenity and biodiversity is significantly improved.

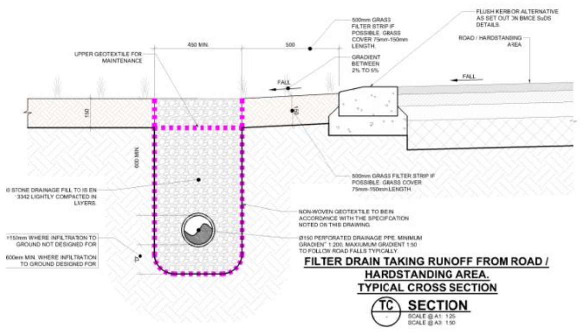


Figure 3.8 –Filter Drain Detail

3.4 SuDS Management Train

The SuDS measures proposed are linked in series, and this is commonly known as a SuDS Management Train, (SMT). The SMT ensures that rainwater falling on a site is captured, conveyed, stored, intercepted and removed of any pollutants, correctly and efficiently before it is discharged back into the surrounding water course of network.

A robust SMT will ensure that the most effective measures are utilised in the correct sequence throughout the site. Table 26.7 (Figure 3.10 below) in *(CIRIA, SuDS Manual 2015)* illustrates the effectiveness of each SuDS measure along the SMT.

3.4.1 Catchment A

The following flowchart was created to illustrate the drainage train that each block will use. This flowchart should be read in conjunction with the proposed drainage drawing C-11020 and SuDS layoutc C-11030 & C-11031.

Block 10 Green Roof → Bio Retention → Attenuation Tank H,J & L → SW Network → Sewer/R.Slang

Blocks 9 Apts → Perm.Paving & Tree Pits → Attenuation Tank J → SW Network → Drainage Ditch

Road Runoff → Tree Pits → Attenuation Tank H,J & L → SW Network → Sewer/R.Slang

3.4.2 Catchment B and C

The following flowchart was created to illustrate the drainage process that each block will use. This flowchart should be read in conjunction with the proposed drainage drawing.

Block 7 Green Roof → Podium Blue Roof → Attenuation Tank E → SW Network → Drainage Ditch

Proposed SuDS management trains on this site are as follows:

Type 1:
Type 2:
Type 3:
Type 4:
Type 5:

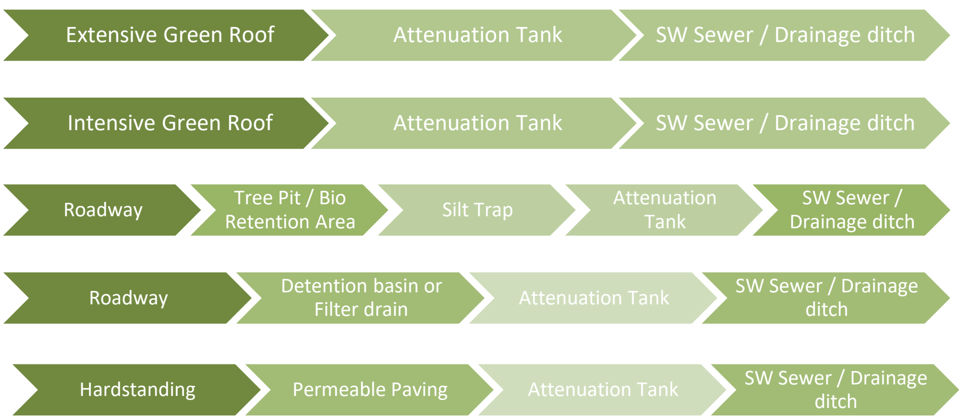


TABLE 26.7 Indicative suitability of SuDS components within the Management Train

SuDS component	Interception[1]	Close to source/ primary treatment	Secondary treatment	Tertiary treatment
Rainwater harvesting	Y			
Filter strip	Y	Y		
Swale	Y	Y	Y	
Filter drain	Y		Y	
Permeable pavement	Y	Y		
Bioretention	Y	Y	Y	
Green roof	Y	Y		
Detention basin	Y	Y	Y	
Pond	[3]	Y[2]	Y	Y
Wetland	[3]	Y[2]	Y	Y
Infiltration system (soakaways/ trenches/ blankets/basins)	Y	Y	Y	Y
Attenuation storage tanks	Y[4]			
Catchpits and gullies		Y		
Proprietary treatment systems		Y[5]	Y[5]	Y[5]

Figure 3.10 - C753 SuDS Manual Table 26.7

3.4.3 SuDS Pollutant Analysis

To ensure that the SuDS measures proposed are sufficient in removing pollutants from the generated run-off, a SuDS pollutant analysis has been carried out in accordance with the guidelines and steps set out in Section 26.7 of CIRIA SuDS Manual (2015).

The main form of pollutant is from surface water run-off from roofs, roads and driveways. Table 26.2 of CIRIA SuDS Manual 2015 highlights the pollution hazards for different land uses (extract below Figure 2.4). The pollution hazards on site are generally 'very low" from roofs. Roads are classed as 'Low'.

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4

Figure 3.11 – C753 SuDS Manual Table 26.2 Extract

Given that a very low to low pollution index applies, then the 'Simple Index Approach,' is applied and can be summarised below.

Total SuDS Mitigation Index ≥ Pollution Hazard Index

The extensive use of SuDS measures throughout the site and the 'Low' or 'Very Low' pollution index associated with the site usages – residential roofs, residential roads, ensures that the SuDS Mitigation index will exceed the Pollution Hazard Index throughout the site.. Using Table 26.2 and Table 26.3, from the SuDS manual we can compare the mitigation index for permeable paving (taking road drainage) with the hazard index for Roads:

Table 3.3 - Pollution Hazard Assessment for road drained through permeable paving

	Total SuDS Mitigation Index (Table 26.3)		Pollution Hazard Index (Table 26.2)	Status
Total Suspended Solids	0.7	>	0.5	O.K.
Metals	0.6	>	0.4	O.K.
Hydrocarbons	0.7	>	0.4	O.K.

From Table 2-2 above it is clear that the SuDS strategy for the site is effective in removing pollutants from the surface water and therefore protecting downstream watercourses.

3.4.4 Surface Water Attenuation Storage

The GDSDS requires that flood waters be managed within the site for a 1 in 100-year flood + 20% climate change factor – the climate change factor is as per the guidelines in Section 3.12 of the GDSDS. The surface water from each sub-catchment will flow into an attenuation tank or detention basin, which has been designed for that drained area.

The surface water system within each catchment has been hydraulically modelled in CAUSEWAY FLOW software. Please see Appendix 6 for full breakdown of calculations.

Table 3.4: Summary of Attenuation Structures

Attenuation Structure	Catchment	Size (m^3)	Discharge (l/s)
Tank H (Block 10)	A	364	2.0
Tank J	A	364	3.0
Tank L (Block 10)	A	154	2.0
Tank A	B	541	4.0
Tank F (Stone voids)	B	84	2.0
Tank E (Block 7)	B	360	3.5
Tank D (Block 7 + 3)	B	254	2.0
Tank B	B	350	3.5
Tank C	B	123	2.0
Tank K (Block 2)	C	364	1.0
Tank G	C	240	4.0

3.4.4.1 Maintenance of Attenuation Systems

The SuDS detail drawings submitted with this report set out the maintenance requirements for the various SuDS measures proposed.

3.4.5 Interception Storage

Section 16.4 of the GDSDS requires that Interception storage, where provided, should ensure that at a minimum the first 5mm and preferably the first 10mm of rainfall is intercepted on site and does not directly pass to the receiving watercourse.

Interception storage can be attained using SuDS features which allow the rainwater to infiltrate into the ground, evaporate into the atmosphere or transpire through vegetation. Soft landscaping and planted areas are conservatively taken as providing natural interception storage of 15mm. Extract from the SuDS Manual regarding infiltration for Bio-retention areas Table 24.6.
Areas of the site drained to unlined bioretention components can be assumed to comply where the impermeable surface area is less than 5 times the vegetated surface area receiving the runoff. They can be designed to deliver Interception for larger areas, where suitable infiltration capacity is available.

3.4.5.1 Interception Storage - Catchment A

Interception storage required m³ = Total catchment area (m²) x minimum rainfall (mm)
Interception storage required for Catchment A = 29 747m² x 10mm = 297.47m³

Table 3.5: Interception Storage Catchment A

Type of areas	Areas (m²)	Storage (l/m²)	Capacity (m³)
Landscaping (Grass / Soft)	12142	15	182.13
Green Roof: Intensive / Extensive	4274	12	51.288
Permeable Paving	4082	30	122.46
Impermeable Paving	6261	0	0
Tree Pits	349	75	26.175
Bio Retention Areas	457	75	34.275
Standard Roof (impermeable)	2182	0	0
Total	29747	-	**416.32**

The proposed Interception storage meets the preferred 10mm storage criteria

3.4.5.2 Interception Storage - Catchment B

Interception storage required m³ = Total catchment area (m²) x minimum rainfall (mm).
Interception storage required for Catchment B = 47 961m² x 10mm = 479.61m³

Table 3.6 – Interception Storage Catchment B

Type of areas	Areas (m²)	Storage (l/m²)	Capacity (m³)
Landscaping (Grass / Soft)	11808	15	177.12
Green Roof: Intensive / Extensive	15669	12	188.028
Permeable Paving	4719	30	141.6
Impermeable Paving	10311	0	0
Tree Pits	378	75	28.35
Bio Retention Areas	1499	75	112.425
Standard Roof (impermeable)	3577	0	0
Total	47961	-	**647.523**

The proposed Interception storage meets the preferred 10mm storage criteria.

3.4.5.3 Interception Storage - Catchment C

Interception storage required m^3 = Total catchment area (m^2) x minimum rainfall (mm)
Interception storage required for Catchment C = 17 788m^2 x 10mm = 177.88m^3

Table 3.6 – Interception Storage Catchment C

Type of areas	Areas (m^2)	Storage (l/m^2)	Capacity (m^3)
Landscaping (Grass / Soft)	7747	15	116.205
Green Roof: Intensive / Extensive	3884	12	46.60
Permeable Paving	859	30	25.77
Impermeable Paving	3986	0	0
Tree Pits	358	75	26.85
Bio Retention Areas	259	75	19.425
Standard Roof (impermeable)	695	0	0
Total	17788	-	**234.35**

The proposed Interception storage meets the preferred 10mm storage criteria.

3.4.5.4 Green Roof Provision

Green roofs are provided on all roofs and podium structures where feasible, with the exception of Blocks 08 and 09 (private two storey own-door apartment blocks), and the existing gate lodge building. The total quantity of green roof provided in the development is 70.3% of the total roof area which exceeds the DLRCC Development Plan requirement of 70% as set out in Appendix 7.2. 100% of apartment podiums have a blue roof build-up with a combination of an intensive green type roof build-up and hard landscaped finishes.

3.4.6 GSDS Criterion Compliance

3.4.6.1 Criterion 1 GDSDS – River Water Quality Protection

Run-off from natural greenfield areas contributes very little pollution and sediment to rivers and for most rainfall events direct run-off from greenfield sites to rivers does not take place as rainfall percolates into the ground. By contrast, urban run-off, when drained by pipe systems, results in run-off from virtually every rainfall event with higher levels of pollution, particularly in the first phase of run-off, with little rainfall percolating to the ground. To prevent this happening, Criterion 1 requires that interception storage and/or treatment storage is provided, thereby replicating the run-off characteristics of the pre-development greenfield site.

3.4.6.2 Criterion 3 GDSDS – Site Flooding

The GDSDS requires that no flooding should occur on site for storms up to and including the 1 in 30-year event. The pipe network and the attenuation storage volumes should, therefore, be checked for such storms to ensure that no site flooding occurs although partial surcharging of the system is allowed if it does not threaten to flood.
For the 1 in 100-year event, the pipe network can fully surcharge and cause site flooding, but the top water level due to any such flooding must be at least 500mm below any vulnerable internal

floor levels, and the flood waters should be contained within the site. In addition, the top water level in any attenuation device during the 100-year storm must be at least 500mm below any vulnerable internal floor levels.

Surface water drains have been oversized to ensure the following:
The system does not surcharge for the 1-year event
The system surcharges but does not flood for the 30-year event.
The system surcharges but does not flood for the 100-year event.

Detailed modelling of the surface water sewer network has been carried out using Causeway Flow software to confirm the above criteria is adequately met. The outputs are appended to this report.

Basements or under croft car parks are covered by podium slabs and do not receive direct rainfall. There will be limited outflow from these areas (rainfall coming off cars & rainwater coming in through car park vents). They are drained by a separate system that outfalls to a petrol interceptor buried below the ground floor slab. From there, the car park drainage is pumped to the nearest foul water manhole, in accordance with DLR requirements, and is not at risk of any backflow from the surface water system during storm conditions. GDSDS Criterion 3 is therefore complied with.

3.4.6.3 Criterion 2 & Criterion 4 GDSDS – River Regime and Flood Protection

Regardless of the rainfall event, unchecked run-off from the developed site through traditional pipe networks will discharge into receiving waters at rates that are an order of magnitude greater than that prior to development. This can cause flash flow in the outfall river / stream that can cause scour, erosion & downstream flooding. Attenuation storage is provided to prevent this occurring by limiting the rate of run-off to that which took place from the pre-development greenfield site. In practice, the rate of run-off needs to be appropriately low for most rainfall events, and attenuation storage volumes should be provided for the 1 and 100-year storm event + 20% for climate change. The rate of outflow from such storage should be controlled so that it does not exceed the greenfield run-off rate of QBAR, which can be factored upwards by factors appropriate to the various return periods (given in the Flood Studies Report) if long term storage is provided. Notwithstanding that significant long-term storage will be provided in the form of interception storage, this does not equate to full long-term storage volume provision and so growth factors will not be applied to QBAR when calculating the attenuation storage volume required.

Qbar for the site has been calculated in accordance with the IH124 method as 36.1 l/s, based on the positively drained area of the site. As the surface runoff flow rate discharged from the site does not exceed Qbar, there is no requirement for long-term storage to limit the impact on the receiving watercourse. The calculated proposed discharge rate for Catchment A = 7.9 l/s, for Catchment B = 20.5 l/s and for Catchment C = 4.0l/s. Please refer to section 3.3.3 of this report for the Qbar calculation.

Criterion 4 is intended to prevent flooding of the receiving system / watercourse by either.

- limiting the volume of run-off to the pre-development greenfield volume using ‘long-term storage’ (Option 1) or by

- limiting the rate of run-off for the 1 in 100-year storm to QBAR without applying growth factors using ‘extended attenuation storage’ (Option 2).

Significant long-term storage will be provided in the form of interception storage. This does not, however, equate to full long term storage volumes and it is not feasible to provide additional storage areas elsewhere on site to achieve the required volume.

Option (2) has therefore been used to comply with Criterion 4 and an attenuation volume will be provided in the proposed attenuation tank to limit the rate of discharge in the 1 in 100-year storm +20% event to QBAR without growth factors applied.

Refer to Appendix 6 for surface water network design calculations.

3.4.7 SuDS CIRIA Pillars of Design

3.4.7.1 Water Quantity

The "Water Quantity" design objective is to ensure that the surface water runoff from a developed site does not have a detrimental impact on people, property or the environment, it is important to control:

- How fast the runoff is discharged from the site (ie the peak runoff rate) and
- How much runoff is discharged from the site (ie the runoff volume)

3.4.7.2 Water Quality

The "Water Quality" design objective seeks to ensure the surface water runoff from the site does not compromise the groundwater or surrounding water courses relating to the site.

A pollutant analysis was performed in 3.4.3 of this report. Pollution hazard levels on site are 'low' or 'very low' and the SuDS treatment trains on site will reduce pollution levels in discharging surface water to acceptable levels.

3.4.7.3 Amenity

The "Amenity" design objective aims to deliver attractive, pleasant, useful and above all liveable urban environments. SuDS measures should be designed to replicate the existing natural environment and blend in with the urban development.

BMCE have worked closely with the landscaping architect throughout the SuDS strategy design process to ensure that the measures which have been suggested and incorporated have a high sense of public use. Throughout the site, there are podium green roofs, bio-retention areas, tree pits and a detention basin.

3.4.7.4 Biodiversity

The encouragement of biodiverse environments within urban environments is incredibly important. The SuDS measures must not only replicate the pre-development surface water runoff systems and treatment for rainfall, but they must only replicate the existing habitats pre-development.

By incorporating large landscaped areas in all areas, green roofs throughout the site and the bio-retention areas, biodiversity on site is promoted. In addition, a large number of mature trees have been retained on site.

3.4.8 SuDS Conclusion

This section of the report has comprehensively discussed the various SuDS measures which can be applied to the site and then selected the applicable devices, based on the site layout. A wide range of measures have been employed. A pollutant analysis and a series of SuDS management trains have then been developed based upon these SuDS measures.

Finally, the chosen SuDS measures have been analysed for various rainfall scenarios to ensure that all the SuDS design criteria are met an extensive range of SuDS measures are proposed with extensive coverage of the developed area of the site. These measures will be effective in treating rainfall on the site to meet GDSDS and CIRIA.

3.5 Assessment for Flood Risk due to Potential Blockage of the surface water drainage system on site.

A secondary check has been carried out to assess for flood risk arising from potential blockages in the proposed surface water network. This analysis was carried out using Causeway Flow by modelling the Hydrobrake at half of the Qbar for 50% blockage of the system. The results are appended in Appendix 6 of this report and indicate the flood volumes. Refer to the Site Specific flood risk assessment report for further information.

4. FOUL DRAINAGE SYSTEM

4.1 Existing Foul Drainage System

The foul drainage from the existing buildings on site drains to a combined drainage system on site which discharges to the Ø300mm combined sewer on the Dundrum Road. The combined sewer drains in a northerly direction towards a pumping station near the River Dodder at Milltown.

4.2 Proposed Foul Drainage System

The proposed foul drainage system will be designed to take discharges from the new residential units & other proposed limited non-residential uses on site – creche, retail units, community centre, medical centre, a restaurant & a café. Drainage from any kitchen/canteen facilities will discharge through a grease separator designed in accordance with IS EN 1825 Part 1 and Part 2 and to Uisce Éireann requirements. The foul system will connect to the Uisce Éireann network at the existing 300mm combined sewer in the Dundrum Road. Refer to BMCE drawings C11021 for layout of the proposed foul drainage.

Refer to Appendix 4 for the estimated wastewater flows calculated in accordance with the Uisce Éireann Code of Practice guidelines.

<u>Total Estimated Wastewater Discharge:</u>

Total Average Daily Flow=	439.3 cum/day
Total Average Flow =	5.085 l/s
Total Peak Flow =	22.884 l/s

<u>Uisce Éireann:</u>

A Pre-connection Enquiry application was submitted to Uisce Éireann to confirm capacity in the receiving network and a Confirmation of Feasibility letter was obtained on the 26th of March 2024 CDS number CDS24000356. Refer to Appendix 5. The letter included site specific comments and states that the UE receiving system is adequate to take flows from the development subject to the following (taken from the letter with numbers added by BM for ease of reference):

I. *The Developer will be required to implement wastewater discharge management to limit the foul flows from the Development to 3DWF. The exact pump flow rate will be agreed at a connection application stage.*
II. *Current storm water discharge from the Site (approx. 3900sqm of hard standing area) must be removed from the combined network and separate storm and foul water connection services to be provided for the Development. The storm water must be discharged only into the existing storm water network that is not connected to an Uisce Éireann network. Further information, verified by surveys, is to be provided at a connection application stage and before any existing infrastructure is demolished, regarding the current storm connection.*
III. *Proposed basement carparks must be designed such that surface water from the Site and/or surrounding areas cannot flow down to the carparks. Wastewater from the carparks (contaminated water generated from run off from cars/tyres) must be pumped to ground level to discharge by gravity to the Uisce Éireann Network via a petrol interceptor.*

Item i will be addressed by the provision of a new controlled flow wastewater pumping station on site prior to discharge to the combined sewer. Refer to BM drawings nr C11220 and C11221 for details.
Item ii will be addressed by the provision of a fully separate surface water drainage system on site which does not discharge to UE wastewater or combined sewers.
Item iii will be complied with i.e. petrol interceptors will be provided for basement car parks.

5. WATER SUPPLY

5.1 EXISTING WATERMAIN INFRASTRUCTURE

The existing 9-inch public watermain in Dundrum Road was recently upgraded to a 355mm diameter HDPE main. The existing buildings on site are serviced from this main.

Refer to Appendix 2 for details of the IW / DCC drainage and watermain records for the area. Note these records have not yet been updated to show the new 355 diameter main.

All of the existing watermains on site will be decommissioned and grubbed up as part of the new proposed development. The existing watermain serving the existing Hospital buildings, which crosses the site and exits onto the Dundrum close to the existing entrance, will be retained until that site is developed.

5.2 PROPOSED WATERMAINS

The proposed development will be connected to the new 355mm diameter public watermain in the Dundrum Road. A stub connection has been left out from this main to receive the connection from the site. Refer to the BM Watermain layout drawing C-11040.

Refer to Appendix 4 for the estimated water demand calculated in accordance with the Uisce Éireann Code of Practice guidelines.

Total Estimated Water Demand:

Total Average Daily Demand	= 500.8 cum/day
Total Average Demand	= 5.797 l/s
Total Peak Flow	= 28.985 l/s

Uisce Éireann:

A Pre-connection Enquiry application was submitted to Uisce Éireann to confirm capacity in the receiving network and a Confirmation of Feasibility letter was obtained on the 26th of March 2024 CDS number CDS24000356. Refer to Appendix 5.

All proposed water mains will be HPPE PE100 SDR17 in accordance with Uisce Éireann Standards. Own-door apartments will have their own service connections and boundary boxes. All apartment blocks will each have a dedicated connection with a bulkmeter in accordance with Uisce Éireann requirements. Non-residential uses – creche, retail units, community centre, medical centre, restaurant & café will each have a dedicated metered service pipe connection.

The proposed water main layout is arranged such that all buildings are a maximum of 46m max, 6m minimum from a hydrant in accordance with the Department of the Environment's Building Regulations "Technical Guidance Document Part B Fire Safety". Hydrants are to be installed in accordance with Uisce Éireann's Code of Practice and Standard Details. Final positions of hydrants will be agreed as part of the Fire Safety Certificate requirements.

Sluice valves are provided at all junctions and appropriate locations to facilitate isolation of the system. Air valve at high points and scour valves at low points are also provided. 24-hour water storage will be provided in each unit or in each apartment block in accordance with the requirements of Uisce Éireann's Code of Practice.

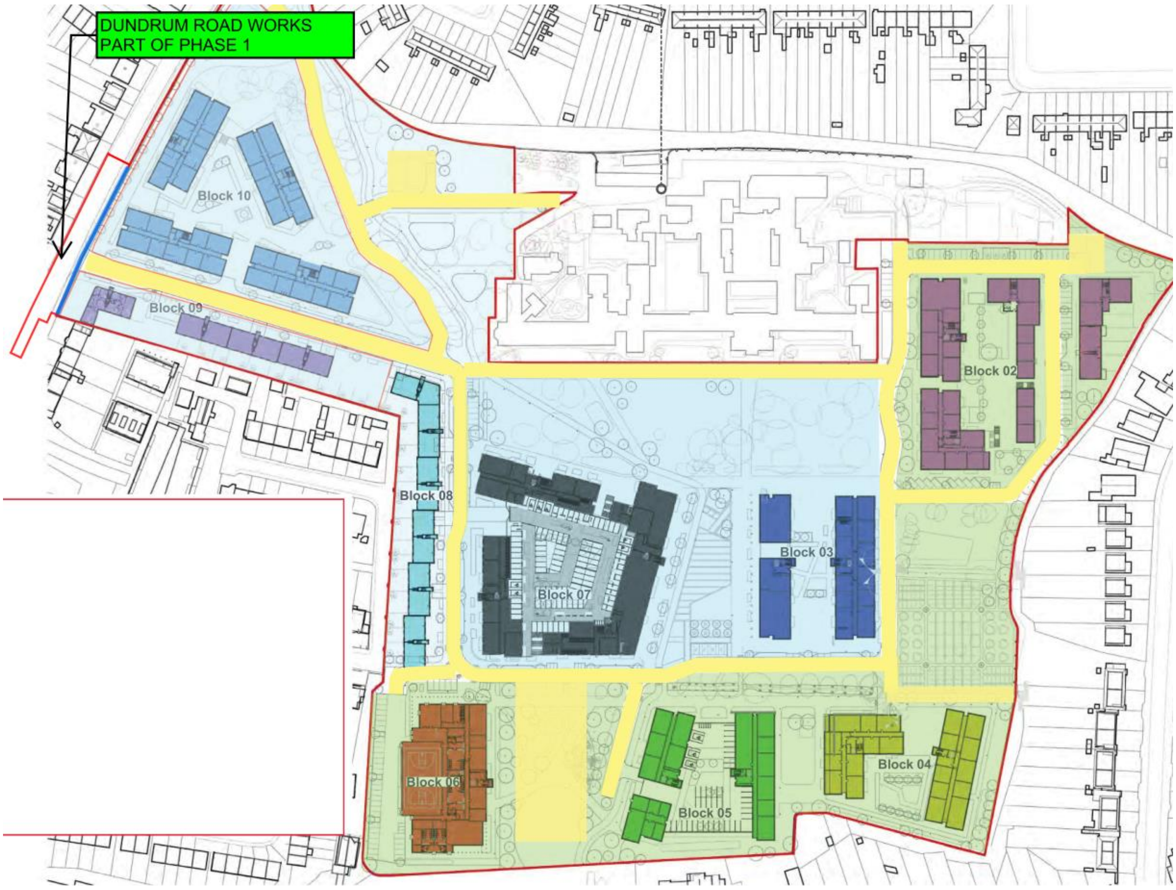
6. DRAINAGE & WATERMAIN DESIGN TO CATER FOR THE PROPOSED PHASING OF THE DEVELOPMENT

6.1 INTRODUCTION

The phasing of the site will be subject to market conditions and commercial considerations at the time of construction. It is currently envisaged that the project will be constructed and handed over in two phased building clusters as shown in Figure 6.1 below. Please note the following;

- Phase 1 includes the roads & primary infrastructure/services for the full scheme including works to the new Dundrum Road junction. Refer also to Note 2 below.
- Block commencements & completions within each phase will be based on a programme to be agreed with the contractor.
- Construction of the phases is expected to overlap and run concurrently.
- Subject to a final planning grant, the expected start date is currently envisaged to be mid-2025 with an envisaged 5 to 6 year construction period.
- Completion of the first residential units is anticipated in mid-2027.

Note 1: The above dates are only an estimate, the exact start date and completions dates may be delayed due to any planning appeals and will also depend on the length of the tendering process.
Note 2: The primary site services are within the road network shown in yellow in Fig 6.1. It is the intention to construct this network in Phase 1, even if Phase 1 differs from the extent shown below. This will ensure that there is flexibility in the phasing and the timing of the construction of particular blocks.



Phase 1: Roads, Drainage & Services and Blocks 3, 7, 8, 9 & 10

Phase 2: Blocks 2, 4, 5 & 6

Fig 6.1 Plan View of the Development Showing the Block Layout and Outline Phasing.

6.2 Surface Water Drainage Design & SuDS for the Phasing

The surface water system has been designed to cater for the proposed phasing as follows:

- Early in Phase 1 the road network and associated buried services including the main surface water drains will be installed. Work at this stage will also include attenuation tanks & SuDs devices not directly associated with a particular block of apartments.
- The sw drains, SuDS devices and attenuation structures local to a particular block and only taking flow from it, will be installed as part of the construction of that block. Each block incorporates. Such measures to ensure that each block is typically stand alone in terms of compliance with SuDS and that QBar flow rates are not exceeded for the areas drained.
- The three surface water connections from the site will be made in Phase 1. These are as follows:
    - Surface water drain connection to the sw sewer feeding into the River Slang ON St.Columbanus Road.
    - Surface water drain connection to the open channel flow ditch in the north east corner of the site at the existing wall opening.
    - Surface water drain connection to the open channel flow ditch in the east of the site.
- The Catchment strategy set out in Section 2.3.1 of this report will be adhered to and there will not be any temporary additional flows into another sub-catchment.

6.3 Foul Water Drainage Design for the phasing

The foul water drainage system has been designed to cater for the proposed phasing as follows:

- Early in Phase 1 the road network and associated buried services including the main foul water drains will be installed. The controlled outflow wastewater pumping station requested by Uisce Éireann will be installed & commissioned early in Phase 1 also as will the connection from it to the combined sewer on the Dundrum Road.
- The foul water drains local to a particular block and only taking flow from it, will be installed as part of the construction of that block and connected to the site foul drainage network.

6.4 Water Supply

The water main layout on site has been designed to cater for the proposed phasing on site as follows:

- Early in Phase 1 the road network and associated buried services including the water supply network and associated hydrants will be installed. The connection to the public watermain on the Dundrum Road will also be made.
- The water supply main local to a particular block and only taking flow from it, will be installed as part of the construction of that block and connected to the site network.

7. TRANSPORT INFRASTRUCTURE

7.1 Traffic impact and Mobility Management

Please refer to the separate reports on these items prepared by ILTP Traffic & Transport Consultants.

7.2 Existing Road Access

The existing site is served by an access off the Dundrum Road at the north west corner.

Photo 7.1 Existing access off the Dundrum Road R117 – Looking South

7.3 Proposed Road Accesses to the New Development

The site will be served by a new access road off the Dundrum Road as shown in Figure 7.1 below. The new junction will be signalised. The existing access will be retained for emergency vehicle use only. These junctions are shown on the Barrett Mahony drawings accompanying the application. The sightlines at the new junction will be in excess of 45metres on a 2.4m set back dimension, in accordance with DMURS.

7.4 Internal Road Network

The main entrance road carriageway is 6.0metres wide reducing to 5.5m wide further inside the site. A mini-roundabout is provided on the road in the southwest corner to facilitate car turning without the need to travel further into the site. Generally 2.0m wide footpaths are provided on either side or on one side of the road, separated from the road by a landscaped verge where space allows it. Traffic calming is achieved by non-linear horizontal alignments & raised table pedestrian crossings. A 30kph speed limit will apply inside the development.

Vehicle tracking drawings for a fire tender and refuse truck across the site road layout have been prepared by Barrett Mahony as part of the planning package.

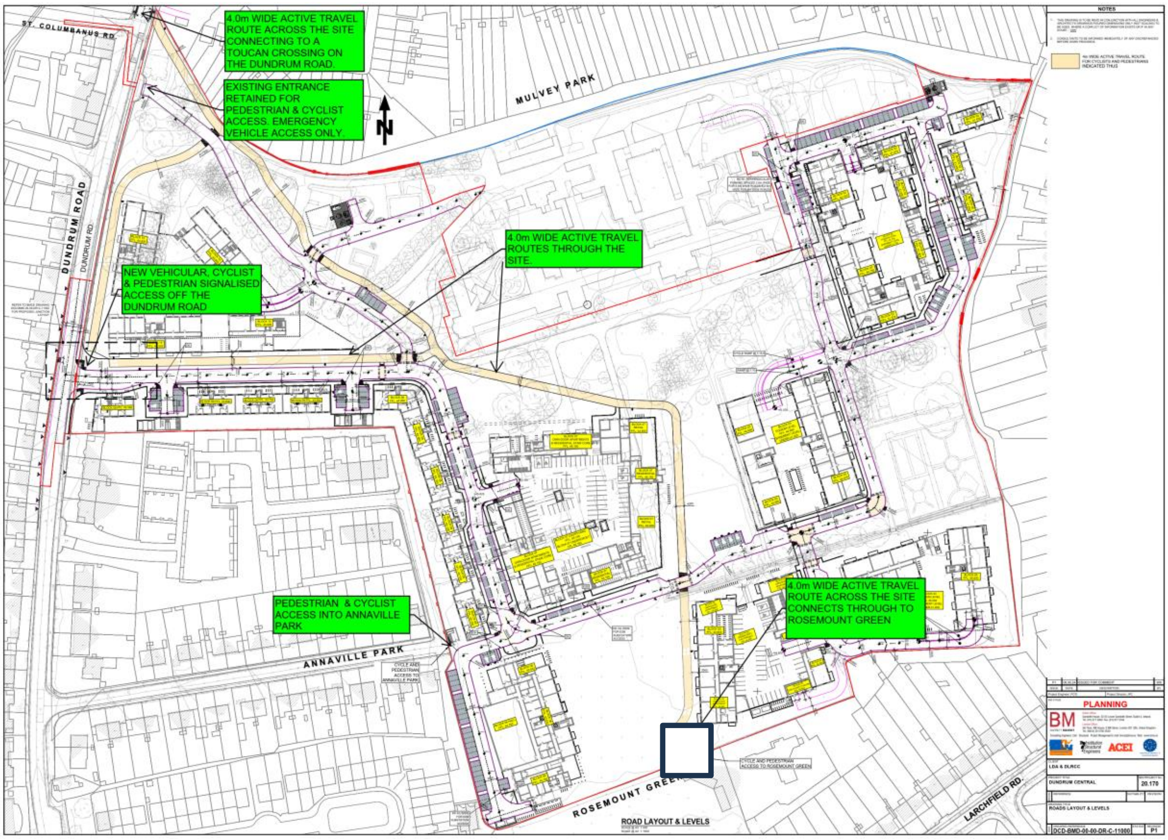


Figure 7.1 Site layout plan with pedestrian, cyclist & vehicular connectivity highlighted. Refer to BM roads' drawings for full details

7.5 Pedestrian Access

Pedestrian access to the site will be via the two Dundrum Road accesses referred to above. In addition, there will be pedestrian access to the existing public footpath at the northwest corner of the site, adjacent to the existing signalised pedestrian crossing here on the Dundrum Road which will be upgraded to a Toucan crossing for pedestrians & cyclists.

Pedestrian permeability through the site will be enhanced by new pedestrian accesses to Annaville Park in the southwest of the site and to Rosemount Green in the south of the site. Active travel routes across the site will provide a safe environment for pedestrian and cyclists away from vehicular traffic. Refer to the ILTP reports and Architect's drawings for further information.

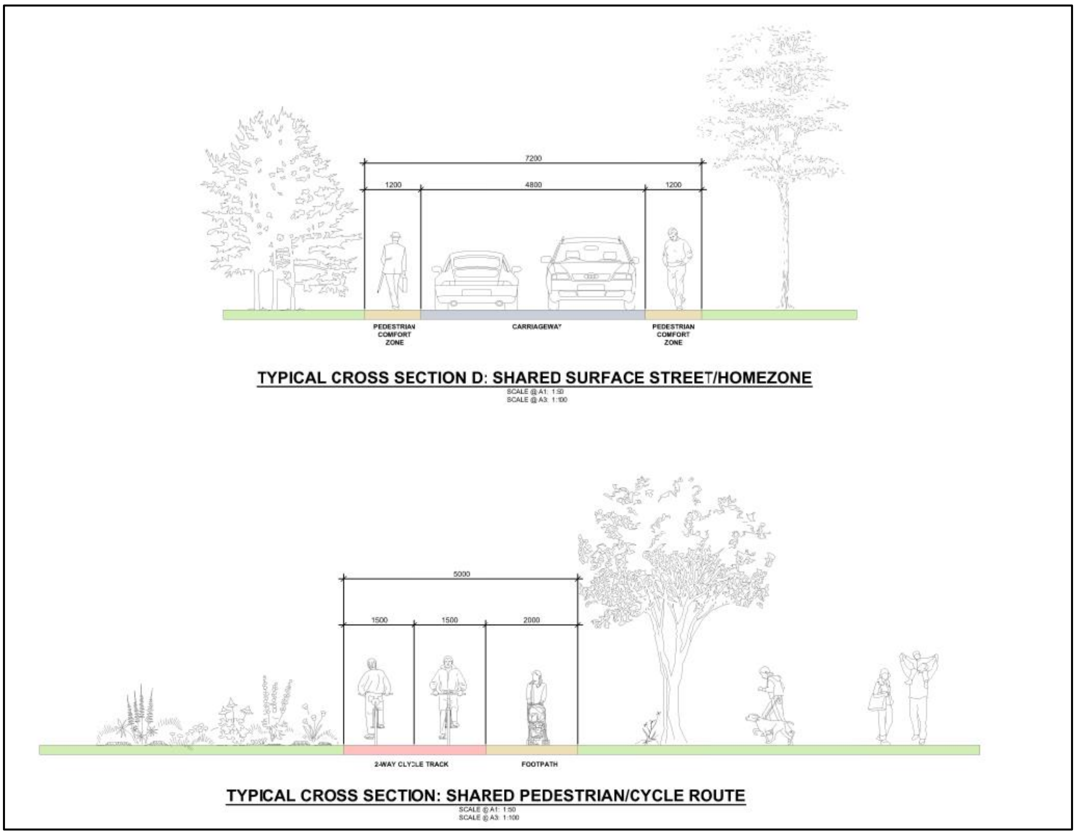


Figure 7.2 Typical Road Sections in the development taken from BM drg. No C11012

7.6 CYCLISTS

Cycle parking will be provided throughout the site as set out on the Architect's/Landscape Architect's plan & in the ILTP traffic reports. Cyclists will share the same accesses to the site as pedestrians, as set out in the preceding section above. As noted above, active travel routes across the site will provide a safe environment for pedestrian and cyclists away from vehicular traffic.

7.7 DMURS COMPLIANCE

A DMURS Compatibility Statement has been completed by ILTP Traffic & Transport Consultants and is submitted under separate cover with this planning application.

7.8 STAGE 1 ROAD SAFETY AUDIT & QUALITY AUDIT

A Stage 1 Road Safety Audit & Quality Audit (covering Cyclists & Pedestrians) has been carried out by a 3rd party consultant for ILTP Traffic & Transport Consultants and is submitted under separate cover with this planning application. This examines the safety implications of the proposed layouts for road users, cyclists and pedestrians. The Design Team have responded to the queries raised in the audit reports and the recommendations of the audits have been accepted and incorporated into the design.

Appendix 1

Extracts from the Site Investigation Report

Appendix 2

Existing Services

Appendix 3

LowFlow Flow Logger

Appendix 4

Water demand and Wastewater Flow Calculations

Appendix 5

Uisce Éireann Confirmation of Feasibility Letter

Uisce Éireann Statement of Design Acceptance

Appendix 6

Causeway Flow Network Model

Appendix 7

Surface Water Drainage Contributing Areas

Appendix 1

Extracts from the Site Investigation Report

S.I. Ltd Contract No: 5811

Client:	Land Development Agency
Engineer:	Barrett Mahony
Contractor:	Site Investigations Ltd

Dundrum Central Development

Dundrum, Dublin 14

Site Investigation Report

Prepared by:

Sletch

....

Stephen Letch

Issue Date:	09/11/2021
Status	Final
Revision	1

Contents: Page No.

Appendices:

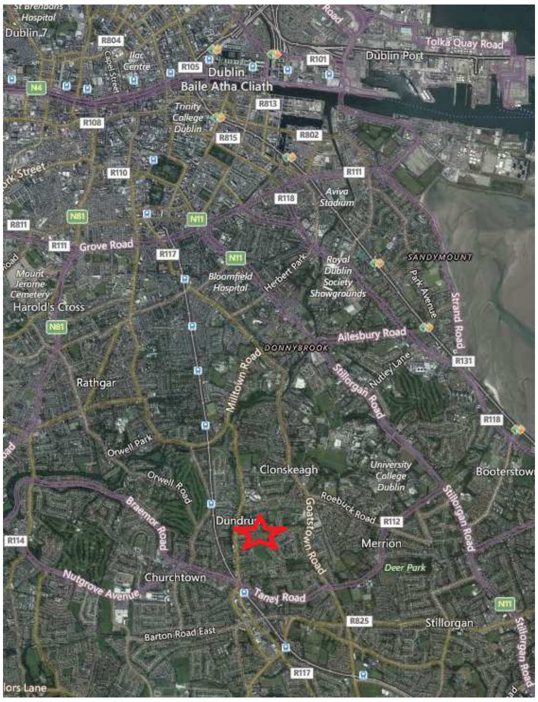
1. Introduction

On the instructions of Barrett Mahony, Site Investigations Ltd (SIL) was appointed to complete a ground investigation at the former Central Mental Hospital site in Dundrum, Dublin 14. The investigation was for a residential development on the site and was completed on behalf of the Client, Land Development Agency. Due to supervision issues, the fieldworks were initially started in March 2021 and then postponed until August and completed in September 2021.

This report presents the factual geotechnical data obtained from the field and laboratory testing with interpretation of the ground conditions discussed.

2. Site Location

The site is located in to the north of Dundrum town centre, which is to the south of Dublin city centre. The first map below shows the location of the site to the south of the city centre and the second map shows the location of the site to the north of Dundrum town centre.



3. Fieldwork

The fieldworks comprised a programme of cable percussive boreholes, trial pits, soakaway tests, foundation pits, slit trenches and California Bearing Ratio tests. All fieldwork was carried out in accordance with BS 5930:2015, Engineers Ireland GI Specification and Related Document 2nd Edition 2016 and Eurocode 7: Geotechnical Design.

The fieldworks comprised of the following:

- 16 No. cable percussive boreholes
- 35 No. trial pits
- 4 No. soakaway tests
- 7 No. foundation inspection pits
- 3 No. slit trenches
- 6 No. California Bearing Ratio tests

3.1. Cable Percussive Boreholes

Cable percussion boring was undertaken at 16 No. locations using a Dando 150 rig and constructed 200mm diameter boreholes. Hand dug inspection pits were excavated to check for underground services at each borehole location. The boreholes terminated at depths ranging from 4.50mbgl (BH12) to 8.60mbgl (BH11). It was not possible to collect undisturbed samples due to the granular soils encountered so bulk disturbed samples were recovered at regular intervals.

To test the strength of the stratum, Standard Penetration Tests (SPT's) were performed at 1.00m intervals in accordance with BS 1377 (1990). In soils with high gravel and cobble content it is appropriate to use a solid cone (60°) (CPT) instead of the split spoon and this was used throughout the testing. The test is completed over 450mm and the cone is driven 150mm into the stratum to ensure that the test is conducted over an undisturbed zone. The cone is then driven the remaining 300mm and the blows recorded to report the N-Value. The report shows the N-Value with the 75mm incremental blows listed in brackets (e.g., BH01 at 1.00mbgl where N=12-(2,2/2,4,3,3)). Where refusal of 50 blows across the test zone was encountered was achieved during testing, the penetration depth is also reported (e.g., BH01 at 7.60mbgl where N=50-(25 for 5mm/50 for 5mm)).

At 5 No. locations, standpipes to allow for long term groundwater monitoring were installed. These were slotted pipes with a gravel response zone to allow for the groundwater to equalise within the standpipe.

The logs are presented in Appendix 1.

3.2. Trial Pits

35 No. trial pits were excavated using a wheeled excavator with TP21 cancelled due to access issues. The pits were logged and photographed by SIL geotechnical engineer and representative disturbed bulk samples were recovered as the pits were excavated, which were returned to the laboratory for geotechnical testing.

The trial pit logs and photographs are presented in Appendix 2.

3.3. Soakaway Tests

At 4 No. locations, soakaway tests were completed and logged by SIL geotechnical engineer. BRE Special Digest 365 stipulates that the pit should be filled three times and that the final cycle is used to provide the infiltration rate. The time taken for the water level to fall from 75% volume to 25% volume is required to calculate the rate of infiltration. However, if the water level does not fall at a steady rate, then the test is deemed to have failed and the area is unsuitable for storm water drainage.

The soakaway test results and photographs are presented in Appendix 3.

3.4. Foundation Pits

At seven locations, foundation pits were excavated to investigate the depths of the foundations of the existing structure. FI02 was cancelled due to issues accessing the proposed location. The pits included hand excavating around the foundation to measure the depth to the top, extension out from the wall and the thickness of the foundation. The pits were then photographed, backfilled with arisings and reinstated.

The foundation pit logs are presented in Appendix 4.

3.5. Slit Trenches

Slit trenching was completed at 3 No. locations by hand digging with machine assistance where possible. The trenches were completed to check for any underground services at the selected locations. The trenches were logged and photographed before they were backfilled with the arisings.

The slit trench logs with photographs are presented in Appendix 5.

3.6. California Bearing Ratio Tests

At 6 No. locations, undisturbed cylindrical mould samples were recovered to complete California Bearing Ratio tests in the laboratory. The results facilitate the designing of the access roads and associated areas and are completed to BS1377: 1990: Part 4, Clause 7 ‘Determination of California Bearing Ratio’. The results are presented as part of Appendix 6 with the geotechnical laboratory test data.

3.7. Surveying

Following completion of all the fieldworks, a survey of the exploratory hole locations was completed using a GeoMax GPS Rover. The data is supplied on each individual log and along with a site plan in Appendix 9.

4. Laboratory Testing

Geotechnical laboratory testing was completed on representative soil samples in accordance with BS 1377 (1990). Testing included:

- 65 No. Moisture contents
- 12 No. Atterberg limits
- 25 No. Particle size gradings with 12 No. hydrometers
- 3 No. shear boxes
- 10 No. pH and sulphate content

Environmental testing was completed by Eurofins Chemtest Ltd and this allows for a Waste Classification report to be produced. The environmental testing consists of the following:

- 70 No. Suite I analysis

The geotechnical laboratory test results are presented in Appendix 6 with the environmental test results and Waste Classification report in Appendix 7 and 8 respectively.

5. Ground Conditions

5.1. MADE GROUND

MADE GROUND was encountered at most locations across the site generally to 1.10mbgl or shallower although it did extend deeper at 6 No. locations with TP02 recording fill material to 2.20mbgl. The fill material is dominated by consists of granular sand and gravel fill although some cohesive clay soils were also recorded. The foreign material recorded in these soils include concrete, timber, tarmacadam, pottery, bone, ash, slag, plastic bags and red brick fragments.

5.2. Overburden

The natural ground conditions are consistent with cohesive soils encountered across the site. This includes brown and brown grey overlying black slightly sandy gravelly silty CLAY with high cobble and low boulder content soils. The black CLAY was recorded at depths ranging from 1.80mbgl to 3.20mbgl. At the trial pit locations, some layers of granular GRAVEL were also recorded towards the north of the site. The boreholes terminated at depths ranging from 4.50mbgl to 8.60mbgl on boulder obstructions.

The SPT N-values in the natural ground at 1.00mbgl range from 4 to 19 indicating soft to stiff soils. The N-values then increase to 11 to 33 at 2.00mbgl and steadily increase with depth as the boreholes progress.

Laboratory tests of the shallow cohesive soils confirm that CLAY soils dominate the site with low to intermediate plasticity indexes of 14% to 16% recorded. The particle size distribution curves were poorly sorted straight-line curves with 22% to 53% fines content.

5.3. Groundwater

Groundwater details in the boreholes and trial pits during the fieldworks are noted on the logs in Appendix 1 and 2. Groundwater ingresses were recorded in 13 No. boreholes with initial water strikes between 0.80mbgl and 3.20mbgl. At four of the boreholes, BH11, BH13, BH15 and BH16, the initial strike was sealed off by the borehole casings and then groundwater re-entered the borehole between 3.50mbgl and 4.50mbgl.

Groundwater was recorded in 12 of the trial pits at depths ranging from 1.30mbgl to 2.10mbgl with ingress rates recorded as seepages to slow.

6. Recommendations and Conclusions

Please note the following caveats:

The recommendations given, and opinions expressed in this report are based on the findings as detailed in the exploratory hole records. Where an opinion is expressed on the material between the exploratory hole locations or below the final level of excavation, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for adjacent unexpected conditions that have not been revealed by the exploratory holes. It is further recommended that all bearing surfaces when excavated should be inspected by a suitably qualified Engineer to verify the information given in this report.

Excavated surfaces in clay strata should be kept dry to avoid softening prior to foundation placement. Foundations should always be taken to a minimum depth of 0.50mBGL to avoid the effects of frost action and possible seasonal shrinkage/swelling.

If it is intended that on-site materials are to be used as fill, then the necessary laboratory testing should be specified by the Client to confirm the suitability. Also, relevant lab testing should be specified where stability of side slopes to excavations is a concern, or where contamination may be an issue.

6.1. Shallow Foundations

Due to the unknown depth of foundation and no longer-term groundwater information, this analysis assumes the groundwater will not influence the construction or performance of these foundations.

As stated previously, man-made soils were recorded across the site to a maximum depth of 2.20mbgl. SIL do not recommend that narrow shallow foundations are placed on fill material due to the unknown compaction methods used during laying of man-made material. This unknown could result in softer spots and differential settlement once construction is completed. If shallow foundations are to be used and man-made soils are encountered below foundation level, then the soil should be removed and replaced with engineered fill which is compacted to the required standard.

Beneath the fill material the boreholes recorded cohesive CLAY soils. Using a correlation proposed by Stroud and Butler, the SPT N-values and plasticity indices can be used to calculate the undrained shear strength. With the low to intermediate plasticity indexes recorded in the laboratory for the soils encountered on site, this correlation is C_u=6N. This value can then be used to calculate the ultimate bearing capacity (UBC), and finally, a factor of safety is applied to get the allowable bearing capacity, with a factor of 3 chosen for this project.

BH:	1.20m				2.00m				3.00m			
	SPT	C_u	UBC	ABC	SPT	C_u	UBC	ABC	SPT	C_u	UBC	ABC
01	-	-	-	**-**	33	198	1045	**350**	32	192	1033	**345**
02	7	42	235	**80**	13	78	434	**145**	21	126	695	**230**
03	-	-	-	**-**	18	108	587	**195**	29	174	942	**315**
04	-	-	-	**-**	20	120	648	**215**	30	180	972	**325**
05	15	90	480	**160**	14	84	465	**155**	20	120	666	**220**
06	7	42	235	**80**	17	102	556	**185**	21	126	695	**230**
07	-	-	-	**-**	22	132	710	**235**	24	144	788	**265**
08	11	66	358	**120**	14	84	465	**155**	31	156	1000	**335**
09	19	114	603	**200**	19	114	617	**205**	31	156	1000	**335**
10	14	84	450	**150**	31	156	985	**330**	31	156	1000	**335**
11	10	60	328	**110**	19	114	617	**205**	35	210	1125	**375**
12	4	24	144	**50**	17	102	556	**185**	22	132	727	**245**
13	11	66	358	**120**	11	66	372	**125**	26	156	850	**285**
14	11	66	358	**120**	25	150	800	**265**	30	180	972	**325**
15	9	54	297	**100**	15	90	495	**165**	32	192	1033	**345**
16	14	84	450	**150**	33	198	1045	**350**	39	234	1247	**415**

All values are in kN/m^2.

The following assumptions were made as part of these analyses. If any of these assumptions are not in accordance with detailed design or observations made during construction these recommendations should be re-evaluated.

- Foundations are to be constructed on a level formation of uniform material type (described above).
- The bulk unit weight of the material in this stratum has a minimum density of $19kN/m^3$.
- All bearing capacity calculations allow for a settlement of 25mm.

The trial pit walls remained stable during excavation. However, it would still be recommended that all excavations should be checked immediately and regular inspection of temporary excavations should be completed during construction to ensure that all slopes are stable. Temporary support should be used on any excavation that will be left open for an extended period.

6.2. Groundwater

The caveats below relating to interpretation of groundwater levels should be noted:
There is always considerable uncertainty as to the likely rates of water ingress into excavations in clayey soil sites due to the possibility of localised unforeseen sand and gravel lenses acting as permeable conduits for unknown volumes of water.

Furthermore, water levels noted on the borehole and trial pit logs do not generally give an accurate indication of the actual groundwater conditions as the borehole or trial pit is rarely left open for sufficient time for the water level to reach equilibrium.

Also, during boring procedures, a permeable stratum may have been sealed off by the borehole casing, or water may have been added to aid drilling. Therefore, an extended period of groundwater monitoring using any constructed standpipes is required to provide more accurate information regarding groundwater conditions. Finally, groundwater levels vary with time of year, rainfall, nearby construction and tides.

Pumping tests would be required to determine likely seepage rates and persistence into excavations taken below the groundwater level. Deep trial pits also aid estimation of seepage rates.

As discussed previously, groundwater was recorded in 13 No. boreholes and 12 No. trial pits during the fieldworks. There is always considerable uncertainty as to the likely rates of water ingress into excavations in cohesive soil sites due to the possibility of localised unforeseen sand and gravel lenses acting as permeable conduits for unknown volumes of water. Based on this information at the exploratory hole locations to date, it is considered likely that any shallow ingress (less than 2.00mbgl) into excavations of the CLAY will be slow to medium. If granular soils are encountered in shallow excavations, then the possibility of water ingressing into an excavation increases.

If groundwater is encountered during excavations then mechanical pumps will be required to remove the groundwater from sumps. Sumps should be carefully located and constructed to ensure that groundwater is efficiently removed from excavations and trenches.

6.3. Soakaway Test

SA02 and SA03 passed the BRE specification with the water draining from the trial pit. SA02 was completed in fill material, which may not have been compacted as much as the natural soils and SA03 was completed in granular SAND and GRAVEL soils. The f-values were calculated as **7.36×10^{-5}m/s** and **2.20×10^{-4}m/s.** It would be recommended that any soakaway is placed in the natural granular soils.

The soakaway tests, SA01 and SA04, failed the specification as the water level did not fall sufficiently enough to complete the test. The BRE Digest stipulates that the pit should half empty within 24hrs, and extrapolation indicates this condition would not be satisfied. The tests were terminated at the end of the first (of a possible three) fill/empty cycle since further testing would give even slower fall rates due to increased soil saturation.

6.4. Pavement Design

The CBR test results in Appendix 6 indicate CBR values ranging from 6.4% to 8.9%.

The CBR samples were recovered at 0.40mbgl and inspection of the formation strata should be completed prior to construction of the pavement. Once the exact formation levels are finalised then additional in-situ testing could be completed to assist with the detailed pavement design.

6.5. Contamination

Environmental testing was carried out on seventy samples from the investigation and the results are shown in Appendix 7. For material to be removed from site, Suite I testing was carried out to determine if the material is hazardous or non-hazardous and then the leachate results were compared with the published waste acceptance limits of BS EN 12457-2 to determine whether the material on the site could be accepted as 'inert material' by an Irish landfill.

The Waste Classification report in Appendix 8, created using HazWasteOnline™ software, shows that the material tested can be classified as non-hazardous material.

Following this analysis of the solid test results, the leachate disposal suite results showed 36 No. samples remained within the Inert waste thresholds. 23 No. samples recorded determinands that exceed the Inert threshold but remain below the non-hazardous waste landfill levels whereas 11 samples exceeded these upper levels. It would be recommended that an Environmental Engineer is consulted prior to any earthworks commencing on site.

Seventy samples were tested for analysis but it cannot be discounted that any localised contamination may have been missed. Any MADE GROUND excavated on site should be stockpiled separately to natural soils to avoid any potential cross contamination of the soils. Additional testing of these soils may be requested by the individual landfill before acceptance and a testing regime designed by an environmental engineer would be recommended to satisfy the landfill.

6.6. Aggressive Ground Conditions

The chemical test results in Appendix 6 indicate a general pH value between 7.32 and 8.11, which is close to neutral and below the level of 9, therefore no special precautions are required.

The maximum value obtained for water soluble sulphate was 127mg/l as SO_3. The BRE Special Digest 1:2005 – '*Concrete in Aggressive Ground'* guidelines require SO_4 values and after conversion ($SO_4 = SO_3 \times 1.2$), the maximum value of 152mg/l shows Class 1 conditions and no special precautions are required.

Legend Key

- Locations By Type - CP
- Locations By Type - DP
- Locations By Type - ICBR
- Locations By Type - IP
- Locations By Type - OP
- Locations By Type - TP

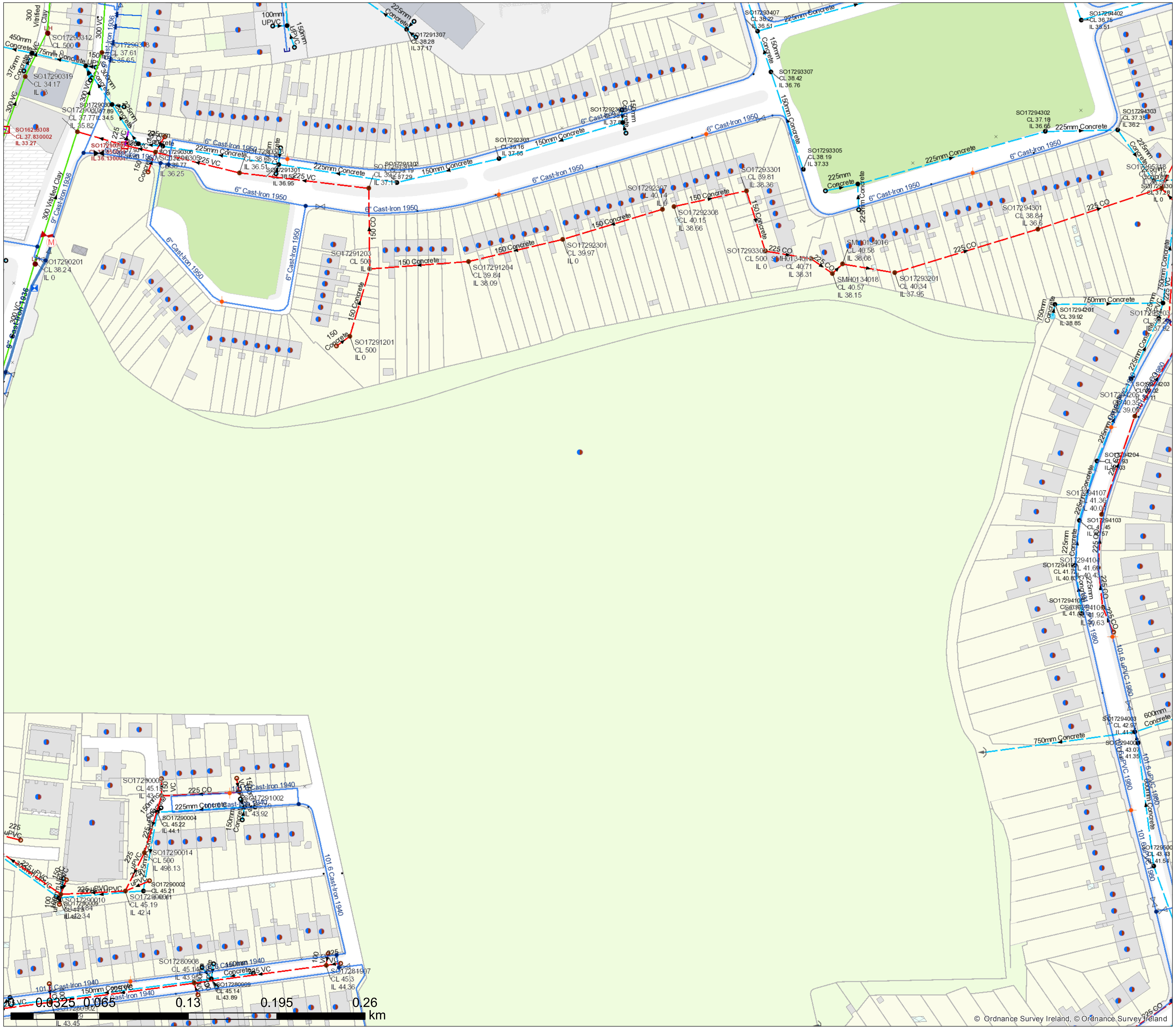
Contract No:	5811
Contract Name:	Dundrum Central Development
Location:	Dundrum, Dublin 14
Client:	Land Development Agency
Engineer:	Barrett Mahony
Title:	Site Plan
Scale:	1:2250
Drawn By:	SL

Site Investigations Ltd
The Grange
12th Lock Road
Lucan
Co. Dublin
T: 01 6108768
e: info@siteinvestigations.ie

Appendix 2

Existing Services

Windy Arbour



UISCE ÉIREANN : IRISH WATER

Print Date: 23/04/2020

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Water Distribution Network
- Water Treatment Plant
- Water Pump Station
- Storage Cell/Tower
- Dosing Point
- Meter Station
- Abstraction Point
- Telemetry Kiosk

Reservoir
- Potable
- Raw Water

Water Distribution Mains
- Irish Water
- Private

Trunk Water Mains
- Irish Water
- Private

Water Lateral Lines
- Irish Water
- Non IW
- Water Casings
- Water Abandoned Lines
- Boundary Meter
- Bulk/Check Meter
- Group Scheme
- Source Meter
- Waste Meter
- Unknown Meter ; Other Meter
- Non-Return
- PRV
- PSV
- Sluice Line Valve Open/Closed
- Butterfly Line Valve Open/Closed
- Sluice Boundary Valve Open/Closed
- Butterfly Boundary Valve Open/Closed
- Scour Valves
- Single Air Control Valve
- Double Air Control Valve
- Water Stop Valves
- Water Service Connections
- Water Distribution Chambers
- Water Network Junctions
- Pressure Monitoring Point
- Fire Hydrant
- Fire Hydrant/Washout

Water Fittings
- Cap
- Reducer
- Tap
- Other Fittings

Sewer Foul Combined Network
- Waste Water Treatment Plant
- Waste Water Pump station

Sewer Mains Irish Water
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow

Sewer Mains Private
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow
- Sewer Lateral Lines
- Sewer Casings

Sewer Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Discharge Type
- Outfall
- Overflow
- Soakaway
- Standard Outlet
- Other; Unknown

Cleanout Type
- Rodding Eye
- Flushing Structure
- Other; Unknown

Sewer Inlets
- Catchpit
- Gully
- Standard
- Other; Unknown

Sewer Fittings
- Vent/Col
- Other; Unknown

Storm Water Network

Surface Water Mains
- Surface Gravity Mains
- Surface Gravity Mains Private
- Surface Water Pressurised Mains
- Surface Water Pressurised Mains Private

Inlet Type
- Gully
- Standard
- Other; Unknown

Storm Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown
- Storm Culverts
- Storm Clean Outs
- Stormwater Chambers

Discharge Type
- Outfall
- Overflow
- Soakaway
- Other; Unknown

Gas Networks Ireland
- Transmission High Pressure Gasline
- Distribution Medium Pressure Gasline
- Distribution Low Pressure Gasline

ESB Networks

ESB HV Lines
- HV Underground
- HV Overhead
- HV Abandoned

ESB MVLV Lines
- MV Overhead Three Phase
- MV Overhead Single Phase
- LV Overhead Three Phase
- LV Overhead Single Phase
- MVLV Underground
- Abandoned

Non Service Categories
- Proposed
- Under Construction
- Out of Service
- Decommissioned

Water Non Service Assets
- Water Point Feature
- Water Pipe
- Water Structure

Waste Non Service Assets
- Waste Point Feature
- Sewer
- Waste Structure

Windy Arbour - South1

UISCE ÉIREANN : IRISH WATER

Print Date: 01/05/2020

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Water Distribution Network
- Water Treatment Plant
- Water Pump Station
- Storage Cell/Tower
- Dosing Point
- Meter Station
- Abstraction Point
- Telemetry Kiosk

Reservoir
- Potable
- Raw Water

Water Distribution Mains
- Irish Water
- Private

Trunk Water Mains
- Irish Water
- Private

Water Lateral Lines
- Irish Water
- Non IW
- Water Casings
- Water Abandoned Lines
- Boundary Meter
- Bulk/Check Meter
- Group Scheme
- Source Meter
- Waste Meter
- Unknown Meter ; Other Meter
- Non-Return
- PRV
- PSV
- Sluice Line Valve Open/Closed
- Butterfly Line Valve Open/Closed
- Sluice Boundary Valve Open/Closed
- Butterfly Boundary Valve Open/Closed
- Scour Valves
- Single Air Control Valve
- Double Air Control Valve
- Water Stop Valves
- Water Service Connections
- Water Distribution Chambers
- Water Network Junctions
- Pressure Monitoring Point
- Fire Hydrant
- Fire Hydrant/Washout

Water Fittings
- Cap
- Reducer
- Tap
- Other Fittings

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- Waste Water Treatment Plant
- Waste Water Pump station

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- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow

Sewer Mains Private
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow
- Sewer Lateral Lines
- Sewer Casings

Sewer Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Discharge Type
- Outfall
- Overflow
- Soakaway
- Standard Outlet
- Other; Unknown

Cleanout Type
- Rodding Eye
- Flushing Structure
- Other; Unknown

Sewer Inlets
- Catchpit
- Gully
- Standard
- Other; Unknown

Sewer Fittings
- Vent/Col
- Other; Unknown

Storm Water Network

Surface Water Mains
- Surface Gravity Mains
- Surface Gravity Mains Private
- Surface Water Pressurised Mains
- Surface Water Pressurised Mains Private

Inlet Type
- Gully
- Standard
- Other; Unknown

Storm Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown
- Storm Culverts
- Storm Clean Outs
- Stormwater Chambers

Discharge Type
- Outfall
- Overflow
- Soakaway
- Other; Unknown

Gas Networks Ireland
- Transmission High Pressure Gasline
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- HV Underground
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- HV Abandoned

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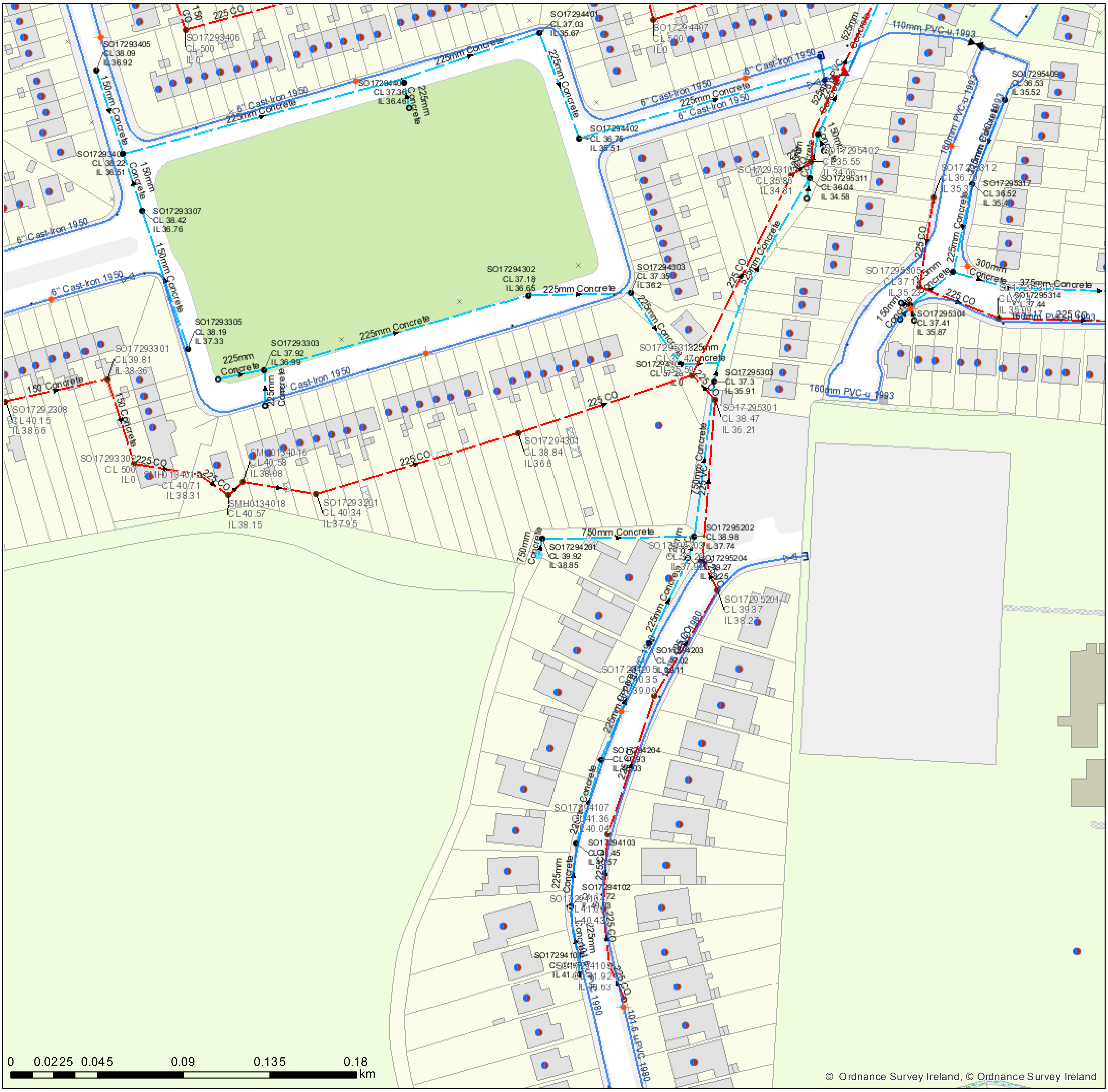
- MV Overhead Three Phase
- MV Overhead Single Phase
- LV Overhead Three Phase
- LV Overhead Single Phase
- MVLV Underground
- Abandoned

Non Service Categories
- Proposed
- Under Construction
- Out of Service
- Decommissioned

Water Non Service Assets
- Water Point Feature
- Water Pipe
- Water Structure

Waste Non Service Assets
- Waste Point Feature
- Sewer
- Waste Structure

Windy Arbour - East1



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- Syphon - Combined
- Syphon - Foul
- Overflow

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- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow
- Sewer Lateral Lines
- Sewer Casings

Sewer Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Discharge Type
- Outfall
- Overflow
- Soakaway
- Standard Outlet
- Other; Unknown

Cleanout Type
- Rodding Eye
- Flushing Structure
- Other; Unknown

Sewer Inlets
- Catchpit
- Gully
- Standard
- Other; Unknown

Sewer Fittings
- Vent/Col
- Other; Unknown

Storm Water Network

Surface Water Mains
- Surface Gravity Mains
- Surface Gravity Mains Private
- Surface Water Pressurised Mains
- Surface Water Pressurised Mains Private

Inlet Type
- Gully
- Standard
- Other; Unknown

Storm Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown
- Storm Culverts
- Storm Clean Outs
- Stormwater Chambers

Discharge Type
- Outfall
- Overflow
- Soakaway
- Other; Unknown

Gas Networks Ireland
- Transmission High Pressure Gasline
- Distribution Medium Pressure Gasline
- Distribution Low Pressure Gasline

ESB Networks

ESB HV Lines
- HV Underground
- HV Overhead
- HV Abandoned

ESB MVLV Lines
- MV Overhead Three Phase
- MV Overhead Single Phase
- LV Overhead Three Phase
- LV Overhead Single Phase
- MVLV Underground
- Abandoned

Non Service Categories
- Proposed
- Under Construction
- Out of Service
- Decommissioned

Water Non Service Assets
- Water Point Feature
- Water Pipe
- Water Structure

Waste Non Service Assets
- Waste Point Feature
- Sewer
- Waste Structure

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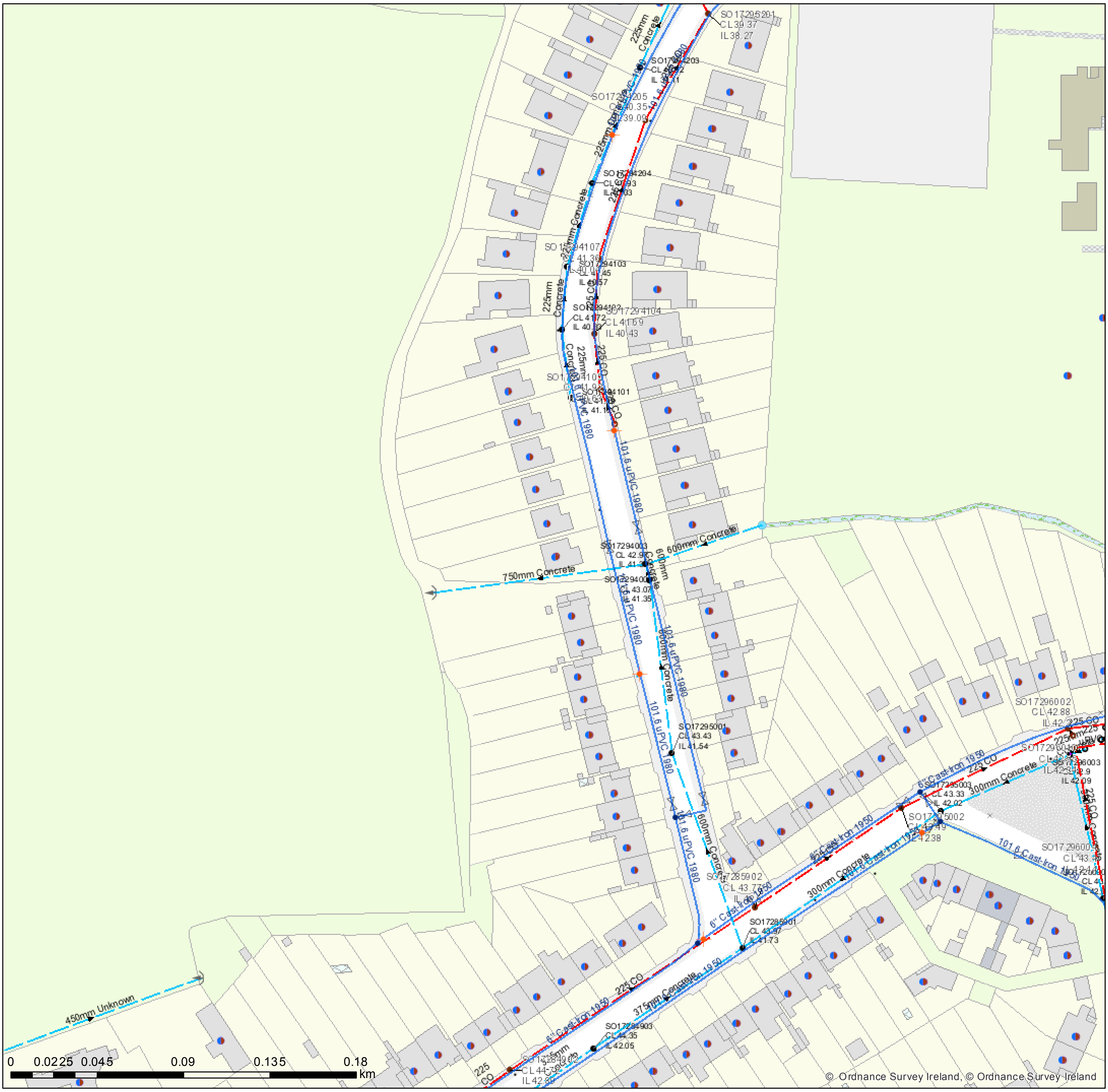
Windy Arbour - East2



Water Distribution Network
- Water Treatment Plant
- Water Pump Station
- Storage Cell/Tower
- Dosing Point
- Meter Station
- Abstraction Point
- Telemetry Kiosk

Reservoir
- Potable
- Raw Water

Water Distribution Mains
- Irish Water
- Private

Trunk Water Mains
- Irish Water
- Private

Water Lateral Lines
- Irish Water
- Non IW
- Water Casings
- Water Abandoned Lines
- Boundary Meter
- Bulk/Check Meter
- Group Scheme
- Source Meter
- Waste Meter
- Unknown Meter ; Other Meter
- Non-Return
- PRV
- PSV
- Sluice Line Valve Open/Closed
- Butterfly Line Valve Open/Closed
- Sluice Boundary Valve Open/Closed
- Butterfly Boundary Valve Open/Closed
- Scour Valves
- Single Air Control Valve
- Double Air Control Valve
- Water Stop Valves
- Water Service Connections
- Water Distribution Chambers
- Water Network Junctions
- Pressure Monitoring Point
- Fire Hydrant
- Fire Hydrant/Washout

Water Fittings
- Cap
- Reducer
- Tap
- Other Fittings

Sewer Foul Combined Network
- Waste Water Treatment Plant
- Waste Water Pump station

Sewer Mains Irish Water
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow

Sewer Mains Private
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
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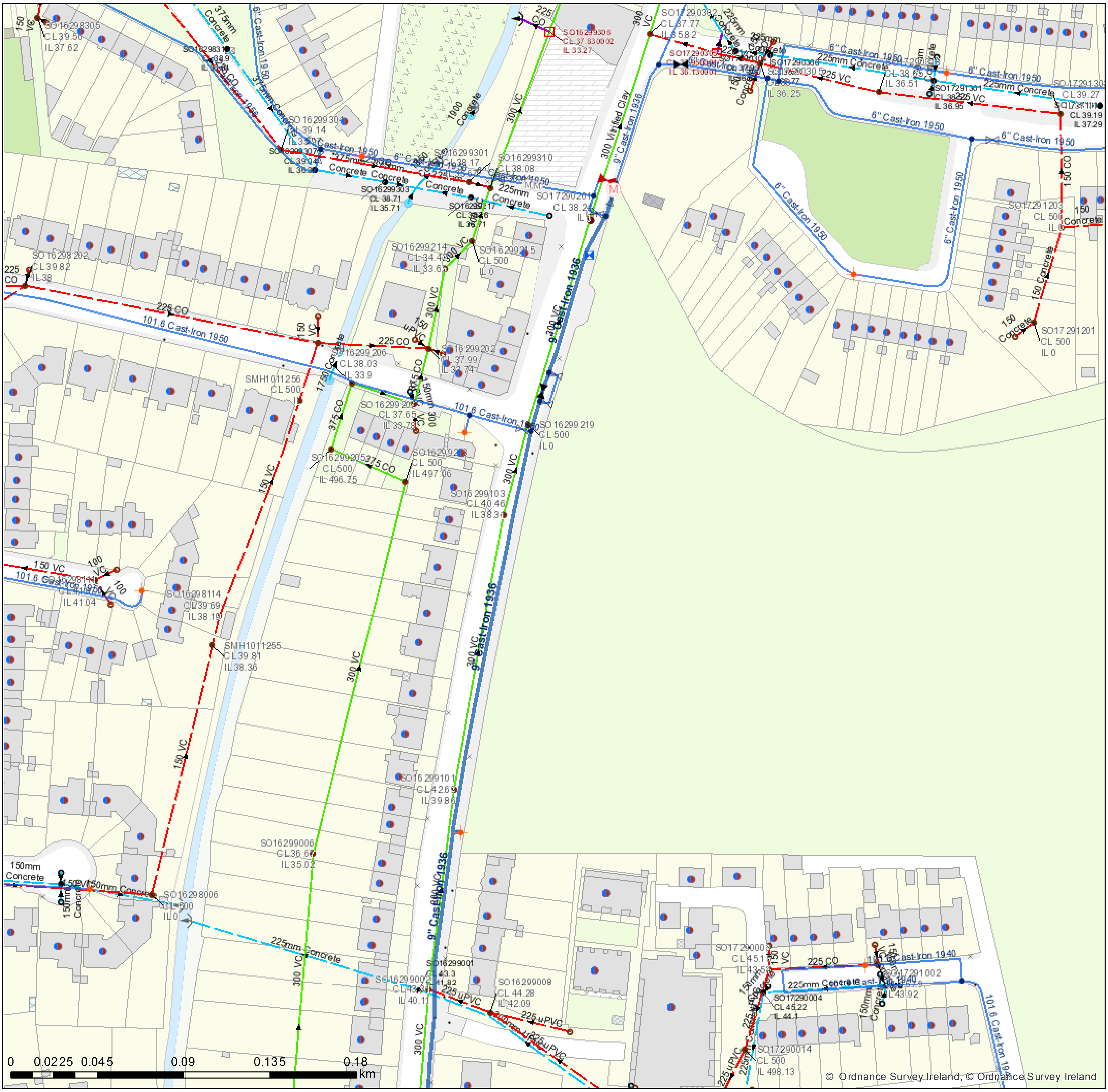
Windy Arbour - West1



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Appendix 3

LowFlow Flow Logger

Flow Survey Report

Reddy Architecture

HSE, Central Mental Hospital,

Dundrum Rd, Friarland, Dublin 14, D14 W0V6

Document Title:	Pressure Testing Report – IW Network Framework		
Document Reference:	LF-REA-WIN-024-0002		
Version:	V. 1.0	Date:	19th May 2021
Written By:	Thomas Algier	Title:	Projects Engineer
Approved By:	Charles Dwyer	Title:	Managing Director

Contents

1. Project

Title: Flow Survey Report
Client: Reddy Architecture
Contact/s: Email Address: rtobin@reddyarchitecture.com
Site: HSE, Central Mental Hospital, Dundrum Rd, Friarland, Dublin 14, D14 W0V6
Engineer: Bob Fagan, Dean McVeight, Angelos Prassas, Mick VanDerMeer
Date: 19th May 2021

2. Brief

Lowflo were commissioned by Reddy Architecture to carry out a Flow and Load Survey at HSE, Central Mental Hospital in Dundrum from the 25th of February 2021 until the 12th of May 2021. The basis of this report is to produce flow data to determine the volumes of overflow into the receiving environment. 2 flow monitors were installed.

3. Training and H&S

Lowflo strive to provide a safe and healthy work environment; this is facilitated via a consultative approach through the use of toolbox meetings involving employees and the client, with the ultimate aim of working safely to achieve zero harm to both personnel and the environment on all projects.

We achieve this by having a suitably trained, competent and committed workforce who undergo extensive training in all aspects of leak detection, water management, as well as workplace health and safety. Below is a list of qualifications of personnel within the organisation:

- Mechanical and Environmental Engineering
- Leakage Detection
- Workplace Health and Safety
- Safe Pass
- Manual Handling
- Confined space entry (using BA)
- Valve Operations
- Hydrant Standpipe Operations
- Leak Correlator Training
- Plumbing (City and Guilds)
- Location of Underground services
- Sign, Lighting & Guarding
- Water Hygiene Card

4. Methodology

ISCO 2150 flow modules was used in combination with Area Velocity (AV) probes. The AV probe was fitted to a 2mm stainless steel insert that was subsequently centred and fixed at the inlet or outlet of the flow stream depending on which was more appropriate for the most accurate measurement.

The flowmeter probes are calibrated on an annual basis by the suppliers of the equipment, Water Technology. Onsite checks are performed to ensure the data produced is accurate and reliable. This involves connecting a flowmeter to a laptop with Flowlink software, getting an instantaneous level measurement, then comparing this reading to the measured level in the liquid stream. If there are any differences, there is an option to recalibrate the flowmeter with the true level thereby applying the appropriate adjustment to flow rates.

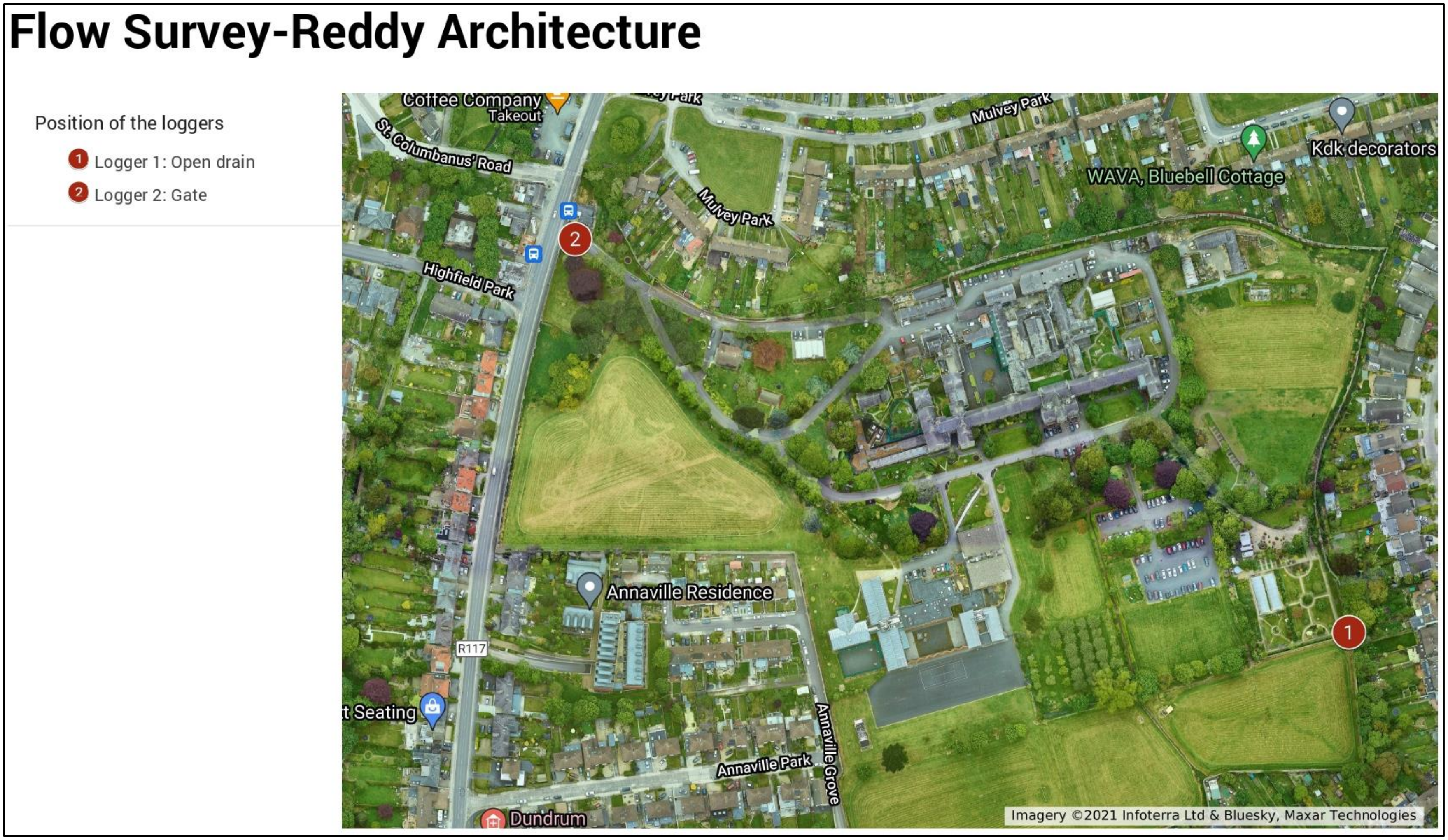
Alternatively, these adjustments can be made retroactively after the data has been considered. Ragging, stones, grit and any number of unspecified solids can potentially interfere with velocity readings, whereas silting can give rise to false levels.

These checks are performed during the installation of the equipment, and during retrieval of equipment if required.

5. Map and pictures of installation

5.1. Interactive Map

To see the Map online, click HERE:



5.2. Pictures of installation

5.2.1. Pictures of the installation on the 25/02/2021

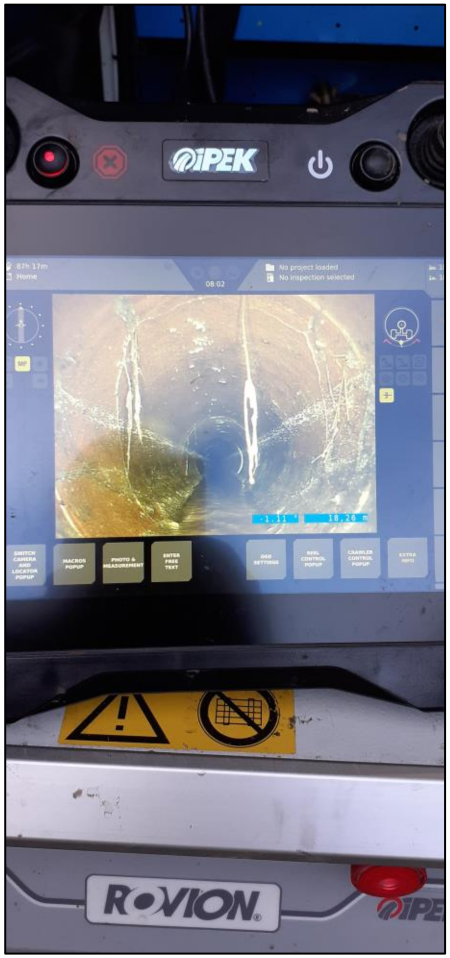
Table 1: Logger at the Open Drain

Table 2: Logger in the Manhole at the gate

5.2.2. Pictures of the CCTV Survey on the 29/03/2021

Table 3: CCTV Survey

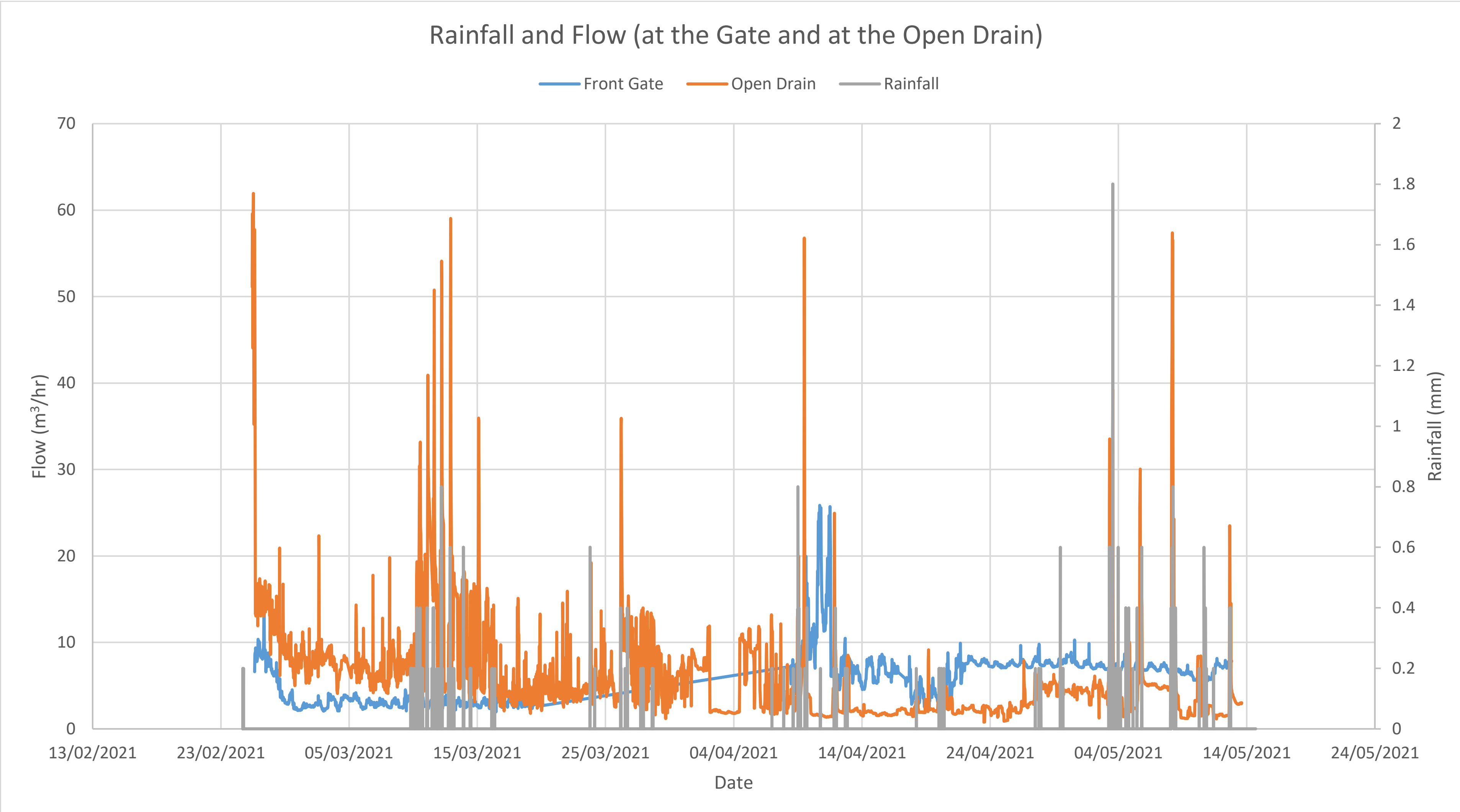
			

5.2.3. Pictures of the flow equipment in chamber

Table 4: Equipment in chamber

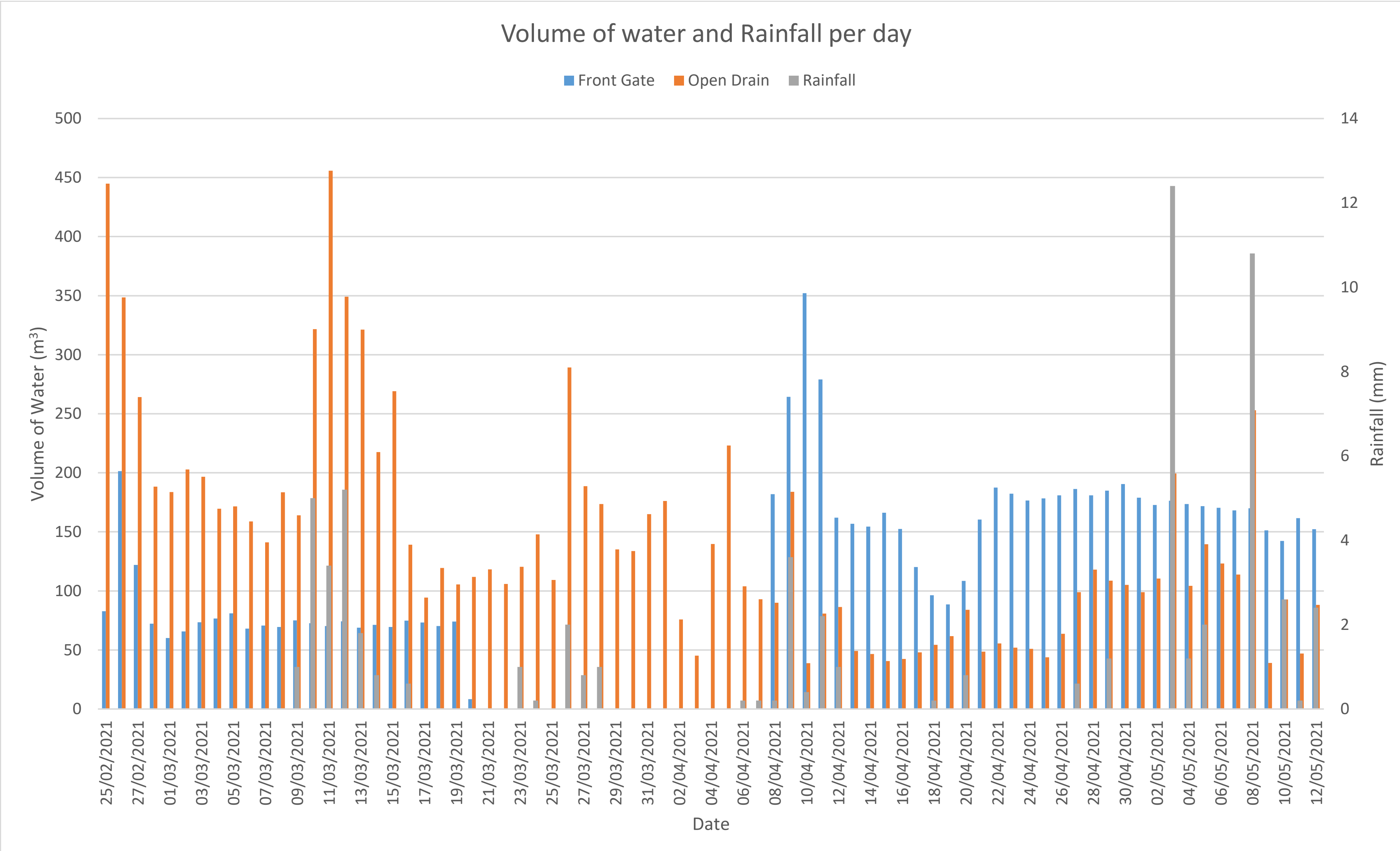
		

6. Flow and Rainfall Graph



See Appendix 1 to see the Volume of water per day at the Gate and at the Open Drain, Appendix 2 for the rainfall Table per day.

7. Volume of Water and Rainfall per day



Should you have any queries do not hesitate to contact me.

Kind Regards,

Charles Dwyer, Managing Director
Lowflo – Water Control & Leak Detection

Appendix 1 – Daily Totals

Date	Water at Front Gate (m^3)	Water at Open Drain (m^3)
25/02/2021	82.831	444.83
26/02/2021	201.373	348.588
27/02/2021	121.943	264.047
28/02/2021	72.299	188.342
01/03/2021	60.041	183.823
02/03/2021	65.721	202.802
03/03/2021	73.391	196.748
04/03/2021	76.586	169.619
05/03/2021	80.922	171.575
06/03/2021	68.057	158.815
07/03/2021	70.71	141.219
08/03/2021	69.441	183.439
09/03/2021	75.079	164.061
10/03/2021	72.673	321.621
11/03/2021	70.306	455.826
12/03/2021	74.171	349.12
13/03/2021	68.841	321.3
14/03/2021	71.238	217.66
15/03/2021	69.483	269.157
16/03/2021	74.877	139.046
17/03/2021	73.163	94.402
18/03/2021	70.266	119.363
19/03/2021	74.04	105.485
20/03/2021	8.405	111.847

Date	Water at Front Gate (m^3)	Water at Open Drain (m^3)
21/03/2021	X	118.2
22/03/2021	X	105.806
23/03/2021	X	120.407
24/03/2021	X	147.959
25/03/2021	X	109.215
26/03/2021	X	289.262
27/03/2021	X	188.767
28/03/2021	X	173.564
29/03/2021	X	135.245
30/03/2021	X	133.754
31/03/2021	X	164.977
01/04/2021	X	176.101
02/04/2021	X	75.784
03/04/2021	X	45.178
04/04/2021	X	139.759
05/04/2021	X	223.073
06/04/2021	X	103.966
07/04/2021	X	92.971
08/04/2021	181.859	90.024
09/04/2021	264.403	183.996
10/04/2021	352.201	38.759
11/04/2021	279.074	80.809
12/04/2021	161.987	86.361
13/04/2021	156.885	49.093

Date	Water at Front Gate (m^3)	Water at Open Drain (m^3)
14/04/2021	154.403	46.611
15/04/2021	166.232	40.671
16/04/2021	152.431	42.497
17/04/2021	120.288	48.024
18/04/2021	96.306	54.285
19/04/2021	88.561	61.696
20/04/2021	108.469	84.06
21/04/2021	160.397	48.477
22/04/2021	187.5	55.532
23/04/2021	182.309	51.936
24/04/2021	176.467	50.931
25/04/2021	178.258	43.699
26/04/2021	181.039	63.68
27/04/2021	186.271	98.886
28/04/2021	180.968	118.021
29/04/2021	184.884	108.659
30/04/2021	190.47	105.128
01/05/2021	178.992	98.955
02/05/2021	172.791	110.528
03/05/2021	176.348	199.418
04/05/2021	173.621	104.309
05/05/2021	171.817	139.635
06/05/2021	170.443	123.198
07/05/2021	168.138	113.814

Date	Water at Front Gate (m^3)	Water at Open Drain (m^3)
08/05/2021	169.942	253.074
09/05/2021	151.19	39.088
10/05/2021	142.282	92.833
11/05/2021	161.687	47.065
12/05/2021	152.285	88.086

Appendix 2 – Rainfall Table per day

Date	Rainfall (mm)
25/02/2021	0
26/02/2021	0
27/02/2021	0
28/02/2021	0
01/03/2021	0
02/03/2021	0
03/03/2021	0
04/03/2021	0
05/03/2021	0
06/03/2021	0
07/03/2021	0
08/03/2021	0
09/03/2021	1
10/03/2021	5
11/03/2021	3.4
12/03/2021	5.2
13/03/2021	1.8
14/03/2021	0.8
15/03/2021	0
16/03/2021	0.6
17/03/2021	0
18/03/2021	0
19/03/2021	0

Date	Rainfall (mm)
20/03/2021	0
21/03/2021	0
22/03/2021	0
23/03/2021	1
24/03/2021	0.2
25/03/2021	0
26/03/2021	2
27/03/2021	0.8
28/03/2021	1
29/03/2021	0
30/03/2021	0
31/03/2021	0
01/04/2021	0
02/04/2021	0
03/04/2021	0
04/04/2021	0
05/04/2021	0
06/04/2021	0.2
07/04/2021	0.2
08/04/2021	0.2
09/04/2021	3.6
10/04/2021	0.4
11/04/2021	2.2

Date	Rainfall (mm)
12/04/2021	1
13/04/2021	0
14/04/2021	0
15/04/2021	0
16/04/2021	0
17/04/2021	0
18/04/2021	0.2
19/04/2021	0
20/04/2021	0.8
21/04/2021	0
22/04/2021	0
23/04/2021	0
24/04/2021	0
25/04/2021	0
26/04/2021	0
27/04/2021	0.6
28/04/2021	0
29/04/2021	1.2
30/04/2021	0
01/05/2021	0
02/05/2021	0
03/05/2021	12.4
04/05/2021	1.2

Date	Rainfall (mm)
05/05/2021	2
06/05/2021	0
07/05/2021	0
08/05/2021	10.8
09/05/2021	0
10/05/2021	2.6
11/05/2021	0.2
12/05/2021	2.4

Appendix 4

Water demand and Wastewater Flow Calculations

BM
BARRETT MAHONY
CONSULTING ENGINEERS
CIVIL & STRUCTURAL

Dublin | London | Sofia
Sandwith House,
52-54 Lower Sandwith Street,
Dublin 2, D02 WR26, Ireland

Phone +353 1 6773200
Email bmce@bmce.ie
www.bmce.ie

	SUMMARY:	Total Peak Flow	Total Average Flow
A:	Residential	21.672 l/s	4.816 l/s
B:	Retail	0.187 l/s	0.042 l/s
C:	Community Centre	0.344 l/s	0.076 l/s
D:	Office	0.069 l/s	0.015 l/s
E:	Restaurant	0.200 l/s	0.044 l/s
F:	Creche	0.413 l/s	0.092 l/s
		22.884 l/s	**5.085 l/s**

A: **RESIDENTIAL - 934no. Apartment**

The wastewater flow from the proposed units is calculated as per the Uisce Éireann Code of Practice for Wastewater Infrastructure assuming dry weather flow of 150 l/head/day plus a 10% infiltration rate and using the Irish Water assumed average occupancy of 2.7 persons/unit. Peaking factor of 4.5 used.

No. of Units = 934
No. of Occupants = 934 x 2.7 = 2521.8

Daily Flow = No. of Occupants x Dry Weather Flow
Daily Flow = 2521.8 x 150 x 1.1 = 416,097 l/day

$$\text{Average Flow} = \frac{\text{Daily Flow}}{\text{Flow Duration}} = \frac{416{,}097 \text{ l/day}}{24 \times 60 \times 60} = \mathbf{4.816 \text{ l/s}}$$

Peak Flow = Average Flow x 4.5
Peak Flow = 4.816 l/s x 4.5 = **21.672 l/s**

B: **RETAIL 1175 sqm in total**

The wastewater flow from the proposed commerical unit is calculated as per the Uisce Éireann Code of Practice for Water Infrastructure assuming a water demand of 50 l/worker/day . Workers calculated: area in m² of area per FTE (Full time equivalent employee); as per Employment Densities Guide from OFFPAT. Type Retail A1 – High street with 1 FTE per 18m².

Area sqm = 1175
No. of Staff = 1175 / 18 = 65.3

Daily Flow = No. of Staff x Dry Weather Flow
Daily Flow = 65.3 x 50 x 1.1 = 3,590 l/day

$$\text{Average Flow} = \frac{\text{Daily Flow}}{\text{Flow Duration}} = \frac{3{,}590 \text{ l/day}}{24 \times 60 \times 60} = \mathbf{0.042 \text{ l/s}}$$

Peak Flow = Average Flow x 4.5
Peak Flow = 0.042 l/s x 4.5 = **0.187 l/s**

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C: **COMMUNITY CENTRE 1725sqm**

The wastewater flow from the proposed centre is calculated as per the Uisce Éireann Code of Practice for Wastewater Infrastructure assuming dry weather flow of 40 l/user/day plus a 10% infiltration rate. The max occupancy will be taken as 150 per day.

No. of Occupants = 150

Daily Flow = No. of Occupants x Dry Weather Flow
Daily Flow = 150.0 x 40 x 1.1 = 6,600 l/day

$$\text{Average Flow} = \frac{\text{Daily Flow}}{\text{Flow Duration}} = \frac{6{,}600 \text{ l/day}}{24 \times 60 \times 60} = \mathbf{0.076\ l/s}$$

Peak Flow = Average Flow x 4.5
Peak Flow = 0.076 l/s x 4.5 = **0.344 l/s**

D: **MEDICAL CENTRE 290sqm**

The wastewater flow from the Medical Centre is calculated as per the Uisce Éireann Code of Practice for Wastewater Infrastructure (latest) treating the centre as office use and assuming dry weather flow of 50 l/worker/day plus a 10% infiltration rate. Workers calculated: area in m² / area per FTE; as per Employment Densities Guide from OFFPAT. Type OFFICE - B1A – General Offices with 12 FTE per m².

Area = 290 m²
Area per FTE in m² = 12

No. of FTE = Area / FTE m²
No. of Occupants = 290 m² / 12 = 24.2

No. of FTE = No. of Occupants x Dry Weather Flow
Daily Flow = 24.2 x 50 x 1.1 = 1,329 l/day

$$\text{Average Flow} = \frac{\text{Daily Flow}}{\text{Flow Duration}} = \frac{1{,}329 \text{ l/day}}{24 \times 60 \times 60} = \mathbf{0.015\ l/s}$$

Peak Flow = Average Flow x 4.5
Peak Flow = 0.015 l/s x 4.5 = **0.069 l/s**

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E: **RESTAURANT/CAFÉ**

- The wastewater flow from the proposed restaurant & Café , 350 sqm in total, is calculated as per the Uisce Éireann Code of Practice for Wastewater Infrastructure assuming dry weather flow of 50 l/head/day plus a 10% infiltration rate for staff and 30l/hd/day +10% for diners.
  Workers calculated: (area in m² per FTE - full time equivalent employee) as per Employment Densities Guide from OFFPAT.
- Type Retail A3: Restaurants & Cafes with 18 sq m per Full Time Employee

STAFF

Area m² = 350 m²

FTE = 1no. FTE per 18 m²

No. of FTE = 350 m² / 18 m² = 19.4

Daily Flow = No. of Workers x Dry Weather Flow x Infiltration Rate

Daily Flow = 19.4 x 50 x 1.1 = 1,069 l/day

$$\text{Average Flow} = \frac{\text{Daily Flow}}{\text{Flow Duration}} = \frac{1{,}069\ \text{l/day}}{24 \times 60 \times 60} = \mathbf{0.012\ l/s}$$

Peak Flow = Average Flow x 4.5

Peak Flow = 0.012 l/s x 4.5 = **0.056 l/s**

DINERS

Dining area = 60% Dining space = 210 m²

Number of diners = 5m² per seat = 42

Assuming 2 sittings / day = 42 x 2 = 84 diners

Daily flow from diners = 84 x 30 l/person/day = 2520 l/day

Average flow (l/s) = Daily flow x 1.1 / (24x60x60) = **0.032 l/s**

Peak Flow (l/s) = Average x 4.5 = **0.144 l/s**

=

RESTAURANT TOTAL

Peak Flow = **0.200 l/s**

Average Flow = **0.044 l/s**

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F: **CRÈCHE 750sqm**

Assume conservatively 120no. children catered for based on 1 child per 5sqm of 80% of the gross floor area. Assume staff:child ratio of 1:5 on average (based on Schedule 6 Part 1 of Child Care Act 1991 (Early Years Services) Regulations 2016.). Thus assume total of 24no. staff + 120no. children = 144no. persons. As per UE CoP for WW Infrastructure Appendix D, assume flow rate for "Schools - non-residential without a canteen" = 50litres/person/day.

No. of Children	=	120					
Staff:Child Ratio	=	1:5					
Total Population	=	120	+	24	=	144	

Daily Flow	=	Population	x	Dry Weather Flow				
Daily Flow	=	144	x	50	x	1.1	=	7,920 l/day

$$\text{Average Flow} = \frac{\text{Daily Flow}}{\text{Flow Duration}} = \frac{7{,}920 \text{ l/day}}{24 \times 60 \times 60} = \mathbf{0.092 \text{ l/s}}$$

Peak Flow	=	Average Flow	x	4.5		
Peak Flow	=	0.092 l/s	x	4.5	=	**0.413 l/s**

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Residential		Commercial	
Population	Peaking Factor	area (ha)	Peaking Factor
0	6	0	4.5
751	4.5	5.5	3.5
1001	3	11	3
5001	2.5	22	2.5
		56	2

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SUMMARY:

		Total Peak Demand	Total Average Demand
A:	Residential	27.363 l/s	5.473 l/s
B:	Retail	0.236 l/s	0.047 l/s
C:	Community Centre	0.543 l/s	0.109 l/s
D:	Office	0.070 l/s	0.014 l/s
D:	Restaurant	0.253 l/s	0.051 l/s
D:	Creche	0.521 l/s	0.104 l/s
		28.985 l/s	**5.797 l/s**

A: **RESIDENTIAL - 934no. Units**

The water demand for the proposed development has been calculated using the guidelines given in the Uisce Eireann Code of Practice for Water Infrastructure assuming a per-capita consumption of 150 l/head/day and using the Irish Water assumed average occupancy of 2.7 persons/unit. The average day/peak week demand is taken as 1.25 times the average daily domestic demand. The peak demand factor is taken as 5 times the average day/peak week demand.

No. of Units = 934
No. of Occupants = 934 x 2.7 = 2521.8

Avg. Daily Demand = No. of Occupants x Allowance per head
Avg. Daily Demand = 2521.8 x 150 = 378,270 l/day

$$\text{Average Demand} = \frac{\text{Daily Demand}}{\text{Demand Duration}} \times 1.25 = \frac{378{,}270 \text{ l/day}}{24 \times 60 \times 60} \times 1.25 = \mathbf{5.473\ l/s}$$

Peak Demand = Average Demand x 5
Peak Demand = 5.473 l/s x 5 = **27.363 l/s**

B: **RETAIL 1175 sqm in total**

The water demand from the proposed retail unit is calculated as per the Uisce Éireann Code of Practice for Water Infrastructure assuming a water demand of 50 l/worker/day . Workers calculated: area in sqm per FTE (Full time equivalent employee); as per Employment Densities Guide from OFFPAT. Type Retail A1 – High street with 1 FTE per 18m².

Area = 1175 m²
Area per FTE in m² = 18

No. of FTE = Area / FTE
No. of Staff = 1175 m² / 18 = 65.3

Daily Demand = Staff x Demand
Daily Demand = 65.3 x 50 = 3,264 l/day

$$\text{Average Demand} = \frac{\text{Daily Demand}}{\text{Demand Duration}} \times 1.25 = \frac{3{,}264 \text{ l/day}}{24 \times 60 \times 60} \times 1.25 = \mathbf{0.047\ l/s}$$

Peak Demand = Average Demand x 5
Peak Demand = 0.047 l/s x 5 = **0.236 l/s**

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C: COMMUNITY CENTRE 1725sqm

The water demand from the proposed centre is calculated as per the Irish Water Code of Practice for Wastewater Infrastructure assuming dry weather flow of 40 l/user/day. The max occupancy will be taken as 150 per day.

No. of Occupants = 150

Daily Demand = No. of Occupants x Demand
= 150.0 x 50 x 1 = 7,500 l/day

$$\text{Average Demand} = \frac{\text{Daily Demand}}{\text{Demand Duration}} \times 1.25 = \frac{7{,}500\ \text{l/day}}{24 \times 60 \times 60} \times 1.25 = \mathbf{0.109\ l/s}$$

Peak Demand = Average Demand x 5
Peak Demand = 0.109 l/s x 5 = **0.543 l/s**

D: Medical Centre 290sqm

The water demand from the Medical Centre is calculated as per the Uisce Eireann Code of Practice for Wastewater Infrastructure (latest) treating the centre as office use and assuming dry weather flow of 50 l/worker/day plus a 10% infiltration rate. Workers calculated: area in m^2 / area per FTE; as per Employment Densities Guide from OFFPAT. Type OFFICE - B1A – General Offices with 12 FTE per m^2.

Area = 290 m^2
Area per FTE in m^2 = 12

No. of FTE = Area / FTE m^2
No. of Occupants = 290 m^2 / 12 = 24.2

No. of FTE = No. of Occupants x Dry Weather Flow
Daily Demand = 24.2 x 50 = 1,208 l/day

$$\text{Average Demand} = \frac{\text{Daily Demand}}{\text{Duration}} = \frac{1{,}208\ \text{l/day}}{24 \times 60 \times 60} = \mathbf{0.014\ l/s}$$

Peak Demand = Average Demand x 5.0
Peak Demand = 0.014 l/s x 5 = **0.070 l/s**

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E: RESTAURANT/CAFÉ

The water demand from the proposed restaurant & Café , 350 sqm in total, is calculated as per the Uisce Éireann Code of Practice for Wastewater Infrastructure assuming dry weather flow of 50 l/head/day plus a 10% infiltration rate for staff and 30l/hd/day +10% for diners. Workers calculated: area in m² of area per FTE; as per Employment Densities Guide from OFFPAT. Type Restaurant – High street with 1 FTE per 18m². Number of diners calculated based on area and

STAFF: Area sqm = 350

Area per FTE = 18

No. of FTE = Area / 18 m²

No. of Staff = 350 m² / 18 = 19.4

Daily Demand = Staff x Demand

Daily Demand = 19.4 x 50 = 972 l/day

$$\text{Average Demand} = \frac{\text{Daily Demand}}{\text{Demand Duration}} \times 1.25 = \frac{972 \text{ l/day}}{24 \times 60 \times 60} \times 1.25 = 0.014 \text{ l/s}$$

Peak Demand = Average Demand x 5

Peak Demand = 0.014 l/s x 5 = **0.070 l/s**

DINERS

Dining area = 60% of total area = 210 m^2

Number of diners = $5m^2$ per seat = 42

Assume 2 sittings/day = = 84 diners

Daily demand = 72 x 30 l/person/day = 2520 l/day

Average Demand (l/s) = Daily Demand x 1.25 / (24x60x60) = **0.036 l/s**

Peak Demand (l/s) = Average x 5 = **0.182 l/s**

=

RESTAURANT TOTAL

Peak Demand = **0.253 l/s**

Average Demand = **0.051 l/s**

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F **CRÈCHE 400sqm**

Assume conservatively 120no. children catered for based on 1 child per 5sqm of 80% of the gross floor area. Assume staff:child ratio of 1:5 on average (based on Schedule 6 Part 1 of Child Care Act 1991 (Early Years Services) Regulations 2016.). Thus assume total of 24no. staff + 120no. children = 144no. persons. As per UE CoP for WW Infrastructure Appendix D, assume flow rate for "Schools - non-residential without a canteen" = 50litres/person/day.

No. of Children = 120
Staff:Child Ratio = 1:5
Total Population = 120 + 24 = 144

Daily Demand = No. of occupants x Demand
Daily Demand = 144 x 50 = 7,200 l/day

$$\text{Average Demand} = \frac{\text{Daily Demand}}{\text{Demand Duration}} \times 1.25 = \frac{7{,}200 \text{ l/day}}{24 \times 60 \times 60} \times 1.25 = \mathbf{0.104\ l/s}$$

Peak Demand = Average Demand x 5
Peak Demand = 0.104 l/s x 5 = **0.521 l/s**

Appendix 5

Uisce Éireann Confirmation of Feasibility Letter

Uisce Éireann Statement of Design Acceptance

CONFIRMATION OF FEASIBILITY

Uisce Éireann
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Cathair Chorcaí

Uisce Éireann
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South City Delivery Office
Cork City

www.water.ie

John Considine

Barrett Mahony
Sandwith House
52-54 Lower Sandwith Street
Dublin

26 March 2024

Our Ref: CDS24000356 Pre-Connection Enquiry
Former Central Mental Hospital, Dundrum Road, Dundrum, Dublin

Dear Applicant/Agent,

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

Uisce Éireann has reviewed the pre-connection enquiry in relation to a Water & Wastewater connection for a Multi/Mixed Use Development of 950 unit(s) at Former Central Mental Hospital, Dundrum Road, Dundrum, Dublin, (the **Development)**.

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

- **Water Connection** - Feasible without infrastructure upgrade by Uisce Éireann

- **Wastewater Connection** - Feasible without infrastructure upgrade by Uisce Éireann subject to following:

- The Developer will be required to implement wastewater discharge management to limit the foul flows from the Development to 3DWF. The exact pump flow rate will be agreed at a connection application stage.
- Current storm water discharge from the Site (approx. 3900sqm of hard standing area) must be removed from the combined network and separate storm and foul water connection services to be provided for the Development. The storm water must be discharged only into the existing

storm water network that is not connected to an Uisce Éireann network. Further information, verified by surveys, is to be provided at a connection application stage and before any existing infrastructure is demolished, regarding the current storm connection.

- Proposed basement carparks must be designed such that surface water from the Site and/or surrounding areas cannot flow down to the carparks. Wastewater from the carparks (contaminated water generated from run off from cars/tyres) must be pumped to ground level to discharge by gravity to the Uisce Éireann Network via a petrol interceptor.

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

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

Where can you find more information?

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

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

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

Yours sincerely,

Dermot Phelan
Connections Delivery Manager

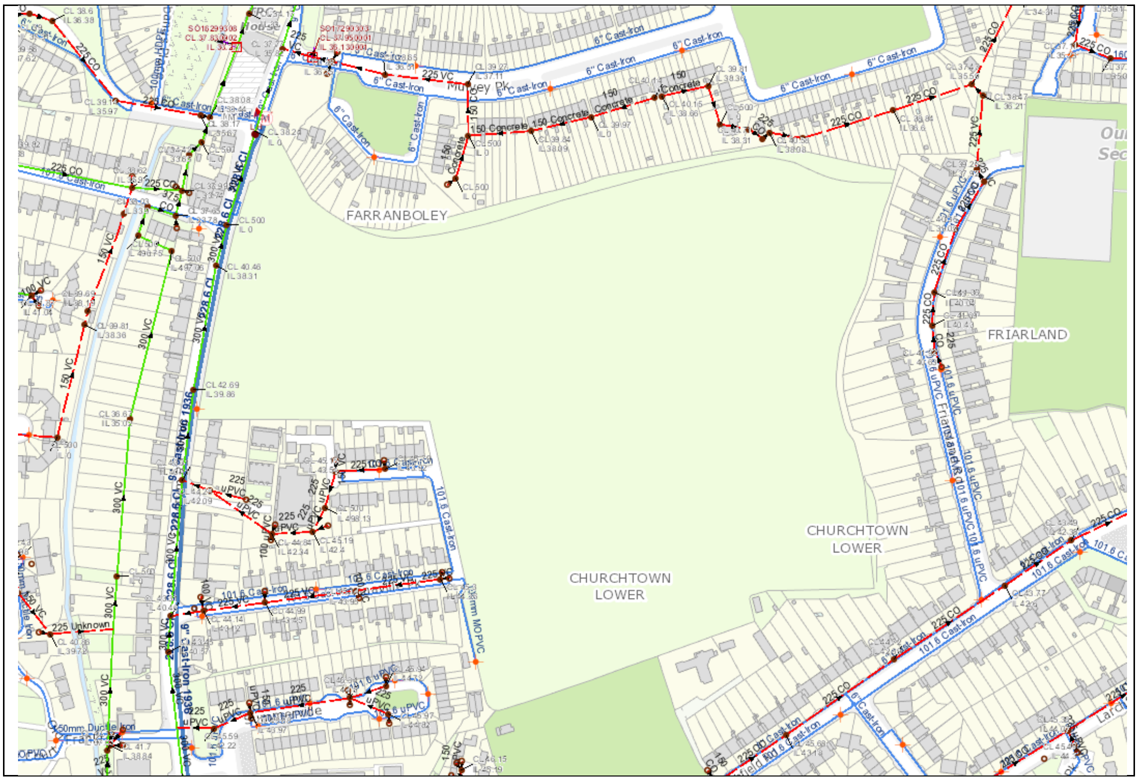
Section A - What is important to know?

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

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

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

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



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

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

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

John Considine
Barrett Mahony Consulting Engineers Limited
Sandwith House
52-54 Lower Sandwith Street
Dublin

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

Uisce Éireann
PO Box 448
South City Delivery Office
Cork City

www.water.ie

31 July 2024

Re: Design Submission for Former Central Mental Hospital, Dundrum Road, Dundrum, Dublin (the "Development")
(the "Design Submission") / Connection Reference No: CDS24000356

Dear John Considine,

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, Uisce Éireann has no objection to your proposals.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Uisce Éireann infrastructure. Before you can connect to our network you must sign a connection agreement with Uisce Éireann. This can be applied for by completing the connection application form at www.water.ie/connections. Uisce Éireann'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 Uisce Éireann's network(s) (the "**Self-Lay Works**"), as reflected in your Design Submission. Acceptance of the Design Submission by Uisce Éireann does not, in any way, render Uisce Éireann liable for any elements of the design and/or construction of the Self-Lay Works.

If you have any further questions, please contact your Uisce Éireann representative:
Name: Antonio Garzón Mielgo
Email: antonio.garzonmielgo@water.ie

Yours sincerely,

Dermot Phelan
Connections Delivery Manager

Appendix A

Document Title & Revision

- DCD-BMD-00-00-DR-C-11021 BURIED FOUL WATER DRAINAGE LAYOUT
- DCD-BMD-00-00-DR-C-11040 BURIED WATERMAIN LAYOUT
- DCD-BMD-00-00-DR-C-DRAINAGE-11110 Foul Water Drainage Sections 1 of 2
- DCD-BMD-00-00-DR-C-DRAINAGE-11111 Foul Water Drainage Sections 2 of 2

Standard Details/Code of Practice Exemption:
<if any – delete if not required>

1. *Proposed use of PVC-A Watermain*
2. *Proprietary wastewater inspection chamber unit*

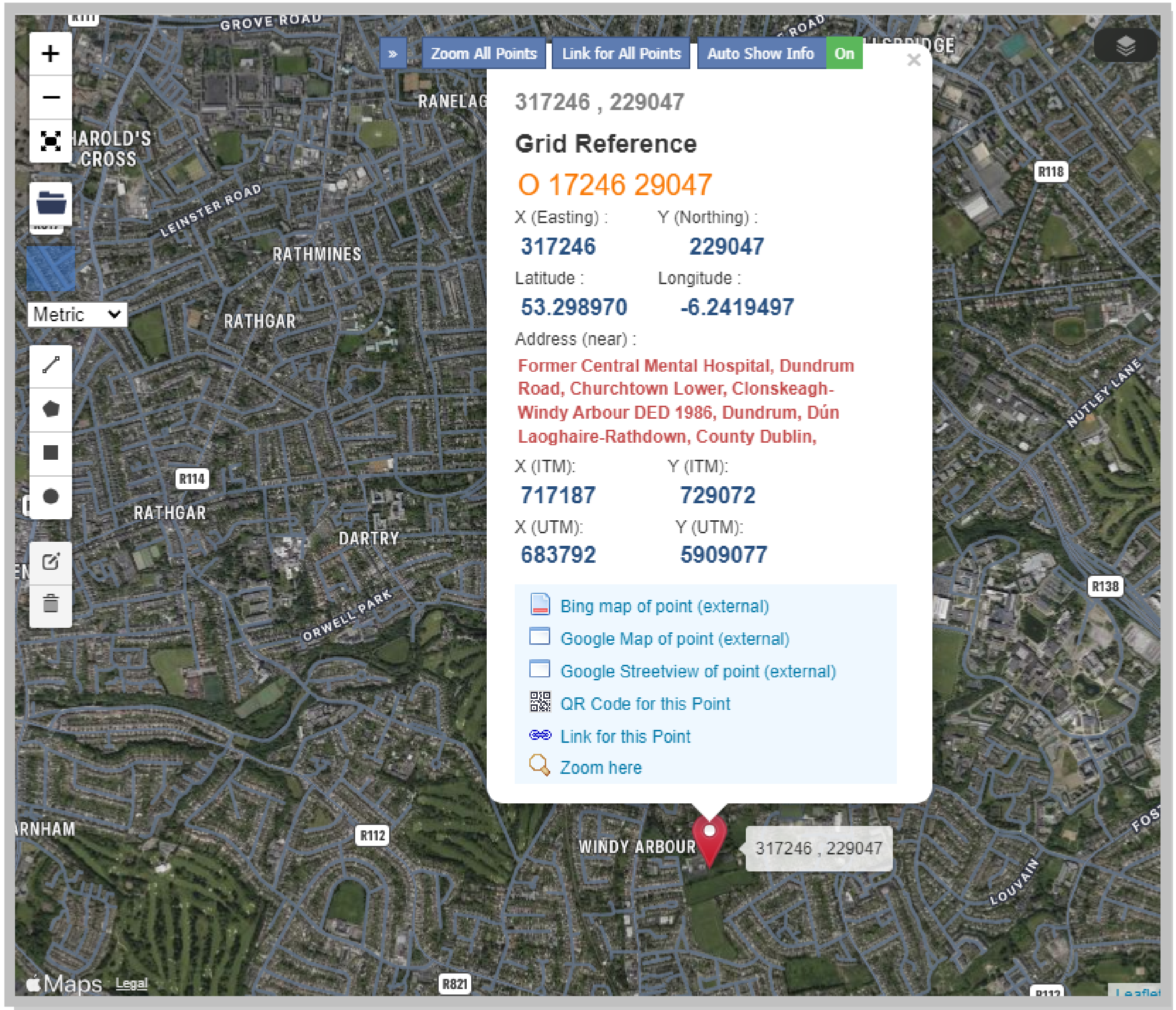
*For further information, visit **www.water.ie/connections***

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

Appendix 6

Causeway Flow Network Model

Former CMH Dundrum



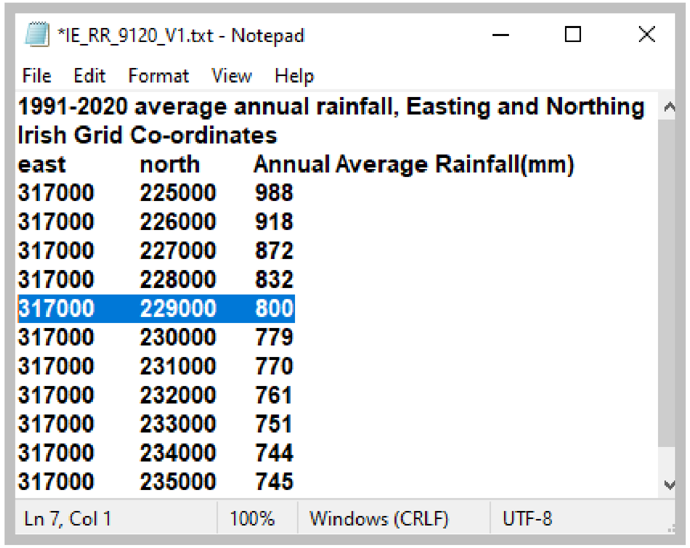
Irish National Grid Coordinates (ING) for approximate centre of site:
Easting: 317246
Northing: 229047

Source:
irish.gridreferencefinder.com

With reference to Met Eireann 1991-2020 Annual Average Rainfall Grid, and using nearest rounded ING Coordinates:

Easting: 317000
Northing: 229000

SAAR = 800mm


*IE_RR_9120_V1.txt - Notepad
File Edit Format View Help

1991-2020 average annual rainfall, Easting and Northing
Irish Grid Co-ordinates

east	north	Annual Average Rainfall(mm)
317000	225000	988
317000	226000	918
317000	227000	872
317000	228000	832
317000	229000	800
317000	230000	779
317000	231000	770
317000	232000	761
317000	233000	751
317000	234000	744
317000	235000	745

Ln 7, Col 1 100% Windows (CRLF) UTF-8

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Former CMH Dundrum

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 317246, Northing: 229047,

M5-60 = 17.2
M5-2D = 62.2
Ratio r = 0.277

	Interval		Years										
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	120,
5 mins	2.5,	3.7,	4.3,	5.3,	5.9,	6.4,	8.1,	10.1,	11.4,	13.3,	15.0,	16.3,	17.2,
10 mins	3.5,	5.1,	6.0,	7.3,	8.3,	9.0,	11.3,	14.1,	15.9,	18.5,	20.9,	22.7,	24.0,
15 mins	4.2,	6.0,	7.1,	8.6,	9.7,	10.6,	13.4,	16.6,	18.7,	21.8,	24.6,	26.7,	28.2,
30 mins	5.5,	7.9,	9.2,	11.1,	12.5,	13.5,	16.9,	20.9,	23.5,	27.2,	30.5,	33.1,	34.8,
1 hours	7.3,	10.3,	11.9,	14.3,	16.0,	17.2,	21.5,	26.2,	29.4,	33.8,	37.8,	40.9,	43.0,
2 hours	9.6,	13.4,	15.4,	18.4,	20.5,	22.0,	27.2,	33.0,	36.8,	42.1,	46.9,	50.5,	53.0,
3 hours	11.3,	15.6,	17.9,	21.4,	23.7,	25.5,	31.2,	37.7,	42.0,	47.9,	53.2,	57.2,	59.9,
4 hours	12.7,	17.5,	20.0,	23.7,	26.2,	28.2,	34.5,	41.5,	46.1,	52.5,	58.1,	62.5,	65.4,
6 hours	14.9,	20.4,	23.3,	27.5,	30.3,	32.5,	39.6,	47.4,	52.6,	59.7,	65.9,	70.7,	74.0,
9 hours	17.6,	23.8,	27.1,	31.9,	35.1,	37.6,	45.5,	54.3,	59.9,	67.8,	74.8,	80.1,	83.6,
12 hours	19.7,	26.6,	30.2,	35.4,	38.9,	41.6,	50.2,	59.7,	65.8,	74.3,	81.8,	87.5,	91.3,
18 hours	23.2,	31.1,	35.1,	41.1,	45.0,	48.0,	57.7,	68.2,	75.1,	84.5,	92.7,	99.0,	103.2,
24 hours	26.1,	34.7,	39.1,	45.6,	49.9,	53.2,	63.6,	75.0,	82.4,	92.6,	101.4,	108.1,	112.6,
2 days	32.4,	42.1,	47.0,	54.1,	58.7,	62.2,	73.3,	85.2,	92.8,	103.2,	112.2,	119.0,	123.5,
3 days	37.8,	48.3,	53.6,	61.2,	66.2,	69.9,	81.6,	94.1,	102.0,	112.8,	122.0,	129.0,	133.6,
4 days	42.6,	53.9,	59.6,	67.6,	72.9,	76.8,	89.1,	102.1,	110.4,	121.5,	131.0,	138.2,	142.9,
6 days	51.2,	63.9,	70.2,	79.1,	84.8,	89.1,	102.4,	116.4,	125.2,	137.0,	147.1,	154.6,	159.6,
8 days	59.0,	72.9,	79.7,	89.3,	95.5,	100.1,	114.3,	129.2,	138.5,	150.9,	161.5,	169.4,	174.6,
10 days	66.3,	81.3,	88.6,	98.8,	105.4,	110.2,	125.3,	141.0,	150.7,	163.7,	174.7,	182.9,	188.3,
12 days	73.3,	89.2,	96.9,	107.8,	114.7,	119.8,	135.6,	152.0,	162.2,	175.7,	187.1,	195.6,	201.2,
16 days	86.4,	104.1,	112.6,	124.5,	132.1,	137.7,	154.8,	172.5,	183.4,	197.9,	210.1,	219.1,	225.1,
20 days	98.7,	118.1,	127.3,	140.2,	148.3,	154.3,	172.7,	191.5,	203.1,	218.5,	231.3,	240.8,	247.1,
25 days	113.5,	134.7,	144.7,	158.7,	167.4,	174.0,	193.7,	213.9,	226.2,	242.5,	256.1,	266.2,	272.7,

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

Catchment A 50% Blockage

Design Settings

Rainfall Methodology	FSR
Return Period (years)	5
Additional Flow (%)	0
FSR Region	Scotland and Ireland
M5-60 (mm)	17.200
Ratio-R	0.277
CV	1.000
Time of Entry (mins)	4.00

Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	0.200
Preferred Cover Depth (m)	1.200
Include Intermediate Ground	✓
Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SA2.0	0.061	4.00	45.060	1200	717097.039	729089.118	1.834
SA2.1	0.057	4.00	44.930	1200	717087.288	729120.781	1.932
SA5.0	0.000	4.00	44.788	1200	717088.224	729156.267	1.588
SA2.2	0.010	4.00	44.470	1200	717079.012	729148.537	1.889
SA1.3	0.010	4.00	43.950	1350	717061.931	729168.574	2.670
SA1.4	0.038	4.00	43.830	1350	717039.272	729185.812	2.888
SA1.5	0.000	4.00	43.760	1350	717020.349	729192.986	3.032
SA3.0	0.449	4.00	43.810	1200	717016.760	729179.141	3.035
SA3.1	0.000		43.720	1200	717015.047	729190.702	2.985
SA1.6	0.015	4.00	43.620	1350	717016.374	729201.864	3.058
SA1.7	0.015	4.00	43.400	1350	717027.775	729210.408	3.046
SA1.8	0.035	4.00	43.750	1350	717064.398	729222.016	3.445
SA1.9	0.000	4.00	43.630	1350	717060.837	729233.253	4.780
SA1.10	0.000		42.960	1350	717045.766	729241.884	4.268
SA1.11	0.000		42.640	1350	717012.882	729231.460	4.179
SA1.12	0.009	4.00	43.070	1350	716997.720	729219.867	4.739
SA1.13	0.013	4.00	42.070	1350	716982.713	729238.540	3.889
SA1.14	0.017	4.00	40.220	1350	716969.397	729265.837	2.239
SA1.15	0.000	4.00	39.270	1350	716947.768	729283.408	1.883
SA4.0	0.057	4.00	43.520	1200	716965.035	729149.817	1.420
SA4.1	0.062	4.00	43.410	1200	716945.309	729149.463	1.575
SA4.2	0.048	4.00	42.640	1200	716907.781	729148.788	1.804
SA4.3	0.012	4.00	42.780	1200	716905.285	729155.311	1.986
SA4.4	0.000		42.950	1200	716907.374	729167.976	2.220
SA4.5	0.000	4.00	43.240	1200	716912.505	729199.090	2.668
SA4.6	0.000	4.00	43.130	1200	716920.555	729242.480	2.779
SA4.7	0.000	4.00	43.330	1200	716924.312	729241.782	3.670
SA4.8	0.000		41.700	1200	716929.196	729258.772	3.815
SA4.9	0.000		41.250	1200	716926.123	729264.265	3.700
SA1.16	0.060	4.00	38.770	1350	716933.905	729291.990	1.795
SA1.17	0.000		38.740	1350	716924.013	729294.106	1.918
SA1.2	0.055	4.00	44.130	1200	717062.142	729151.563	2.732
SA1.0	0.047	4.00	43.600	1200	716979.717	729150.081	1.400
SA1.1	0.084	4.00	43.840	1200	717028.148	729150.964	2.155

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
2.000	SA2.0	SA2.1	33.140	0.600	43.226	42.998	0.228	145.4	225	4.51	50.0
2.001	SA2.1	SA2.2	28.970	0.600	42.998	42.653	0.345	84.0	225	4.85	50.0
3.000	SA5.0	SA2.2	12.026	0.600	43.200	42.981	0.219	54.9	225	4.11	50.0
2.002	SA2.2	SA1.3	26.340	0.600	42.581	42.153	0.428	61.5	300	5.07	50.0
1.000	SA1.0	SA1.1	48.450	0.600	42.200	41.715	0.485	100.0	225	4.62	50.0
1.001	SA1.1	SA1.2	34.010	0.600	41.685	41.398	0.287	118.5	225	5.09	50.0
1.002	SA1.2	SA1.3	17.020	0.600	41.398	41.280	0.118	144.2	300	5.31	50.0
1.003	SA1.3	SA1.4	24.480	0.600	41.280	40.942	0.338	72.4	375	5.50	50.0
1.004	SA1.4	SA1.5	20.240	0.600	40.942	40.728	0.214	94.6	375	5.68	50.0
1.005	SA1.5	SA1.6	9.730	0.600	40.728	40.562	0.166	58.6	375	5.75	50.0
4.000	SA3.0	SA3.1	3.770	0.600	40.775	40.735	0.040	94.3	300	4.04	50.0
4.001	SA3.1	SA1.6	11.690	0.600	40.735	40.562	0.173	67.6	300	4.14	50.0
1.006	SA1.6	SA1.7	14.250	0.600	40.562	40.354	0.208	68.5	375	5.86	50.0
1.007	SA1.7	SA1.8	38.419	0.600	40.354	40.305	0.049	784.1	375	6.86	50.0
1.008	SA1.8	SA1.9	11.790	0.600	40.305	40.260	0.045	262.0	450	7.02	50.0
1.009	SA1.9	SA1.10	17.370	0.600	38.850	38.692	0.158	109.9	450	7.16	50.0
1.010	SA1.10	SA1.11	34.500	0.600	38.692	38.461	0.231	149.4	450	7.51	50.0
1.011	SA1.11	SA1.12	19.090	0.600	38.461	38.331	0.130	146.8	450	7.70	50.0
1.012	SA1.12	SA1.13	23.960	0.600	38.331	38.181	0.150	159.7	450	7.95	50.0
1.013	SA1.13	SA1.14	30.380	0.600	38.181	37.981	0.200	151.9	450	8.26	50.0
1.014	SA1.14	SA1.15	27.880	0.600	37.981	37.387	0.594	46.9	450	8.41	50.0
1.015	SA1.15	SA1.16	16.310	0.600	37.387	37.000	0.387	42.1	450	8.50	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
2.000	1.082	43.0	11.0	1.609	1.707	0.061	0.0	78	0.911
2.001	1.428	56.8	21.3	1.707	1.592	0.118	0.0	95	1.328
3.000	1.768	70.3	0.0	1.363	1.264	0.000	0.0	0	0.000
2.002	2.007	141.9	23.1	1.589	1.497	0.128	0.0	81	1.488
1.000	1.307	52.0	8.5	1.175	1.900	0.047	0.0	61	0.967
1.001	1.200	47.7	23.7	1.930	2.507	0.131	0.0	112	1.198
1.002	1.307	92.4	33.6	2.432	2.370	0.186	0.0	125	1.207
1.003	2.131	235.4	58.5	2.295	2.513	0.324	0.0	127	1.782
1.004	1.863	205.8	65.4	2.513	2.657	0.362	0.0	145	1.660
1.005	2.370	261.8	65.4	2.657	2.683	0.362	0.0	127	1.982
4.000	1.620	114.5	81.1	2.735	2.685	0.449	0.0	187	1.753
4.001	1.915	135.4	81.1	2.685	2.758	0.449	0.0	168	1.999
1.006	2.191	242.0	149.3	2.683	2.671	0.826	0.0	214	2.301
1.007	0.639	70.6	152.0	2.671	3.070	0.841	0.0	375	0.647
1.008	1.251	199.0	158.3	2.995	2.920	0.876	0.0	305	1.382
1.009	1.938	308.2	158.3	4.330	3.818	0.876	0.0	229	1.952
1.010	1.661	264.2	158.3	3.818	3.729	0.876	0.0	252	1.733
1.011	1.675	266.4	158.3	3.729	4.289	0.876	0.0	250	1.744
1.012	1.606	255.4	159.9	4.289	3.439	0.885	0.0	259	1.692
1.013	1.647	261.9	162.3	3.439	1.789	0.898	0.0	257	1.731
1.014	2.973	472.8	165.3	1.789	1.433	0.915	0.0	183	2.720
1.015	3.138	499.1	165.3	1.433	1.320	0.915	0.0	178	2.832

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
5.000	SA4.0	SA4.1	19.740	0.600	42.100	41.835	0.265	74.5	225	4.22	50.0
5.001	SA4.1	SA4.2	37.540	0.600	41.835	41.336	0.499	75.2	225	4.63	50.0
5.002	SA4.2	SA4.3	6.990	0.600	40.836	40.794	0.042	166.4	225	4.75	50.0
5.003	SA4.3	SA4.4	12.840	0.600	40.794	40.730	0.064	200.6	225	4.98	50.0
5.004	SA4.4	SA4.5	31.540	0.600	40.730	40.572	0.158	199.6	225	5.55	50.0
5.005	SA4.5	SA4.6	44.140	0.600	40.572	40.351	0.221	199.7	225	6.35	50.0
5.006	SA4.6	SA4.7	3.830	0.600	40.351	40.332	0.019	201.6	225	6.42	50.0
5.007	SA4.7	SA4.8	17.678	0.600	39.660	37.885	1.775	10.0	225	6.49	50.0
5.008	SA4.8	SA4.9	6.300	0.600	37.885	37.860	0.025	252.0	225	6.62	50.0
5.009	SA4.9	SA1.16	28.210	0.600	37.550	36.975	0.575	49.1	225	6.87	50.0
1.016	SA1.16	SA1.17	10.120	0.600	36.975	36.822	0.153	66.1	450	8.57	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
5.000	1.517	60.3	10.3	1.195	1.350	0.057	0.0	63	1.140
5.001	1.509	60.0	21.5	1.350	1.079	0.119	0.0	93	1.385
5.002	1.010	40.2	30.2	1.579	1.761	0.167	0.0	145	1.106
5.003	0.919	36.5	32.3	1.761	1.995	0.179	0.0	165	1.034
5.004	0.922	36.6	32.3	1.995	2.443	0.179	0.0	165	1.037
5.005	0.921	36.6	32.3	2.443	2.554	0.179	0.0	165	1.036
5.006	0.917	36.5	32.3	2.554	2.773	0.179	0.0	166	1.032
5.007	4.170	165.8	32.3	3.445	3.590	0.179	0.0	67	3.257
5.008	0.819	32.6	32.3	3.590	3.165	0.179	0.0	184	0.930
5.009	1.872	74.4	32.3	3.475	1.570	0.179	0.0	103	1.805
1.016	2.502	398.0	208.5	1.345	1.468	1.154	0.0	232	2.531

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	Scotland and Ireland	Drain Down Time (mins)	240
M5-60 (mm)	17.200	Additional Storage (m³/ha)	20.0
Ratio-R	0.277	Check Discharge Rate(s)	x
Summer CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

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

Node SA1.8 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	40.305	Product Number	CTL-SHE-0070-3000-2000-3000
Design Depth (m)	2.000	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.0	Min Node Diameter (mm)	1200

Node SA3.0 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	40.775	Product Number	CTL-SHE-0057-2000-2000-2000
Design Depth (m)	2.000	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node SA4.8 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	37.885	Product Number	CTL-SHE-0057-2000-2000-2000
Design Depth (m)	2.000	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node SA1.16 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	36.975	Product Number	CTL-SHE-0084-4000-1800-4000
Design Depth (m)	1.800	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	4.0	Min Node Diameter (mm)	1200

Node SA1.8 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.26400	Safety Factor	5.0	Invert Level (m)	40.305
Side Inf Coefficient (m/hr)	0.26400	Porosity	1.00	Time to half empty (mins)	128

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	238.7	238.7	1.525	238.7	394.7	1.526	0.0	394.7

Node SA3.0 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	40.775
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	182.2	0.0	2.000	182.2	0.0	2.010	0.0	0.0

Node SA3.0 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	40.775
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1572.0	0.0	0.065	1572.0	0.0	0.066	0.0	0.0

Node SA4.8 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.26400	Safety Factor	2.0	Invert Level (m)	37.885
Side Inf Coefficient (m/hr)	0.26400	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	77.0	77.0	2.000	77.0	156.4	2.010	0.0	156.4

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 99.59%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SA2.0	10	43.329	0.103	18.6	0.1844	0.0000	OK
15 minute summer	SA2.1	10	43.134	0.136	36.1	0.2343	0.0000	OK
15 minute summer	SA5.0	1	43.200	0.000	0.0	0.0000	0.0000	OK
15 minute summer	SA2.2	10	42.693	0.112	38.8	0.1381	0.0000	OK
15 minute summer	SA1.3	10	41.460	0.180	96.9	0.2704	0.0000	OK
15 minute summer	SA1.4	10	41.154	0.212	107.6	0.3586	0.0000	OK
15 minute summer	SA1.5	11	40.931	0.203	106.6	0.2907	0.0000	OK
5760 minute summer	SA3.0	3720	41.605	0.830	5.2	252.4794	0.0000	SURCHARGED
15 minute summer	SA3.1	11	40.778	0.043	2.1	0.0491	0.0000	OK
15 minute summer	SA1.6	11	40.777	0.215	111.5	0.3291	0.0000	OK
480 minute summer	SA1.7	312	40.709	0.355	26.1	0.5428	0.0000	OK
480 minute summer	SA1.8	336	40.679	0.374	24.9	89.7660	0.0000	OK
120 minute summer	SA1.9	150	38.877	0.027	2.2	0.0387	0.0000	OK
360 minute summer	SA1.10	208	38.721	0.029	2.2	0.0420	0.0000	OK
120 minute summer	SA1.11	148	38.490	0.029	2.2	0.0420	0.0000	OK
60 minute summer	SA1.12	33	38.368	0.037	3.6	0.0543	0.0000	OK
240 minute summer	SA1.13	164	38.312	0.131	4.1	0.1968	0.0000	OK
240 minute summer	SA1.14	164	38.314	0.333	9.5	0.5264	0.0000	OK
240 minute summer	SA1.15	164	38.314	0.927	6.9	1.3263	0.0000	SURCHARGED
15 minute summer	SA4.0	10	42.183	0.083	17.4	0.1604	0.0000	OK
15 minute summer	SA4.1	10	41.966	0.131	36.3	0.2504	0.0000	OK
15 minute summer	SA4.2	11	41.430	0.594	50.7	0.9871	0.0000	SURCHARGED
15 minute summer	SA4.3	11	41.346	0.552	49.9	0.6911	0.0000	SURCHARGED
15 minute summer	SA4.4	11	41.207	0.477	46.8	0.5393	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SA2.0	2.000	SA2.1	18.7	0.874	0.434	0.7083	
15 minute summer	SA2.1	2.001	SA2.2	35.7	1.473	0.629	0.7023	
15 minute summer	SA5.0	3.000	SA2.2	0.0	0.000	0.000	0.0000	
15 minute summer	SA2.2	2.002	SA1.3	38.4	1.670	0.271	0.6058	
15 minute summer	SA1.3	1.003	SA1.4	96.0	1.661	0.408	1.4217	
15 minute summer	SA1.4	1.004	SA1.5	106.6	1.715	0.518	1.2592	
15 minute summer	SA1.5	1.005	SA1.6	107.7	1.729	0.411	0.6146	
5760 minute summer	SA3.0	Hydro-Brake®	SA3.1	1.3				
15 minute summer	SA3.1	4.001	SA1.6	-2.0	0.415	-0.015	0.3528	
15 minute summer	SA1.6	1.006	SA1.7	112.1	1.305	0.463	1.1995	
480 minute summer	SA1.7	1.007	SA1.8	22.9	0.652	0.324	4.1832	
480 minute summer	SA1.8	Hydro-Brake®	SA1.9	2.2				
480 minute summer	SA1.8	Infiltration		4.0				
120 minute summer	SA1.9	1.009	SA1.10	2.2	0.538	0.007	0.0709	
360 minute summer	SA1.10	1.010	SA1.11	2.2	0.513	0.008	0.1484	
120 minute summer	SA1.11	1.011	SA1.12	2.2	0.506	0.008	0.0932	
60 minute summer	SA1.12	1.012	SA1.13	3.6	0.503	0.014	0.1922	
240 minute summer	SA1.13	1.013	SA1.14	4.3	0.657	0.016	2.4917	
240 minute summer	SA1.14	1.014	SA1.15	5.4	0.896	0.011	3.9595	
240 minute summer	SA1.15	1.015	SA1.16	3.4	0.312	0.007	2.5842	
15 minute summer	SA4.0	5.000	SA4.1	17.4	0.952	0.289	0.3667	
15 minute summer	SA4.1	5.001	SA4.2	36.1	1.552	0.601	0.8719	
15 minute summer	SA4.2	5.002	SA4.3	46.2	1.163	1.151	0.2780	
15 minute summer	SA4.3	5.003	SA4.4	46.8	1.176	1.280	0.5107	
15 minute summer	SA4.4	5.004	SA4.5	44.7	1.125	1.221	1.2544	

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 99.59%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SA4.5	12	40.940	0.368	44.7	0.4161	0.0000	SURCHARGED
15 minute summer	SA4.6	12	40.584	0.233	44.3	0.2633	0.0000	SURCHARGED
15 minute summer	SA4.7	11	39.743	0.083	44.5	0.0939	0.0000	OK
240 minute summer	SA4.8	172	38.274	0.389	16.3	30.4232	0.0000	SURCHARGED
240 minute summer	SA4.9	164	38.314	0.764	1.3	0.8641	0.0000	SURCHARGED
240 minute summer	SA1.16	164	38.314	1.339	7.7	2.8116	0.0000	SURCHARGED
15 minute summer	SA1.17	1	36.822	0.000	3.3	0.0000	0.0000	OK
15 minute summer	SA1.2	10	41.583	0.185	56.0	0.2845	0.0000	OK
15 minute summer	SA1.0	10	42.280	0.080	14.4	0.1446	0.0000	OK
15 minute summer	SA1.1	10	41.848	0.163	39.9	0.3107	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SA4.5	5.005	SA4.6	44.3	1.115	1.210	1.7555	
15 minute summer	SA4.6	5.006	SA4.7	44.5	1.172	1.219	0.1401	
15 minute summer	SA4.7	5.007	SA4.8	44.5	3.913	0.269	0.3951	
240 minute summer	SA4.8	Hydro-Brake®	SA4.9	1.3				
240 minute summer	SA4.8	Infiltration		3.3				
240 minute summer	SA4.9	5.009	SA1.16	1.8	0.052	0.024	1.1219	
240 minute summer	SA1.16	Hydro-Brake®	SA1.17	3.5				81.4
15 minute summer	SA1.2	1.002	SA1.3	55.4	1.235	0.600	0.7636	
15 minute summer	SA1.0	1.000	SA1.1	14.3	0.807	0.276	0.8966	
15 minute summer	SA1.1	1.001	SA1.2	39.2	1.191	0.823	1.1180	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.59%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SA2.0	10	43.355	0.129	27.3	0.2314	0.0000	OK
15 minute summer	SA2.1	10	43.181	0.183	52.8	0.3153	0.0000	OK
15 minute summer	SA5.0	1	43.200	0.000	0.0	0.0000	0.0000	OK
15 minute summer	SA2.2	10	42.720	0.139	56.6	0.1720	0.0000	OK
15 minute summer	SA1.3	10	41.506	0.226	135.1	0.3396	0.0000	OK
15 minute summer	SA1.4	11	41.221	0.279	149.7	0.4729	0.0000	OK
15 minute summer	SA1.5	11	41.031	0.303	149.5	0.4329	0.0000	OK
4320 minute summer	SA3.0	2940	42.064	1.289	8.0	337.9194	0.0000	SURCHARGED
15 minute summer	SA3.1	11	40.961	0.226	7.0	0.2560	0.0000	OK
15 minute summer	SA1.6	11	40.962	0.400	151.8	0.6109	0.0000	SURCHARGED
480 minute summer	SA1.7	352	40.904	0.550	33.1	0.8411	0.0000	SURCHARGED
480 minute summer	SA1.8	360	40.902	0.597	34.9	143.5757	0.0000	SURCHARGED
30 minute summer	SA1.9	83	38.877	0.027	2.2	0.0387	0.0000	OK
30 minute summer	SA1.10	24	38.721	0.029	2.2	0.0420	0.0000	OK
240 minute summer	SA1.11	168	38.578	0.117	2.2	0.1677	0.0000	OK
240 minute summer	SA1.12	164	38.578	0.247	3.5	0.3634	0.0000	OK
240 minute summer	SA1.13	168	38.578	0.397	5.1	0.5947	0.0000	OK
240 minute summer	SA1.14	168	38.578	0.597	9.1	0.9447	0.0000	SURCHARGED
240 minute summer	SA1.15	168	38.578	1.191	6.1	1.7037	0.0000	SURCHARGED
15 minute summer	SA4.0	9	42.204	0.104	25.5	0.2019	0.0000	OK
15 minute summer	SA4.1	11	42.205	0.370	53.4	0.7090	0.0000	SURCHARGED
15 minute summer	SA4.2	11	41.953	1.117	69.2	1.8578	0.0000	SURCHARGED
15 minute summer	SA4.3	12	41.828	1.034	62.1	1.2949	0.0000	SURCHARGED
15 minute summer	SA4.4	12	41.633	0.903	57.2	1.0218	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SA2.0	2.000	SA2.1	27.3	0.947	0.636	0.9631	
15 minute summer	SA2.1	2.001	SA2.2	52.1	1.575	0.919	0.9610	
15 minute summer	SA5.0	3.000	SA2.2	0.0	0.000	0.000	0.0000	
15 minute summer	SA2.2	2.002	SA1.3	56.1	1.836	0.396	0.8053	
15 minute summer	SA1.3	1.003	SA1.4	134.7	1.718	0.572	1.9219	
15 minute summer	SA1.4	1.004	SA1.5	149.5	1.758	0.727	1.8541	
15 minute summer	SA1.5	1.005	SA1.6	146.2	1.756	0.559	1.0001	
4320 minute summer	SA3.0	Hydro-Brake®	SA3.1	1.6				
15 minute summer	SA3.1	4.001	SA1.6	-7.0	0.495	-0.052	0.7449	
15 minute summer	SA1.6	1.006	SA1.7	148.2	1.344	0.612	1.5717	
480 minute summer	SA1.7	1.007	SA1.8	32.1	0.697	0.454	4.2375	
480 minute summer	SA1.8	Hydro-Brake®	SA1.9	2.2				
480 minute summer	SA1.8	Infiltration		4.4				
30 minute summer	SA1.9	1.009	SA1.10	2.2	0.538	0.007	0.0709	
30 minute summer	SA1.10	1.010	SA1.11	2.2	0.514	0.008	0.1485	
240 minute summer	SA1.11	1.011	SA1.12	2.4	0.505	0.009	1.1645	
240 minute summer	SA1.12	1.012	SA1.13	3.4	0.503	0.013	2.8415	
240 minute summer	SA1.13	1.013	SA1.14	5.0	0.665	0.019	4.6553	
240 minute summer	SA1.14	1.014	SA1.15	5.8	0.869	0.012	4.4174	
240 minute summer	SA1.15	1.015	SA1.16	-4.4	0.298	-0.009	2.5842	
15 minute summer	SA4.0	5.000	SA4.1	25.6	1.016	0.424	0.5641	
15 minute summer	SA4.1	5.001	SA4.2	47.7	1.573	0.795	1.4930	
15 minute summer	SA4.2	5.002	SA4.3	56.7	1.425	1.410	0.2780	
15 minute summer	SA4.3	5.003	SA4.4	57.2	1.439	1.566	0.5107	
15 minute summer	SA4.4	5.004	SA4.5	55.4	1.392	1.511	1.2544	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.59%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SA4.5	12	41.211	0.639	55.4	0.7231	0.0000	SURCHARGED
15 minute summer	SA4.6	12	40.633	0.282	55.6	0.3187	0.0000	SURCHARGED
15 minute summer	SA4.7	10	39.750	0.090	55.6	0.1016	0.0000	OK
240 minute summer	SA4.8	184	38.542	0.657	24.5	51.3243	0.0000	SURCHARGED
240 minute summer	SA4.9	164	38.578	1.028	2.5	1.1622	0.0000	SURCHARGED
240 minute summer	SA1.16	168	38.577	1.602	7.8	3.3652	0.0000	FLOOD RISK
15 minute summer	SA1.17	1	36.822	0.000	3.3	0.0000	0.0000	OK
15 minute summer	SA1.2	10	41.634	0.236	75.6	0.3620	0.0000	OK
15 minute summer	SA1.0	10	42.299	0.099	21.1	0.1781	0.0000	OK
15 minute summer	SA1.1	11	42.042	0.357	58.6	0.6826	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SA4.5	5.005	SA4.6	55.6	1.398	1.518	1.7555	
15 minute summer	SA4.6	5.006	SA4.7	55.6	1.405	1.525	0.1460	
15 minute summer	SA4.7	5.007	SA4.8	55.6	3.936	0.335	0.4741	
240 minute summer	SA4.8	Hydro-Brake®	SA4.9	1.2				
240 minute summer	SA4.8	Infiltration		3.7				
240 minute summer	SA4.9	5.009	SA1.16	-2.4	-0.061	-0.033	1.1219	
240 minute summer	SA1.16	Hydro-Brake®	SA1.17	3.8				90.9
15 minute summer	SA1.2	1.002	SA1.3	74.7	1.294	0.809	0.9894	
15 minute summer	SA1.0	1.000	SA1.1	21.1	0.821	0.405	1.3699	
15 minute summer	SA1.1	1.001	SA1.2	53.4	1.343	1.120	1.3526	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.59%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SA2.0	11	43.441	0.215	35.5	0.3861	0.0000	OK
15 minute summer	SA2.1	10	43.316	0.318	67.5	0.5468	0.0000	SURCHARGED
15 minute summer	SA5.0	1	43.200	0.000	0.0	0.0000	0.0000	OK
15 minute summer	SA2.2	10	42.737	0.156	67.9	0.1924	0.0000	OK
15 minute summer	SA1.3	11	41.694	0.414	167.8	0.6234	0.0000	SURCHARGED
15 minute summer	SA1.4	11	41.498	0.556	186.0	0.9428	0.0000	SURCHARGED
15 minute summer	SA1.5	11	41.283	0.555	170.6	0.7943	0.0000	SURCHARGED
4320 minute summer	SA3.0	3000	42.472	1.697	9.7	413.8955	0.0000	SURCHARGED
15 minute summer	SA3.1	11	41.147	0.412	8.1	0.4659	0.0000	SURCHARGED
15 minute summer	SA1.6	11	41.148	0.586	177.2	0.8967	0.0000	SURCHARGED
480 minute summer	SA1.7	384	41.115	0.761	39.3	1.1640	0.0000	SURCHARGED
480 minute summer	SA1.8	384	41.114	0.809	46.2	194.4856	0.0000	SURCHARGED
15 minute summer	SA1.9	59	38.877	0.027	2.2	0.0387	0.0000	OK
180 minute summer	SA1.10	112	38.780	0.088	2.2	0.1256	0.0000	OK
240 minute summer	SA1.11	144	38.775	0.314	4.0	0.4487	0.0000	OK
240 minute summer	SA1.12	144	38.774	0.443	8.2	0.6515	0.0000	OK
240 minute summer	SA1.13	144	38.773	0.592	7.8	0.8866	0.0000	SURCHARGED
180 minute summer	SA1.14	128	38.772	0.791	12.7	1.2524	0.0000	SURCHARGED
180 minute summer	SA1.15	128	38.771	1.384	9.0	1.9805	0.0000	SURCHARGED
15 minute summer	SA4.0	12	42.813	0.713	33.1	1.3798	0.0000	SURCHARGED
15 minute summer	SA4.1	12	42.772	0.937	67.9	1.7967	0.0000	SURCHARGED
15 minute summer	SA4.2	12	42.462	1.626	72.9	2.7036	0.0000	FLOOD RISK
15 minute summer	SA4.3	12	42.306	1.512	70.5	1.8932	0.0000	SURCHARGED
15 minute summer	SA4.4	12	42.032	1.302	66.9	1.4724	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SA2.0	2.000	SA2.1	34.4	0.975	0.799	1.3071	
15 minute summer	SA2.1	2.001	SA2.2	62.1	1.563	1.094	1.1209	
15 minute summer	SA5.0	3.000	SA2.2	0.0	0.000	0.000	0.0000	
15 minute summer	SA2.2	2.002	SA1.3	67.4	1.921	0.475	0.9256	
15 minute summer	SA1.3	1.003	SA1.4	163.9	1.716	0.696	2.7001	
15 minute summer	SA1.4	1.004	SA1.5	170.6	1.766	0.829	2.2324	
15 minute summer	SA1.5	1.005	SA1.6	170.0	1.645	0.649	1.0732	
4320 minute summer	SA3.0	Hydro-Brake®	SA3.1	1.9				
15 minute summer	SA3.1	4.001	SA1.6	-8.1	0.540	-0.060	0.8232	
15 minute summer	SA1.6	1.006	SA1.7	174.1	1.579	0.719	1.5717	
480 minute summer	SA1.7	1.007	SA1.8	42.6	0.712	0.604	4.2375	
480 minute summer	SA1.8	Hydro-Brake®	SA1.9	2.2				
480 minute summer	SA1.8	Infiltration		4.7				
15 minute summer	SA1.9	1.009	SA1.10	2.2	0.595	0.007	0.0709	
180 minute summer	SA1.10	1.010	SA1.11	3.5	0.513	0.013	2.3972	
240 minute summer	SA1.11	1.011	SA1.12	3.2	0.493	0.012	2.6335	
240 minute summer	SA1.12	1.012	SA1.13	-5.5	0.499	-0.022	3.7907	
240 minute summer	SA1.13	1.013	SA1.14	-5.2	0.657	-0.020	4.8135	
180 minute summer	SA1.14	1.014	SA1.15	-9.2	0.860	-0.020	4.4174	
180 minute summer	SA1.15	1.015	SA1.16	-9.0	0.237	-0.018	2.5842	
15 minute summer	SA4.0	5.000	SA4.1	31.8	1.043	0.527	0.7851	
15 minute summer	SA4.1	5.001	SA4.2	46.4	1.582	0.773	1.4930	
15 minute summer	SA4.2	5.002	SA4.3	64.7	1.627	1.611	0.2780	
15 minute summer	SA4.3	5.003	SA4.4	66.9	1.681	1.830	0.5107	
15 minute summer	SA4.4	5.004	SA4.5	64.8	1.631	1.770	1.2544	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.59%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SA4.5	12	41.451	0.879	64.8	0.9944	0.0000	SURCHARGED
15 minute summer	SA4.6	12	40.672	0.321	64.4	0.3634	0.0000	SURCHARGED
15 minute summer	SA4.7	12	39.757	0.097	64.3	0.1093	0.0000	OK
360 minute summer	SA4.8	256	38.776	0.891	23.3	69.6012	0.0000	SURCHARGED
120 minute summer	SA4.9	84	38.771	1.221	4.1	1.3809	0.0000	SURCHARGED
360 minute summer	SA1.16	216	38.770	1.795	8.6	3.7695	3.9101	FLOOD
15 minute summer	SA1.17	1	36.822	0.000	3.5	0.0000	0.0000	OK
15 minute summer	SA1.2	11	41.834	0.436	95.2	0.6694	0.0000	SURCHARGED
15 minute summer	SA1.0	11	42.419	0.219	27.3	0.3940	0.0000	OK
15 minute summer	SA1.1	11	42.342	0.657	74.7	1.2559	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SA4.5	5.005	SA4.6	64.4	1.620	1.758	1.7555	
15 minute summer	SA4.6	5.006	SA4.7	64.3	1.618	1.763	0.1487	
15 minute summer	SA4.7	5.007	SA4.8	64.2	3.948	0.387	0.4950	
360 minute summer	SA4.8	Hydro-Brake®	SA4.9	1.2				
360 minute summer	SA4.8	Infiltration		4.1				
120 minute summer	SA4.9	5.009	SA1.16	-4.1	-0.104	-0.056	1.1219	
360 minute summer	SA1.16	Hydro-Brake®	SA1.17	4.0				118.2
15 minute summer	SA1.2	1.002	SA1.3	94.7	1.374	1.025	1.1985	
15 minute summer	SA1.0	1.000	SA1.1	25.9	0.819	0.499	1.9188	
15 minute summer	SA1.1	1.001	SA1.2	63.3	1.591	1.326	1.3526	

CATCHMENT A

Design Settings

Rainfall Methodology	FSR
Return Period (years)	5
Additional Flow (%)	0
FSR Region	Scotland and Ireland
M5-60 (mm)	17.200
Ratio-R	0.277
CV	1.000
Time of Entry (mins)	4.00

Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	0.200
Preferred Cover Depth (m)	1.200
Include Intermediate Ground	✓
Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SA2.0	0.061	4.00	45.060	1200	717097.039	729089.118	1.834
SA2.1	0.057	4.00	44.930	1200	717087.288	729120.781	1.932
SA5.0	0.000	4.00	44.788	1200	717088.224	729156.267	1.588
SA2.2	0.010	4.00	44.470	1200	717079.012	729148.537	1.889
SA1.3	0.010	4.00	43.950	1350	717061.931	729168.574	2.670
SA1.4	0.038	4.00	43.830	1350	717039.272	729185.812	2.888
SA1.5	0.000	4.00	43.760	1350	717020.349	729192.986	3.032
SA3.0	0.449	4.00	43.810	1200	717016.760	729179.141	3.035
SA3.1	0.000		43.720	1200	717015.047	729190.702	2.985
SA1.6	0.015	4.00	43.620	1350	717016.374	729201.864	3.058
SA1.7	0.015	4.00	43.400	1350	717027.775	729210.408	3.046
SA1.8	0.035	4.00	43.750	1350	717064.398	729222.016	3.445
SA1.9	0.000	4.00	43.630	1350	717060.837	729233.253	4.780
SA1.10	0.000		42.960	1350	717045.766	729241.884	4.268
SA1.11	0.000		42.640	1350	717012.882	729231.460	4.179
SA1.12	0.009	4.00	43.070	1350	716997.720	729219.867	4.739
SA1.13	0.013	4.00	42.070	1350	716982.713	729238.540	3.889
SA1.14	0.017	4.00	40.220	1350	716969.397	729265.837	2.239
SA1.15	0.000	4.00	39.270	1350	716947.768	729283.408	1.883
SA4.0	0.057	4.00	43.520	1200	716965.035	729149.817	1.420
SA4.1	0.062	4.00	43.410	1200	716945.309	729149.463	1.575
SA4.2	0.048	4.00	42.640	1200	716907.781	729148.788	1.804
SA4.3	0.012	4.00	42.780	1200	716905.285	729155.311	1.986
SA4.4	0.000		42.950	1200	716907.374	729167.976	2.220
SA4.5	0.000	4.00	43.240	1200	716912.505	729199.090	2.668
SA4.6	0.000	4.00	43.130	1200	716920.555	729242.480	2.779
SA4.7	0.000	4.00	43.330	1200	716924.312	729241.782	3.670
SA4.8	0.000		41.700	1200	716929.196	729258.772	3.815
SA4.9	0.000		41.250	1200	716926.123	729264.265	3.700
SA1.16	0.060	4.00	38.770	1350	716933.905	729291.990	1.795
SA1.17	0.000		38.740	1350	716924.013	729294.106	1.918
SA1.2	0.055	4.00	44.130	1200	717062.142	729151.563	2.732
SA1.0	0.047	4.00	43.600	1200	716979.717	729150.081	1.400
SA1.1	0.084	4.00	43.840	1200	717028.148	729150.964	2.155

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
2.000	SA2.0	SA2.1	33.140	0.600	43.226	42.998	0.228	145.4	225	4.51	50.0
2.001	SA2.1	SA2.2	28.970	0.600	42.998	42.653	0.345	84.0	225	4.85	50.0
3.000	SA5.0	SA2.2	12.026	0.600	43.200	42.981	0.219	54.9	225	4.11	50.0
2.002	SA2.2	SA1.3	26.340	0.600	42.581	42.153	0.428	61.5	300	5.07	50.0
1.000	SA1.0	SA1.1	48.450	0.600	42.200	41.715	0.485	100.0	225	4.62	50.0
1.001	SA1.1	SA1.2	34.010	0.600	41.685	41.398	0.287	118.5	225	5.09	50.0
1.002	SA1.2	SA1.3	17.020	0.600	41.398	41.280	0.118	144.2	300	5.31	50.0
1.003	SA1.3	SA1.4	24.480	0.600	41.280	40.942	0.338	72.4	375	5.50	50.0
1.004	SA1.4	SA1.5	20.240	0.600	40.942	40.728	0.214	94.6	375	5.68	50.0
1.005	SA1.5	SA1.6	9.730	0.600	40.728	40.562	0.166	58.6	375	5.75	50.0
4.000	SA3.0	SA3.1	3.770	0.600	40.775	40.735	0.040	94.3	300	4.04	50.0
4.001	SA3.1	SA1.6	11.690	0.600	40.735	40.562	0.173	67.6	300	4.14	50.0
1.006	SA1.6	SA1.7	14.250	0.600	40.562	40.354	0.208	68.5	375	5.86	50.0
1.007	SA1.7	SA1.8	38.419	0.600	40.354	40.305	0.049	784.1	375	6.86	50.0
1.008	SA1.8	SA1.9	11.790	0.600	40.305	40.260	0.045	262.0	450	7.02	50.0
1.009	SA1.9	SA1.10	17.370	0.600	38.850	38.692	0.158	109.9	450	7.16	50.0
1.010	SA1.10	SA1.11	34.500	0.600	38.692	38.461	0.231	149.4	450	7.51	50.0
1.011	SA1.11	SA1.12	19.090	0.600	38.461	38.331	0.130	146.8	450	7.70	50.0
1.012	SA1.12	SA1.13	23.960	0.600	38.331	38.181	0.150	159.7	450	7.95	50.0
1.013	SA1.13	SA1.14	30.380	0.600	38.181	37.981	0.200	151.9	450	8.26	50.0
1.014	SA1.14	SA1.15	27.880	0.600	37.981	37.387	0.594	46.9	450	8.41	50.0
1.015	SA1.15	SA1.16	16.310	0.600	37.387	37.000	0.387	42.1	450	8.50	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
2.000	1.082	43.0	11.0	1.609	1.707	0.061	0.0	78	0.911
2.001	1.428	56.8	21.3	1.707	1.592	0.118	0.0	95	1.328
3.000	1.768	70.3	0.0	1.363	1.264	0.000	0.0	0	0.000
2.002	2.007	141.9	23.1	1.589	1.497	0.128	0.0	81	1.488
1.000	1.307	52.0	8.5	1.175	1.900	0.047	0.0	61	0.967
1.001	1.200	47.7	23.7	1.930	2.507	0.131	0.0	112	1.198
1.002	1.307	92.4	33.6	2.432	2.370	0.186	0.0	125	1.207
1.003	2.131	235.4	58.5	2.295	2.513	0.324	0.0	127	1.782
1.004	1.863	205.8	65.4	2.513	2.657	0.362	0.0	145	1.660
1.005	2.370	261.8	65.4	2.657	2.683	0.362	0.0	127	1.982
4.000	1.620	114.5	81.1	2.735	2.685	0.449	0.0	187	1.753
4.001	1.915	135.4	81.1	2.685	2.758	0.449	0.0	168	1.999
1.006	2.191	242.0	149.3	2.683	2.671	0.826	0.0	214	2.301
1.007	0.639	70.6	152.0	2.671	3.070	0.841	0.0	375	0.647
1.008	1.251	199.0	158.3	2.995	2.920	0.876	0.0	305	1.382
1.009	1.938	308.2	158.3	4.330	3.818	0.876	0.0	229	1.952
1.010	1.661	264.2	158.3	3.818	3.729	0.876	0.0	252	1.733
1.011	1.675	266.4	158.3	3.729	4.289	0.876	0.0	250	1.744
1.012	1.606	255.4	159.9	4.289	3.439	0.885	0.0	259	1.692
1.013	1.647	261.9	162.3	3.439	1.789	0.898	0.0	257	1.731
1.014	2.973	472.8	165.3	1.789	1.433	0.915	0.0	183	2.720
1.015	3.138	499.1	165.3	1.433	1.320	0.915	0.0	178	2.832

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
5.000	SA4.0	SA4.1	19.740	0.600	42.100	41.835	0.265	74.5	225	4.22	50.0
5.001	SA4.1	SA4.2	37.540	0.600	41.835	41.336	0.499	75.2	225	4.63	50.0
5.002	SA4.2	SA4.3	6.990	0.600	40.836	40.794	0.042	166.4	225	4.75	50.0
5.003	SA4.3	SA4.4	12.840	0.600	40.794	40.730	0.064	200.6	225	4.98	50.0
5.004	SA4.4	SA4.5	31.540	0.600	40.730	40.572	0.158	199.6	225	5.55	50.0
5.005	SA4.5	SA4.6	44.140	0.600	40.572	40.351	0.221	199.7	225	6.35	50.0
5.006	SA4.6	SA4.7	3.830	0.600	40.351	40.332	0.019	201.6	225	6.42	50.0
5.007	SA4.7	SA4.8	17.678	0.600	39.660	37.885	1.775	10.0	225	6.49	50.0
5.008	SA4.8	SA4.9	6.300	0.600	37.885	37.860	0.025	252.0	225	6.62	50.0
5.009	SA4.9	SA1.16	28.210	0.600	37.550	36.975	0.575	49.1	225	6.87	50.0
1.016	SA1.16	SA1.17	10.120	0.600	36.975	36.822	0.153	66.1	450	8.57	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
5.000	1.517	60.3	10.3	1.195	1.350	0.057	0.0	63	1.140
5.001	1.509	60.0	21.5	1.350	1.079	0.119	0.0	93	1.385
5.002	1.010	40.2	30.2	1.579	1.761	0.167	0.0	145	1.106
5.003	0.919	36.5	32.3	1.761	1.995	0.179	0.0	165	1.034
5.004	0.922	36.6	32.3	1.995	2.443	0.179	0.0	165	1.037
5.005	0.921	36.6	32.3	2.443	2.554	0.179	0.0	165	1.036
5.006	0.917	36.5	32.3	2.554	2.773	0.179	0.0	166	1.032
5.007	4.170	165.8	32.3	3.445	3.590	0.179	0.0	67	3.257
5.008	0.819	32.6	32.3	3.590	3.165	0.179	0.0	184	0.930
5.009	1.872	74.4	32.3	3.475	1.570	0.179	0.0	103	1.805
1.016	2.502	398.0	208.5	1.345	1.468	1.154	0.0	232	2.531

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	Scotland and Ireland	Drain Down Time (mins)	240
M5-60 (mm)	17.200	Additional Storage (m³/ha)	20.0
Ratio-R	0.277	Check Discharge Rate(s)	x
Summer CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

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

Node SA1.8 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	40.305	Product Number	CTL-SHE-0070-3000-2000-3000
Design Depth (m)	2.000	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.0	Min Node Diameter (mm)	1200

Node SA3.0 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	40.775	Product Number	CTL-SHE-0057-2000-2000-2000
Design Depth (m)	2.000	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node SA4.8 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	37.885	Product Number	CTL-SHE-0057-2000-2000-2000
Design Depth (m)	2.000	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node SA1.16 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	36.975	Product Number	CTL-SHE-0119-7900-1800-7900
Design Depth (m)	1.800	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	7.9	Min Node Diameter (mm)	1200

Node SA1.8 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.26400	Safety Factor	5.0	Invert Level (m)	40.305
Side Inf Coefficient (m/hr)	0.26400	Porosity	1.00	Time to half empty (mins)	128

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	238.7	238.7	1.525	238.7	394.7	1.526	0.0	394.7

Node SA3.0 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	40.775
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	182.2	0.0	2.000	182.2	0.0	2.010	0.0	0.0

Node SA3.0 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	40.775
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1572.0	0.0	0.065	1572.0	0.0	0.066	0.0	0.0

Node SA4.8 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.26400	Safety Factor	2.0	Invert Level (m)	37.885
Side Inf Coefficient (m/hr)	0.26400	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	77.0	77.0	2.000	77.0	156.4	2.010	0.0	156.4

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 99.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SA2.0	10	43.329	0.103	18.6	0.1844	0.0000	OK
15 minute summer	SA2.1	10	43.134	0.136	36.1	0.2343	0.0000	OK
15 minute summer	SA5.0	1	43.200	0.000	0.0	0.0000	0.0000	OK
15 minute summer	SA2.2	10	42.693	0.112	38.8	0.1381	0.0000	OK
15 minute summer	SA1.3	10	41.460	0.180	96.9	0.2704	0.0000	OK
15 minute summer	SA1.4	10	41.154	0.212	107.6	0.3586	0.0000	OK
15 minute summer	SA1.5	11	40.931	0.203	106.6	0.2907	0.0000	OK
5760 minute summer	SA3.0	3720	41.605	0.830	5.2	252.4794	0.0000	SURCHARGED
15 minute summer	SA3.1	11	40.778	0.043	2.1	0.0491	0.0000	OK
15 minute summer	SA1.6	11	40.777	0.215	111.5	0.3291	0.0000	OK
480 minute summer	SA1.7	312	40.709	0.355	26.1	0.5428	0.0000	OK
480 minute summer	SA1.8	336	40.679	0.374	24.9	89.7660	0.0000	OK
720 minute summer	SA1.9	600	38.877	0.027	2.2	0.0387	0.0000	OK
360 minute summer	SA1.10	208	38.721	0.029	2.2	0.0420	0.0000	OK
600 minute summer	SA1.11	540	38.490	0.029	2.2	0.0420	0.0000	OK
60 minute summer	SA1.12	33	38.368	0.037	3.6	0.0543	0.0000	OK
30 minute summer	SA1.13	18	38.230	0.049	6.6	0.0736	0.0000	OK
15 minute summer	SA1.14	10	38.030	0.049	11.6	0.0770	0.0000	OK
60 minute summer	SA1.15	44	37.804	0.417	14.5	0.5964	0.0000	OK
15 minute summer	SA4.0	10	42.183	0.083	17.4	0.1604	0.0000	OK
15 minute summer	SA4.1	10	41.966	0.131	36.3	0.2504	0.0000	OK
15 minute summer	SA4.2	11	41.430	0.594	50.7	0.9871	0.0000	SURCHARGED
15 minute summer	SA4.3	11	41.346	0.552	49.9	0.6911	0.0000	SURCHARGED
15 minute summer	SA4.4	11	41.207	0.477	46.8	0.5393	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SA2.0	2.000	SA2.1	18.7	0.874	0.434	0.7083	
15 minute summer	SA2.1	2.001	SA2.2	35.7	1.473	0.629	0.7023	
15 minute summer	SA5.0	3.000	SA2.2	0.0	0.000	0.000	0.0000	
15 minute summer	SA2.2	2.002	SA1.3	38.4	1.670	0.271	0.6058	
15 minute summer	SA1.3	1.003	SA1.4	96.0	1.661	0.408	1.4217	
15 minute summer	SA1.4	1.004	SA1.5	106.6	1.715	0.518	1.2592	
15 minute summer	SA1.5	1.005	SA1.6	107.7	1.729	0.411	0.6146	
5760 minute summer	SA3.0	Hydro-Brake®	SA3.1	1.3				
15 minute summer	SA3.1	4.001	SA1.6	-2.0	0.415	-0.015	0.3528	
15 minute summer	SA1.6	1.006	SA1.7	112.1	1.305	0.463	1.1995	
480 minute summer	SA1.7	1.007	SA1.8	22.9	0.652	0.324	4.1832	
480 minute summer	SA1.8	Hydro-Brake®	SA1.9	2.2				
480 minute summer	SA1.8	Infiltration		4.0				
720 minute summer	SA1.9	1.009	SA1.10	2.2	0.538	0.007	0.0708	
360 minute summer	SA1.10	1.010	SA1.11	2.2	0.513	0.008	0.1485	
600 minute summer	SA1.11	1.011	SA1.12	2.2	0.505	0.008	0.0862	
60 minute summer	SA1.12	1.012	SA1.13	3.6	0.487	0.014	0.1824	
30 minute summer	SA1.13	1.013	SA1.14	6.4	0.724	0.024	0.2718	
15 minute summer	SA1.14	1.014	SA1.15	11.8	1.241	0.025	1.3574	
60 minute summer	SA1.15	1.015	SA1.16	7.6	0.596	0.015	2.5419	
15 minute summer	SA4.0	5.000	SA4.1	17.4	0.952	0.289	0.3667	
15 minute summer	SA4.1	5.001	SA4.2	36.1	1.552	0.601	0.8719	
15 minute summer	SA4.2	5.002	SA4.3	46.2	1.163	1.151	0.2780	
15 minute summer	SA4.3	5.003	SA4.4	46.8	1.176	1.280	0.5107	
15 minute summer	SA4.4	5.004	SA4.5	44.7	1.125	1.221	1.2544	

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 99.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SA4.5	12	40.940	0.368	44.7	0.4161	0.0000	SURCHARGED
15 minute summer	SA4.6	12	40.584	0.233	44.3	0.2633	0.0000	SURCHARGED
15 minute summer	SA4.7	11	39.743	0.083	44.5	0.0939	0.0000	OK
180 minute summer	SA4.8	124	38.226	0.341	19.1	26.6483	0.0000	SURCHARGED
60 minute summer	SA4.9	46	37.806	0.256	5.2	0.2901	0.0000	SURCHARGED
60 minute summer	SA1.16	43	37.808	0.833	19.0	1.7493	0.0000	SURCHARGED
15 minute summer	SA1.17	1	36.822	0.000	7.8	0.0000	0.0000	OK
15 minute summer	SA1.2	10	41.583	0.185	56.0	0.2845	0.0000	OK
15 minute summer	SA1.0	10	42.280	0.080	14.4	0.1446	0.0000	OK
15 minute summer	SA1.1	10	41.848	0.163	39.9	0.3107	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SA4.5	5.005	SA4.6	44.3	1.115	1.210	1.7555	
15 minute summer	SA4.6	5.006	SA4.7	44.5	1.172	1.219	0.1401	
15 minute summer	SA4.7	5.007	SA4.8	44.5	3.913	0.269	0.3951	
180 minute summer	SA4.8	Hydro-Brake®	SA4.9	1.3				
180 minute summer	SA4.8	Infiltration		3.3				
60 minute summer	SA4.9	5.009	SA1.16	-3.9	0.179	-0.053	1.1219	
60 minute summer	SA1.16	Hydro-Brake®	SA1.17	7.8				61.5
15 minute summer	SA1.2	1.002	SA1.3	55.4	1.235	0.600	0.7636	
15 minute summer	SA1.0	1.000	SA1.1	14.3	0.807	0.276	0.8966	
15 minute summer	SA1.1	1.001	SA1.2	39.2	1.191	0.823	1.1180	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SA2.0	10	43.355	0.129	27.3	0.2314	0.0000	OK
15 minute summer	SA2.1	10	43.181	0.183	52.8	0.3153	0.0000	OK
15 minute summer	SA5.0	1	43.200	0.000	0.0	0.0000	0.0000	OK
15 minute summer	SA2.2	10	42.720	0.139	56.6	0.1720	0.0000	OK
15 minute summer	SA1.3	10	41.506	0.226	135.1	0.3396	0.0000	OK
15 minute summer	SA1.4	11	41.221	0.279	149.7	0.4729	0.0000	OK
15 minute summer	SA1.5	11	41.031	0.303	149.5	0.4329	0.0000	OK
4320 minute summer	SA3.0	2940	42.064	1.289	8.0	337.9194	0.0000	SURCHARGED
15 minute summer	SA3.1	11	40.961	0.226	7.0	0.2560	0.0000	OK
15 minute summer	SA1.6	11	40.962	0.400	151.8	0.6109	0.0000	SURCHARGED
480 minute summer	SA1.7	352	40.904	0.550	33.1	0.8411	0.0000	SURCHARGED
480 minute summer	SA1.8	360	40.902	0.597	34.9	143.5757	0.0000	SURCHARGED
30 minute summer	SA1.9	83	38.877	0.027	2.2	0.0387	0.0000	OK
30 minute summer	SA1.10	24	38.721	0.029	2.2	0.0420	0.0000	OK
2160 minute summer	SA1.11	1680	38.490	0.029	2.2	0.0419	0.0000	OK
30 minute summer	SA1.12	18	38.375	0.044	5.2	0.0640	0.0000	OK
120 minute summer	SA1.13	88	38.333	0.152	6.7	0.2270	0.0000	OK
120 minute summer	SA1.14	84	38.330	0.349	10.1	0.5525	0.0000	OK
120 minute summer	SA1.15	84	38.332	0.945	11.9	1.3516	0.0000	SURCHARGED
15 minute summer	SA4.0	9	42.204	0.104	25.5	0.2019	0.0000	OK
15 minute summer	SA4.1	11	42.205	0.370	53.4	0.7090	0.0000	SURCHARGED
15 minute summer	SA4.2	11	41.953	1.117	69.2	1.8578	0.0000	SURCHARGED
15 minute summer	SA4.3	12	41.828	1.034	62.1	1.2949	0.0000	SURCHARGED
15 minute summer	SA4.4	12	41.633	0.903	57.2	1.0218	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SA2.0	2.000	SA2.1	27.3	0.947	0.636	0.9631	
15 minute summer	SA2.1	2.001	SA2.2	52.1	1.575	0.919	0.9610	
15 minute summer	SA5.0	3.000	SA2.2	0.0	0.000	0.000	0.0000	
15 minute summer	SA2.2	2.002	SA1.3	56.1	1.836	0.396	0.8053	
15 minute summer	SA1.3	1.003	SA1.4	134.7	1.718	0.572	1.9219	
15 minute summer	SA1.4	1.004	SA1.5	149.5	1.758	0.727	1.8541	
15 minute summer	SA1.5	1.005	SA1.6	146.2	1.756	0.559	1.0001	
4320 minute summer	SA3.0	Hydro-Brake®	SA3.1	1.6				
15 minute summer	SA3.1	4.001	SA1.6	-7.0	0.495	-0.052	0.7449	
15 minute summer	SA1.6	1.006	SA1.7	148.2	1.344	0.612	1.5717	
480 minute summer	SA1.7	1.007	SA1.8	32.1	0.697	0.454	4.2375	
480 minute summer	SA1.8	Hydro-Brake®	SA1.9	2.2				
480 minute summer	SA1.8	Infiltration		4.4				
30 minute summer	SA1.9	1.009	SA1.10	2.2	0.538	0.007	0.0709	
30 minute summer	SA1.10	1.010	SA1.11	2.2	0.514	0.008	0.1485	
2160 minute summer	SA1.11	1.011	SA1.12	2.2	0.505	0.008	0.0850	
30 minute summer	SA1.12	1.012	SA1.13	5.1	0.503	0.020	0.2476	
120 minute summer	SA1.13	1.013	SA1.14	6.6	0.742	0.025	2.7074	
120 minute summer	SA1.14	1.014	SA1.15	9.9	1.077	0.021	4.0477	
120 minute summer	SA1.15	1.015	SA1.16	6.3	0.468	0.013	2.5842	
15 minute summer	SA4.0	5.000	SA4.1	25.6	1.016	0.424	0.5641	
15 minute summer	SA4.1	5.001	SA4.2	47.7	1.573	0.795	1.4930	
15 minute summer	SA4.2	5.002	SA4.3	56.7	1.425	1.410	0.2780	
15 minute summer	SA4.3	5.003	SA4.4	57.2	1.439	1.566	0.5107	
15 minute summer	SA4.4	5.004	SA4.5	55.4	1.392	1.511	1.2544	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SA4.5	12	41.211	0.639	55.4	0.7231	0.0000	SURCHARGED
15 minute summer	SA4.6	12	40.633	0.282	55.6	0.3187	0.0000	SURCHARGED
15 minute summer	SA4.7	10	39.750	0.090	55.6	0.1016	0.0000	OK
180 minute summer	SA4.8	132	38.453	0.568	27.5	44.4052	0.0000	SURCHARGED
120 minute summer	SA4.9	82	38.338	0.788	4.5	0.8911	0.0000	SURCHARGED
120 minute summer	SA1.16	84	38.331	1.356	15.1	2.8480	0.0000	SURCHARGED
15 minute summer	SA1.17	1	36.822	0.000	7.8	0.0000	0.0000	OK
15 minute summer	SA1.2	10	41.634	0.236	75.6	0.3620	0.0000	OK
15 minute summer	SA1.0	10	42.299	0.099	21.1	0.1781	0.0000	OK
15 minute summer	SA1.1	11	42.042	0.357	58.6	0.6826	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SA4.5	5.005	SA4.6	55.6	1.398	1.518	1.7555	
15 minute summer	SA4.6	5.006	SA4.7	55.6	1.405	1.525	0.1460	
15 minute summer	SA4.7	5.007	SA4.8	55.6	3.936	0.335	0.4739	
180 minute summer	SA4.8	Hydro-Brake®	SA4.9	1.3				
180 minute summer	SA4.8	Infiltration		3.6				
120 minute summer	SA4.9	5.009	SA1.16	-3.1	0.182	-0.042	1.1219	
120 minute summer	SA1.16	Hydro-Brake®	SA1.17	7.8				98.1
15 minute summer	SA1.2	1.002	SA1.3	74.7	1.294	0.809	0.9894	
15 minute summer	SA1.0	1.000	SA1.1	21.1	0.821	0.405	1.3699	
15 minute summer	SA1.1	1.001	SA1.2	53.4	1.343	1.120	1.3526	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SA2.0	11	43.441	0.215	35.5	0.3861	0.0000	OK
15 minute summer	SA2.1	10	43.316	0.318	67.5	0.5468	0.0000	SURCHARGED
15 minute summer	SA5.0	1	43.200	0.000	0.0	0.0000	0.0000	OK
15 minute summer	SA2.2	10	42.737	0.156	67.9	0.1924	0.0000	OK
15 minute summer	SA1.3	11	41.694	0.414	167.8	0.6234	0.0000	SURCHARGED
15 minute summer	SA1.4	11	41.498	0.556	186.0	0.9428	0.0000	SURCHARGED
15 minute summer	SA1.5	11	41.283	0.555	170.6	0.7943	0.0000	SURCHARGED
4320 minute summer	SA3.0	3000	42.472	1.697	9.7	413.8955	0.0000	SURCHARGED
15 minute summer	SA3.1	11	41.147	0.412	8.1	0.4659	0.0000	SURCHARGED
15 minute summer	SA1.6	11	41.148	0.586	177.2	0.8967	0.0000	SURCHARGED
480 minute summer	SA1.7	384	41.115	0.761	39.3	1.1640	0.0000	SURCHARGED
480 minute summer	SA1.8	384	41.114	0.809	46.2	194.4856	0.0000	SURCHARGED
15 minute summer	SA1.9	59	38.877	0.027	2.2	0.0387	0.0000	OK
15 minute summer	SA1.10	15	38.721	0.029	2.2	0.0421	0.0000	OK
120 minute summer	SA1.11	90	38.545	0.084	2.4	0.1201	0.0000	OK
120 minute summer	SA1.12	88	38.544	0.213	4.6	0.3132	0.0000	OK
120 minute summer	SA1.13	86	38.542	0.361	9.1	0.5406	0.0000	OK
120 minute summer	SA1.14	86	38.543	0.562	12.6	0.8902	0.0000	SURCHARGED
120 minute summer	SA1.15	86	38.544	1.157	14.0	1.6561	0.0000	SURCHARGED
15 minute summer	SA4.0	12	42.813	0.713	33.1	1.3798	0.0000	SURCHARGED
15 minute summer	SA4.1	12	42.772	0.937	67.9	1.7967	0.0000	SURCHARGED
15 minute summer	SA4.2	12	42.462	1.626	72.9	2.7036	0.0000	FLOOD RISK
15 minute summer	SA4.3	12	42.306	1.512	70.5	1.8932	0.0000	SURCHARGED
15 minute summer	SA4.4	12	42.032	1.302	66.9	1.4724	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SA2.0	2.000	SA2.1	34.4	0.975	0.799	1.3071	
15 minute summer	SA2.1	2.001	SA2.2	62.1	1.563	1.094	1.1209	
15 minute summer	SA5.0	3.000	SA2.2	0.0	0.000	0.000	0.0000	
15 minute summer	SA2.2	2.002	SA1.3	67.4	1.921	0.475	0.9256	
15 minute summer	SA1.3	1.003	SA1.4	163.9	1.716	0.696	2.7001	
15 minute summer	SA1.4	1.004	SA1.5	170.6	1.766	0.829	2.2324	
15 minute summer	SA1.5	1.005	SA1.6	170.0	1.645	0.649	1.0732	
4320 minute summer	SA3.0	Hydro-Brake®	SA3.1	1.9				
15 minute summer	SA3.1	4.001	SA1.6	-8.1	0.540	-0.060	0.8232	
15 minute summer	SA1.6	1.006	SA1.7	174.1	1.579	0.719	1.5717	
480 minute summer	SA1.7	1.007	SA1.8	42.6	0.712	0.604	4.2375	
480 minute summer	SA1.8	Hydro-Brake®	SA1.9	2.2				
480 minute summer	SA1.8	Infiltration		4.7				
15 minute summer	SA1.9	1.009	SA1.10	2.2	0.595	0.007	0.0709	
15 minute summer	SA1.10	1.010	SA1.11	2.2	0.587	0.008	0.1485	
120 minute summer	SA1.11	1.011	SA1.12	3.6	0.501	0.014	0.8903	
120 minute summer	SA1.12	1.012	SA1.13	4.6	0.516	0.018	2.5173	
120 minute summer	SA1.13	1.013	SA1.14	8.0	0.768	0.031	4.4766	
120 minute summer	SA1.14	1.014	SA1.15	11.5	1.056	0.024	4.4174	
120 minute summer	SA1.15	1.015	SA1.16	-6.0	0.443	-0.012	2.5842	
15 minute summer	SA4.0	5.000	SA4.1	31.8	1.043	0.527	0.7851	
15 minute summer	SA4.1	5.001	SA4.2	46.4	1.582	0.773	1.4930	
15 minute summer	SA4.2	5.002	SA4.3	64.7	1.627	1.611	0.2780	
15 minute summer	SA4.3	5.003	SA4.4	66.9	1.681	1.830	0.5107	
15 minute summer	SA4.4	5.004	SA4.5	64.8	1.631	1.770	1.2544	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SA4.5	12	41.451	0.879	64.8	0.9944	0.0000	SURCHARGED
15 minute summer	SA4.6	12	40.672	0.321	64.4	0.3634	0.0000	SURCHARGED
15 minute summer	SA4.7	12	39.757	0.097	64.3	0.1093	0.0000	OK
180 minute summer	SA4.8	140	38.677	0.792	35.4	61.8489	0.0000	SURCHARGED
120 minute summer	SA4.9	86	38.548	0.998	3.7	1.1288	0.0000	SURCHARGED
120 minute summer	SA1.16	86	38.545	1.570	16.1	3.2968	0.0000	FLOOD RISK
15 minute summer	SA1.17	1	36.822	0.000	7.8	0.0000	0.0000	OK
15 minute summer	SA1.2	11	41.834	0.436	95.2	0.6694	0.0000	SURCHARGED
15 minute summer	SA1.0	11	42.419	0.219	27.3	0.3940	0.0000	OK
15 minute summer	SA1.1	11	42.342	0.657	74.7	1.2559	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SA4.5	5.005	SA4.6	64.4	1.620	1.758	1.7555	
15 minute summer	SA4.6	5.006	SA4.7	64.3	1.618	1.763	0.1487	
15 minute summer	SA4.7	5.007	SA4.8	64.2	3.948	0.387	0.4950	
180 minute summer	SA4.8	Hydro-Brake®	SA4.9	1.3				
180 minute summer	SA4.8	Infiltration		3.9				
120 minute summer	SA4.9	5.009	SA1.16	-2.4	0.189	-0.032	1.1219	
120 minute summer	SA1.16	Hydro-Brake®	SA1.17	7.8				110.6
15 minute summer	SA1.2	1.002	SA1.3	94.7	1.374	1.025	1.1985	
15 minute summer	SA1.0	1.000	SA1.1	25.9	0.819	0.499	1.9188	
15 minute summer	SA1.1	1.001	SA1.2	63.3	1.591	1.326	1.3526	

CATCHMENT B 50% BLOCKAGE

Design Settings

Rainfall Methodology	FSR
Return Period (years)	5
Additional Flow (%)	0
FSR Region	Scotland and Ireland
M5-60 (mm)	17.200
Ratio-R	0.277
CV	1.000
Time of Entry (mins)	4.00

Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	0.200
Preferred Cover Depth (m)	0.600
Include Intermediate Ground	✓
Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SB7.0	0.033	4.00	43.700	1200	717360.812	729023.397	1.200
SB7.1	0.253	4.00	43.700	1350	717358.537	729046.984	1.640
SB7.2	0.033	4.00	43.700	1350	717355.029	729078.491	1.690
OUT 2	0.000	4.00	43.250	1350	717354.659	729086.655	1.270
SB6.0	0.000	4.00	44.635	1200	717279.389	729013.162	1.190
SB6.1	0.037	4.00	44.282	1200	717271.281	729018.810	0.887
SB6.2	0.014	4.00	44.800	1200	717248.235	729011.502	1.525
SB9.0	0.045	4.00	44.650	1200	717240.727	728979.415	1.250
SB9.1	0.000	4.00	44.800	1200	717234.518	728998.685	1.525
SB6.3	0.305	4.00	44.800	1200	717243.240	729021.013	1.575
OUT 3	0.000	4.00	44.700	1200	717234.102	729049.594	1.687
SB2.0	0.076	4.00	44.680	1200	717090.180	729005.064	1.045
SB1.0	0.002	4.00	45.040	1200	717098.176	729083.206	1.240
SB1.1	0.030	4.00	44.943	1200	717099.046	729074.197	1.199
SB2.1	0.003	4.00	44.810	1200	717091.669	729010.988	1.213
SB1.2	0.160	4.00	44.973	1200	717116.580	729018.884	1.511
SB1.3	0.069	4.00	45.159	1200	717150.487	729020.444	1.802
SB1.4	0.069	4.00	45.117	1350	717164.794	729014.172	1.827
SB3.0	0.107	4.00	45.286	1200	717161.809	728951.363	1.446
SB3.2	0.121	4.00	45.286	1200	717140.878	729017.392	1.862
SB3.1	0.000	4.00	45.286	1200	717148.816	728992.351	1.996
SB1.5	0.000	4.00	45.255	1350	717156.263	728994.711	2.050
SB1.6	0.069	4.00	45.240	1350	717162.185	728976.028	2.090
SB1.7	0.110	4.00	44.920	1350	717188.055	728984.228	1.820
SB4.0	0.000	4.00	45.150	1200	717148.553	729093.832	1.950
SB4.1	0.490	4.00	45.150	1350	717152.637	729080.859	2.050
SB1.8	0.028	4.00	45.150	1500	717170.987	729038.075	2.296
SB1.9	0.010	4.00	44.971	1500	717187.095	729043.184	2.181
SB1.10	0.010	4.00	44.795	1500	717205.877	729050.030	2.069
SB1.10A	0.000	4.00	44.615	1500	717219.891	729060.469	1.990
SB5.0	0.000	4.00	45.151	1200	717167.356	729131.520	1.151
SB5.1	0.000	4.00	45.094	1200	717199.427	729132.065	1.894
SB5.2	0.000	4.00	45.104	1200	717200.222	729114.879	2.004
SB5.3	0.293	4.00	44.656	1350	717215.160	729114.904	1.656
SB5.4	0.161	4.00	44.501	1350	717225.888	729080.985	1.576
SB1.11	0.098	4.00	44.499	1500	717231.022	729063.983	1.942
SB1.12	0.062	4.00	43.368	1500	717299.168	729085.538	1.049
MH	0.092	4.00	42.900	1200	717319.537	729135.812	0.800
SB1.13	0.000	4.00	43.250	1500	717348.285	729100.193	1.235
OUT1	0.000	4.00	43.250	1500	717351.888	729088.527	1.270

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
SB7.0	SB7.0	SB7.1	23.696	0.600	42.500	42.210	0.290	81.7	225	4.27	50.0
SB7.1	SB7.1	SB7.2	31.702	0.600	42.060	42.010	0.050	634.0	375	5.01	50.0
SB7.2	SB7.2	OUT 2	8.172	0.600	42.010	41.980	0.030	272.4	375	5.14	50.0
SB6.0	SB6.0	SB6.1	9.881	0.600	43.445	43.395	0.050	197.6	225	4.18	50.0
SB6.1	SB6.1	SB6.2	24.177	0.600	43.395	43.275	0.120	201.5	225	4.62	50.0
SB6.2	SB6.2	SB6.3	10.743	0.600	43.275	43.225	0.050	214.9	225	4.82	50.0
SB9.0	SB9.0	SB9.1	20.246	0.600	43.400	43.275	0.125	162.0	225	4.33	50.0
SB9.1	SB9.1	SB6.3	23.971	0.600	43.275	43.225	0.050	479.4	225	5.01	50.0
SB6.3	SB6.3	OUT 3	30.006	0.600	43.225	43.013	0.212	141.5	300	5.39	50.0
SB2.0	SB2.0	SB2.1	6.108	0.600	43.635	43.597	0.038	160.7	225	4.10	50.0
SB1.0	SB1.0	SB1.1	9.051	0.600	43.800	43.744	0.056	161.6	225	4.15	50.0
SB1.1	SB1.1	SB1.2	58.026	0.600	43.744	43.462	0.282	205.8	225	5.21	50.0
SB2.1	SB2.1	SB1.2	26.132	0.600	43.597	43.462	0.135	193.6	225	4.56	50.0
SB1.2	SB1.2	SB1.3	33.943	0.600	43.462	43.357	0.105	323.3	300	5.86	50.0
SB1.3	SB1.3	SB1.4	15.621	0.600	43.357	43.290	0.067	233.2	300	6.12	50.0
SB1.4	SB1.4	SB1.5	21.249	0.600	43.290	43.205	0.085	250.0	375	6.43	50.0
SB3.0	SB3.0	SB3.1	42.998	0.600	43.840	43.625	0.215	200.0	225	4.78	50.0
SB3.2	SB3.2	SB3.1	26.269	0.600	43.424	43.290	0.134	196.0	225	4.47	50.0
SB3.1	SB3.1	SB1.5	7.812	0.600	43.290	43.205	0.085	91.9	225	4.87	50.0
SB1.5	SB1.5	SB1.6	19.599	0.600	43.205	43.150	0.055	356.3	450	6.73	50.0
SB1.6	SB1.6	SB1.7	27.138	0.600	43.150	43.100	0.050	542.8	450	7.26	50.0
SB1.7	SB1.7	SB1.8	56.487	0.600	43.100	42.854	0.246	229.6	450	7.96	50.0
SB4.0	SB4.0	SB4.1	13.601	0.600	43.200	43.100	0.100	136.0	225	4.20	50.0
SB4.1	SB4.1	SB1.8	46.553	0.600	43.100	42.854	0.246	189.2	375	4.79	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
SB7.0	1.447	57.5	6.0	0.975	1.265	0.033	0.0	49	0.943
SB7.1	0.712	78.6	51.7	1.265	1.315	0.286	0.0	222	0.758
SB7.2	1.093	120.7	57.6	1.315	0.895	0.319	0.0	183	1.081
SB6.0	0.926	36.8	0.0	0.965	0.662	0.000	0.0	0	0.000
SB6.1	0.917	36.5	6.7	0.662	1.300	0.037	0.0	65	0.704
SB6.2	0.888	35.3	9.2	1.300	1.350	0.051	0.0	79	0.751
SB9.0	1.024	40.7	8.1	1.025	1.300	0.045	0.0	68	0.804
SB9.1	0.590	23.5	8.1	1.300	1.350	0.045	0.0	91	0.537
SB6.3	1.319	93.3	72.5	1.275	1.387	0.401	0.0	200	1.453
SB2.0	1.028	40.9	13.7	0.820	0.988	0.076	0.0	90	0.931
SB1.0	1.026	40.8	0.4	1.015	0.974	0.002	0.0	15	0.319
SB1.1	0.908	36.1	5.8	0.974	1.286	0.032	0.0	61	0.671
SB2.1	0.936	37.2	14.3	0.988	1.286	0.079	0.0	96	0.874
SB1.2	0.869	61.4	49.0	1.211	1.502	0.271	0.0	203	0.961
SB1.3	1.025	72.5	61.4	1.502	1.527	0.340	0.0	213	1.146
SB1.4	1.141	126.0	73.9	1.452	1.675	0.409	0.0	207	1.185
SB3.0	0.921	36.6	19.3	1.221	1.436	0.107	0.0	116	0.934
SB3.2	0.930	37.0	21.9	1.637	1.771	0.121	0.0	124	0.967
SB3.1	1.364	54.2	41.2	1.771	1.825	0.228	0.0	147	1.497
SB1.5	1.071	170.3	115.1	1.600	1.640	0.637	0.0	272	1.147
SB1.6	0.865	137.6	127.6	1.640	1.370	0.706	0.0	344	0.977
SB1.7	1.337	212.7	147.5	1.370	1.846	0.816	0.0	276	1.439
SB4.0	1.119	44.5	0.0	1.725	1.825	0.000	0.0	0	0.000
SB4.1	1.313	145.1	88.5	1.675	1.921	0.490	0.0	212	1.376

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
SB1.8	SB1.8	SB1.9	16.899	0.600	42.854	42.790	0.064	264.0	525	8.17	50.0
SB1.9	SB1.9	SB1.10	19.991	0.600	42.790	42.726	0.064	312.4	525	8.43	50.0
SB1.10	SB1.10	SB1.10A	17.475	0.600	42.726	42.625	0.101	173.0	525	8.60	50.0
SB1.10A	SB1.10A	SB1.11	11.673	0.600	42.625	42.557	0.068	171.7	525	8.71	50.0
SB5.0	SB5.0	SB5.1	32.076	0.600	44.000	43.535	0.465	69.0	225	4.34	50.0
SB5.1	SB5.1	SB5.2	17.204	0.600	43.200	43.100	0.100	172.0	225	4.63	50.0
SB5.2	SB5.2	SB5.3	14.938	0.600	43.100	43.000	0.100	149.4	225	4.86	50.0
SB5.3	SB5.3	SB5.4	35.575	0.600	43.000	42.925	0.075	474.3	375	5.58	50.0
SB5.4	SB5.4	SB1.11	17.760	0.600	42.925	42.557	0.368	48.3	375	5.69	50.0
SB1.11	SB1.11	SB1.12	71.474	0.600	42.557	42.319	0.238	300.3	600	9.57	49.4
SB1.12	SB1.12	SB1.13	51.257	0.600	42.319	42.015	0.304	168.6	600	10.02	48.4
MH	MH	SB1.13	45.773	0.600	42.100	42.015	0.085	538.5	225	5.37	50.0
SB1.13	SB1.13	OUT1	12.210	0.600	42.015	41.980	0.035	348.8	600	10.18	48.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
SB1.8	1.373	297.3	241.1	1.771	1.656	1.334	0.0	360	1.521
SB1.9	1.262	273.1	242.9	1.656	1.544	1.344	0.0	388	1.417
SB1.10	1.700	367.9	244.7	1.544	1.465	1.354	0.0	314	1.812
SB1.10A	1.706	369.4	244.7	1.465	1.417	1.354	0.0	313	1.819
SB5.0	1.576	62.7	0.0	0.926	1.334	0.000	0.0	0	0.000
SB5.1	0.994	39.5	0.0	1.669	1.779	0.000	0.0	0	0.000
SB5.2	1.067	42.4	0.0	1.779	1.431	0.000	0.0	0	0.000
SB5.3	0.825	91.1	52.9	1.281	1.201	0.293	0.0	205	0.855
SB5.4	2.613	288.6	82.0	1.201	1.567	0.454	0.0	137	2.265
SB1.11	1.400	395.8	340.4	1.342	0.449	1.906	0.0	432	1.564
SB1.12	1.872	529.4	344.0	0.449	0.635	1.968	0.0	353	1.987
MH	0.556	22.1	16.6	0.575	1.010	0.092	0.0	145	0.609
SB1.13	1.298	366.9	357.4	0.635	0.670	2.060	0.0	483	1.468

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	Scotland and Ireland	Drain Down Time (mins)	240
M5-60 (mm)	17.200	Additional Storage (m³/ha)	20.0
Ratio-R	0.277	Check Discharge Rate(s)	x
Summer CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

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

Node SB7.2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	42.010	Product Number	CTL-SHE-0065-2000-1145-2000
Design Depth (m)	1.145	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node SB6.3 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	43.225	Product Number	CTL-SHE-0081-3500-1575-3500
Design Depth (m)	1.575	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.5	Min Node Diameter (mm)	1200

Node SB2.0 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	43.635	Product Number	CTL-SHE-0071-2000-0750-2000
Design Depth (m)	0.750	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node SB1.7 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	43.100	Product Number	CTL-SHE-0094-4000-1060-4000
Design Depth (m)	1.060	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	4.0	Min Node Diameter (mm)	1200

Node SB4.1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	43.100	Product Number	CTL-SHE-0076-3500-2050-3500
Design Depth (m)	2.050	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.5	Min Node Diameter (mm)	1200

Node SB5.4 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	42.925	Product Number	CTL-SHE-0071-2000-0762-2000
Design Depth (m)	0.762	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node MH Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	42.100	Product Number	CTL-SHE-0076-2000-0400-2000
Design Depth (m)	0.400	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node SB1.13 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	42.015	Product Number	CTL-SHE-0116-7500-1800-7500
Design Depth (m)	1.800	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	7.5	Min Node Diameter (mm)	1200

Node SB7.2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.26400	Safety Factor	5.0	Invert Level (m)	42.010
Side Inf Coefficient (m/hr)	0.26400	Porosity	1.00	Time to half empty (mins)	405

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	107.5	107.5	1.145	107.5	186.8	1.146	0.0	186.8

Node SB7.1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	42.060
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	969.0	0.0	0.065	969.0	0.0	0.066	0.0	0.0

Node SB6.3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	43.225
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	840

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	225.8	0.0	1.550	225.8	0.0	1.551	0.0	0.0

Node SB6.3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	43.225
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1225.0	0.0	0.065	1225.0	0.0	0.066	0.0	0.0

Node SB2.0 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.26400	Safety Factor	5.0	Invert Level (m)	43.635
Side Inf Coefficient (m/hr)	0.26400	Porosity	0.30	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	372.0	372.0	0.750	372.0	489.0	0.751	0.0	489.0

Node SB1.7 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	5.0	Invert Level (m)	43.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	510.4	510.4	1.060	510.4	644.3	1.061	0.0	644.3

Node SB4.1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	43.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	175.6	0.0	2.050	175.6	0.0	2.051	0.0	0.0

Node SB4.1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	43.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	2239.0	0.0	0.065	2239.0	0.0	0.066	0.0	0.0

Node SB5.4 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.26400	Safety Factor	5.0	Invert Level (m)	42.925
Side Inf Coefficient (m/hr)	0.26400	Porosity	1.00	Time to half empty (mins)	180

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	333.3	333.3	0.762	333.3	405.3	0.763	0.0	405.3

Node SB5.4 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	42.925
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1163.0	0.0	0.065	1163.0	0.0	0.066	0.0	0.0

Node MH Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	42.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	183.0	0.0	0.400	366.0	0.0	0.401	0.0	0.0

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 99.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SB7.0	10	42.565	0.065	10.1	0.1099	0.0000	OK
960 minute summer	SB7.1	615	42.318	0.258	10.5	61.4593	0.0000	OK
960 minute summer	SB7.2	615	42.317	0.307	10.3	33.6113	0.0000	OK
15 minute summer	OUT 2	1	41.980	0.000	0.4	0.0000	0.0000	OK
2160 minute summer	SB6.0	1380	43.554	0.109	0.0	0.1238	0.0000	OK
2160 minute summer	SB6.1	1380	43.554	0.159	0.8	0.3134	0.0000	OK
2160 minute summer	SB6.2	1380	43.554	0.279	1.1	0.3675	0.0000	SURCHARGED
2160 minute summer	SB9.0	1380	43.554	0.154	0.9	0.2859	0.0000	OK
2160 minute summer	SB9.1	1380	43.554	0.279	0.9	0.3161	0.0000	SURCHARGED
2160 minute summer	SB6.3	1380	43.554	0.329	8.0	152.2678	0.0000	SURCHARGED
15 minute summer	OUT 3	1	43.013	0.000	0.5	0.0000	0.0000	OK
30 minute summer	SB2.0	22	43.699	0.064	21.0	7.3161	0.0000	OK
15 minute summer	SB1.0	11	43.847	0.047	1.8	0.0550	0.0000	OK
15 minute summer	SB1.1	11	43.847	0.103	9.7	0.1688	0.0000	OK
15 minute summer	SB2.1	10	43.863	0.266	7.4	0.3133	0.0000	SURCHARGED
15 minute summer	SB1.2	11	43.832	0.370	57.6	1.2013	0.0000	SURCHARGED
15 minute summer	SB1.3	10	43.748	0.391	67.7	0.7410	0.0000	SURCHARGED
15 minute summer	SB1.4	10	43.671	0.381	86.6	0.8334	0.0000	SURCHARGED
15 minute summer	SB3.0	10	44.010	0.170	32.7	0.4435	0.0000	OK
15 minute summer	SB3.2	10	43.963	0.539	36.9	1.3107	0.0000	SURCHARGED
15 minute summer	SB3.1	10	43.818	0.528	67.9	0.5967	0.0000	SURCHARGED
15 minute summer	SB1.5	9	43.618	0.413	156.5	0.5910	0.0000	OK
1440 minute summer	SB1.6	990	43.585	0.435	16.6	0.9103	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SB7.0	SB7.0	SB7.1	10.1	1.078	0.175	0.2218	
960 minute summer	SB7.1	SB7.1	SB7.2	9.1	0.381	0.116	2.8121	
960 minute summer	SB7.2	Hydro-Brake®	OUT 2	1.8				67.1
960 minute summer	SB7.2	Infiltration		1.9				
2160 minute summer	SB6.0	SB6.0	SB6.1	0.0	0.003	-0.001	0.2433	
2160 minute summer	SB6.1	SB6.1	SB6.2	0.8	0.308	0.022	0.8446	
2160 minute summer	SB6.2	SB6.2	SB6.3	1.0	0.344	0.028	0.4273	
2160 minute summer	SB9.0	SB9.0	SB9.1	0.9	0.321	0.022	0.6968	
2160 minute summer	SB9.1	SB9.1	SB6.3	0.8	0.271	0.033	0.9534	
2160 minute summer	SB6.3	Hydro-Brake®	OUT 3	3.0				218.8
30 minute summer	SB2.0	Hydro-Brake®	SB2.1	1.2				
30 minute summer	SB2.0	Infiltration		5.5				
15 minute summer	SB1.0	SB1.0	SB1.1	1.9	0.206	0.047	0.1080	
15 minute summer	SB1.1	SB1.1	SB1.2	12.8	0.398	0.354	1.6706	
15 minute summer	SB2.1	SB2.1	SB1.2	-6.5	0.249	-0.174	1.0393	
15 minute summer	SB1.2	SB1.2	SB1.3	51.8	0.767	0.844	2.3902	
15 minute summer	SB1.3	SB1.3	SB1.4	69.2	0.983	0.955	1.1000	
15 minute summer	SB1.4	SB1.4	SB1.5	89.0	0.855	0.706	2.3437	
15 minute summer	SB3.0	SB3.0	SB3.1	32.9	1.006	0.898	1.4695	
15 minute summer	SB3.2	SB3.2	SB3.1	35.0	0.881	0.947	1.0447	
15 minute summer	SB3.1	SB3.1	SB1.5	67.4	1.696	1.244	0.3107	
15 minute summer	SB1.5	SB1.5	SB1.6	159.1	1.134	0.934	3.0136	
1440 minute summer	SB1.6	SB1.6	SB1.7	16.4	0.590	0.119	4.2792	

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 99.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	SB1.7	990	43.585	0.485	19.4	248.8702	0.0000	SURCHARGED
4320 minute summer	SB4.0	2640	43.610	0.410	0.1	0.4641	0.0000	SURCHARGED
4320 minute summer	SB4.1	2640	43.610	0.510	6.7	232.1115	0.0000	SURCHARGED
720 minute summer	SB1.8	555	42.950	0.096	7.0	0.1931	0.0000	OK
720 minute summer	SB1.9	555	42.949	0.159	7.2	0.2963	0.0000	OK
720 minute summer	SB1.10	555	42.949	0.223	7.5	0.4159	0.0000	OK
720 minute summer	SB1.10A	555	42.949	0.324	7.4	0.5727	0.0000	OK
15 minute summer	SB5.0	1	44.000	0.000	0.0	0.0000	0.0000	OK
15 minute summer	SB5.1	10	43.860	0.660	16.5	0.7460	0.0000	SURCHARGED
15 minute summer	SB5.2	10	43.842	0.742	20.2	0.8395	0.0000	SURCHARGED
15 minute summer	SB5.3	10	43.824	0.824	90.9	4.0965	0.0000	SURCHARGED
480 minute summer	SB5.4	312	43.047	0.122	26.2	113.4235	0.0000	OK
720 minute summer	SB1.11	555	42.949	0.392	12.5	1.0883	0.0000	OK
720 minute summer	SB1.12	555	42.949	0.630	15.2	1.8578	0.0000	SURCHARGED
2160 minute summer	MH	1800	42.900	0.800	3.9	112.7278	13.7805	FLOOD
720 minute summer	SB1.13	555	42.949	0.934	13.5	1.6501	0.0000	SURCHARGED
15 minute summer	OUT1	1	41.980	0.000	7.3	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute summer	SB1.7	Hydro-Brake®	SB1.8	4.0				
4320 minute summer	SB4.0	SB4.0	SB4.1	-0.1	-0.003	-0.001	0.5409	
4320 minute summer	SB4.1	Hydro-Brake®	SB1.8	2.6				
720 minute summer	SB1.8	SB1.8	SB1.9	7.0	0.555	0.024	0.6950	
720 minute summer	SB1.9	SB1.9	SB1.10	7.2	0.597	0.026	1.4260	
720 minute summer	SB1.10	SB1.10	SB1.10A	7.4	0.673	0.020	1.9856	
720 minute summer	SB1.10A	SB1.10A	SB1.11	8.4	0.513	0.023	1.8260	
15 minute summer	SB5.0	SB5.0	SB5.1	0.0	0.000	0.000	0.6379	
15 minute summer	SB5.1	SB5.1	SB5.2	18.0	0.454	0.457	0.6842	
15 minute summer	SB5.2	SB5.2	SB5.3	22.9	0.577	0.541	0.5941	
15 minute summer	SB5.3	SB5.3	SB5.4	106.4	1.852	1.167	2.0174	
480 minute summer	SB5.4	Hydro-Brake®	SB1.11	1.9				
480 minute summer	SB5.4	Infiltration		5.0				
720 minute summer	SB1.11	SB1.11	SB1.12	12.5	0.608	0.031	17.0367	
720 minute summer	SB1.12	SB1.12	SB1.13	13.5	0.232	0.026	14.4379	
2160 minute summer	MH	Hydro-Brake®	SB1.13	0.3				
720 minute summer	SB1.13	Hydro-Brake®	OUT1	7.3				316.6

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute summer	SB7.0	645	42.699	0.199	1.7	0.3350	0.0000	OK
960 minute summer	SB7.1	645	42.699	0.639	14.5	63.1835	0.0000	SURCHARGED
960 minute summer	SB7.2	645	42.699	0.689	15.0	75.3389	0.0000	SURCHARGED
15 minute summer	OUT 2	1	41.980	0.000	1.0	0.0000	0.0000	OK
2160 minute summer	SB6.0	1440	43.841	0.396	0.1	0.4479	0.0000	SURCHARGED
2160 minute summer	SB6.1	1440	43.841	0.446	1.0	0.8765	0.0000	SURCHARGED
2160 minute summer	SB6.2	1440	43.841	0.566	1.2	0.7443	0.0000	SURCHARGED
2160 minute summer	SB9.0	1440	43.841	0.441	1.2	0.8164	0.0000	SURCHARGED
2160 minute summer	SB9.1	1440	43.841	0.566	1.1	0.6402	0.0000	SURCHARGED
2160 minute summer	SB6.3	1440	43.841	0.616	10.6	218.4056	0.0000	SURCHARGED
15 minute summer	OUT 3	1	43.013	0.000	1.0	0.0000	0.0000	OK
60 minute summer	SB2.0	40	43.746	0.111	24.3	12.6609	0.0000	OK
15 minute summer	SB1.0	11	44.268	0.468	9.4	0.5437	0.0000	SURCHARGED
15 minute summer	SB1.1	11	44.260	0.516	19.3	0.8420	0.0000	SURCHARGED
15 minute summer	SB2.1	11	44.258	0.661	8.4	0.7805	0.0000	SURCHARGED
15 minute summer	SB1.2	11	44.243	0.781	74.7	2.5378	0.0000	SURCHARGED
15 minute summer	SB1.3	11	44.064	0.707	98.4	1.3403	0.0000	SURCHARGED
15 minute summer	SB1.4	11	43.881	0.591	124.4	1.2923	0.0000	SURCHARGED
15 minute summer	SB3.0	11	44.477	0.637	47.9	1.6622	0.0000	SURCHARGED
15 minute summer	SB3.2	11	44.419	0.995	54.2	2.4193	0.0000	SURCHARGED
15 minute summer	SB3.1	11	44.148	0.858	90.9	0.9703	0.0000	SURCHARGED
1440 minute summer	SB1.5	990	43.793	0.588	19.9	0.8413	0.0000	SURCHARGED
1440 minute summer	SB1.6	990	43.793	0.643	22.1	1.3450	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
960 minute summer	SB7.0	SB7.0	SB7.1	1.7	0.621	0.030	0.9121	
960 minute summer	SB7.1	SB7.1	SB7.2	13.3	0.357	0.170	3.4966	
960 minute summer	SB7.2	Hydro-Brake®	OUT 2	1.8				80.1
960 minute summer	SB7.2	Infiltration		2.3				
2160 minute summer	SB6.0	SB6.0	SB6.1	-0.1	-0.009	-0.002	0.3930	
2160 minute summer	SB6.1	SB6.1	SB6.2	0.8	0.308	0.022	0.9615	
2160 minute summer	SB6.2	SB6.2	SB6.3	1.1	0.330	0.032	0.4273	
2160 minute summer	SB9.0	SB9.0	SB9.1	1.1	0.335	0.027	0.8052	
2160 minute summer	SB9.1	SB9.1	SB6.3	1.1	0.261	0.045	0.9534	
2160 minute summer	SB6.3	Hydro-Brake®	OUT 3	3.0				271.0
60 minute summer	SB2.0	Hydro-Brake®	SB2.1	1.8				
60 minute summer	SB2.0	Infiltration		5.6				
15 minute summer	SB1.0	SB1.0	SB1.1	-8.5	0.225	-0.209	0.3600	
15 minute summer	SB1.1	SB1.1	SB1.2	21.2	0.537	0.588	2.3078	
15 minute summer	SB2.1	SB2.1	SB1.2	-7.3	0.376	-0.195	1.0393	
15 minute summer	SB1.2	SB1.2	SB1.3	72.9	1.035	1.187	2.3902	
15 minute summer	SB1.3	SB1.3	SB1.4	99.0	1.406	1.366	1.1000	
15 minute summer	SB1.4	SB1.4	SB1.5	125.2	1.136	0.994	2.3437	
15 minute summer	SB3.0	SB3.0	SB3.1	42.5	1.070	1.162	1.7101	
15 minute summer	SB3.2	SB3.2	SB3.1	48.5	1.220	1.312	1.0447	
15 minute summer	SB3.1	SB3.1	SB1.5	91.7	2.305	1.690	0.3107	
1440 minute summer	SB1.5	SB1.5	SB1.6	19.5	0.398	0.115	3.1053	
1440 minute summer	SB1.6	SB1.6	SB1.7	21.7	0.614	0.157	4.2998	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	SB1.7	990	43.793	0.693	25.8	355.4805	0.0000	SURCHARGED
2880 minute summer	SB4.0	1920	44.139	0.939	0.1	1.0617	0.0000	SURCHARGED
2880 minute summer	SB4.1	1920	44.139	1.039	11.4	328.1719	0.0000	SURCHARGED
360 minute summer	SB1.8	224	43.257	0.403	8.5	0.8098	0.0000	OK
360 minute summer	SB1.9	224	43.256	0.466	9.3	0.8661	0.0000	OK
360 minute summer	SB1.10	224	43.255	0.529	10.4	0.9855	0.0000	SURCHARGED
360 minute summer	SB1.10A	224	43.254	0.629	9.9	1.1114	0.0000	SURCHARGED
15 minute summer	SB5.0	11	44.033	0.033	3.9	0.0368	0.0000	OK
15 minute summer	SB5.1	10	44.037	0.837	19.2	0.9468	0.0000	SURCHARGED
15 minute summer	SB5.2	10	44.036	0.936	24.1	1.0591	0.0000	SURCHARGED
15 minute summer	SB5.3	10	44.036	1.036	131.1	5.1465	0.0000	SURCHARGED
600 minute summer	SB5.4	435	43.236	0.311	30.6	177.2130	0.0000	OK
360 minute summer	SB1.11	224	43.253	0.696	19.3	1.9325	0.0000	SURCHARGED
600 minute summer	SB1.12	375	43.251	0.932	17.3	2.7492	0.0000	FLOOD RISK
4320 minute summer	MH	2400	42.900	0.800	3.5	112.7278	92.6594	FLOOD
600 minute summer	SB1.13	360	43.250	1.235	14.8	2.1822	8.8517	FLOOD
15 minute summer	OUT1	1	41.980	0.000	7.3	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute summer	SB1.7	Hydro-Brake®	SB1.8	4.0				
2880 minute summer	SB4.0	SB4.0	SB4.1	-0.1	-0.004	-0.002	0.5409	
2880 minute summer	SB4.1	Hydro-Brake®	SB1.8	2.6				
360 minute summer	SB1.8	SB1.8	SB1.9	8.4	0.547	0.028	3.2139	
360 minute summer	SB1.9	SB1.9	SB1.10	9.5	0.623	0.035	4.1838	
360 minute summer	SB1.10	SB1.10	SB1.10A	9.9	0.722	0.027	3.7745	
360 minute summer	SB1.10A	SB1.10A	SB1.11	9.0	0.504	0.024	2.5218	
15 minute summer	SB5.0	SB5.0	SB5.1	-3.9	0.355	-0.062	0.6942	
15 minute summer	SB5.1	SB5.1	SB5.2	-19.2	-0.483	-0.486	0.6842	
15 minute summer	SB5.2	SB5.2	SB5.3	-24.1	-0.607	-0.569	0.5941	
15 minute summer	SB5.3	SB5.3	SB5.4	147.6	2.178	1.619	2.0654	
600 minute summer	SB5.4	Hydro-Brake®	SB1.11	1.9				
600 minute summer	SB5.4	Infiltration		5.3				
360 minute summer	SB1.11	SB1.11	SB1.12	15.6	0.646	0.039	20.1326	
600 minute summer	SB1.12	SB1.12	SB1.13	14.8	0.232	0.028	14.4379	
4320 minute summer	MH	Hydro-Brake®	SB1.13	0.2				
600 minute summer	SB1.13	Hydro-Brake®	OUT1	7.3				273.7

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute summer	SB7.0	645	43.030	0.530	2.1	0.8905	0.0000	SURCHARGED
960 minute summer	SB7.1	645	43.030	0.970	18.0	64.6764	0.0000	SURCHARGED
960 minute summer	SB7.2	645	43.030	1.020	18.9	111.4628	0.0000	SURCHARGED
15 minute summer	OUT 2	1	41.980	0.000	1.5	0.0000	0.0000	OK
2160 minute summer	SB6.0	1500	44.123	0.678	0.1	0.7671	0.0000	SURCHARGED
2160 minute summer	SB6.1	1500	44.123	0.728	1.2	1.4311	0.0000	FLOOD RISK
2160 minute summer	SB6.2	1500	44.123	0.848	1.6	1.1155	0.0000	SURCHARGED
2160 minute summer	SB9.0	1500	44.123	0.723	1.5	1.3388	0.0000	SURCHARGED
2160 minute summer	SB9.1	1500	44.123	0.848	1.4	0.9594	0.0000	SURCHARGED
2160 minute summer	SB6.3	1500	44.123	0.898	13.1	283.5493	0.0000	SURCHARGED
15 minute summer	OUT 3	1	43.013	0.000	1.5	0.0000	0.0000	OK
60 minute summer	SB2.0	42	43.797	0.162	32.2	18.4496	0.0000	OK
15 minute summer	SB1.0	11	44.778	0.978	14.6	1.1370	0.0000	FLOOD RISK
15 minute summer	SB1.1	11	44.771	1.027	37.8	1.6754	0.0000	FLOOD RISK
15 minute summer	SB2.1	11	44.711	1.114	21.4	1.3146	0.0000	FLOOD RISK
15 minute summer	SB1.2	11	44.712	1.250	104.4	4.0597	0.0000	FLOOD RISK
15 minute summer	SB1.3	11	44.452	1.095	120.2	2.0772	0.0000	SURCHARGED
15 minute summer	SB1.4	11	44.181	0.891	154.5	1.9483	0.0000	SURCHARGED
15 minute summer	SB3.0	11	45.075	1.235	62.1	3.2246	0.0000	FLOOD RISK
15 minute summer	SB3.2	11	45.005	1.581	70.3	3.8441	0.0000	FLOOD RISK
15 minute summer	SB3.1	11	44.582	1.292	111.9	1.4618	0.0000	SURCHARGED
1440 minute summer	SB1.5	1050	44.002	0.797	24.1	1.1409	0.0000	SURCHARGED
1440 minute summer	SB1.6	1050	44.002	0.852	27.2	1.7829	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
960 minute summer	SB7.0	SB7.0	SB7.1	2.1	0.633	0.036	0.9424	
960 minute summer	SB7.1	SB7.1	SB7.2	16.8	0.456	0.213	3.4966	
960 minute summer	SB7.2	Hydro-Brake®	OUT 2	1.9				87.7
960 minute summer	SB7.2	Infiltration		2.6				
2160 minute summer	SB6.0	SB6.0	SB6.1	-0.1	-0.014	-0.002	0.3930	
2160 minute summer	SB6.1	SB6.1	SB6.2	1.1	0.308	0.029	0.9615	
2160 minute summer	SB6.2	SB6.2	SB6.3	1.5	0.319	0.043	0.4273	
2160 minute summer	SB9.0	SB9.0	SB9.1	1.4	0.321	0.035	0.8052	
2160 minute summer	SB9.1	SB9.1	SB6.3	1.4	0.254	0.058	0.9534	
2160 minute summer	SB6.3	Hydro-Brake®	OUT 3	3.0				259.3
60 minute summer	SB2.0	Hydro-Brake®	SB2.1	2.0				
60 minute summer	SB2.0	Infiltration		5.7				
15 minute summer	SB1.0	SB1.0	SB1.1	-13.4	-0.337	-0.328	0.3600	
15 minute summer	SB1.1	SB1.1	SB1.2	24.3	0.612	0.675	2.3078	
15 minute summer	SB2.1	SB2.1	SB1.2	-20.0	-0.502	-0.536	1.0393	
15 minute summer	SB1.2	SB1.2	SB1.3	89.1	1.266	1.451	2.3902	
15 minute summer	SB1.3	SB1.3	SB1.4	121.3	1.723	1.674	1.1000	
15 minute summer	SB1.4	SB1.4	SB1.5	155.9	1.414	1.237	2.3437	
15 minute summer	SB3.0	SB3.0	SB3.1	51.8	1.303	1.416	1.7101	
15 minute summer	SB3.2	SB3.2	SB3.1	60.0	1.510	1.624	1.0447	
15 minute summer	SB3.1	SB3.1	SB1.5	112.2	2.821	2.068	0.3107	
1440 minute summer	SB1.5	SB1.5	SB1.6	24.0	0.392	0.141	3.1053	
1440 minute summer	SB1.6	SB1.6	SB1.7	27.1	0.659	0.197	4.2998	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	SB1.7	1050	44.002	0.902	32.2	462.8795	0.0000	SURCHARGED
2880 minute summer	SB4.0	1980	44.561	1.361	0.1	1.5395	0.0000	SURCHARGED
2880 minute summer	SB4.1	1980	44.561	1.461	13.8	404.9832	0.0000	SURCHARGED
120 minute summer	SB1.8	72	43.291	0.437	12.6	0.8791	0.0000	OK
120 minute summer	SB1.9	72	43.285	0.495	15.9	0.9201	0.0000	OK
120 minute summer	SB1.10	72	43.280	0.554	18.8	1.0323	0.0000	SURCHARGED
120 minute summer	SB1.10A	72	43.278	0.653	23.3	1.1536	0.0000	SURCHARGED
15 minute summer	SB5.0	10	44.261	0.261	8.9	0.2950	0.0000	SURCHARGED
15 minute summer	SB5.1	10	44.213	1.013	18.8	1.1459	0.0000	SURCHARGED
15 minute summer	SB5.2	10	44.198	1.098	25.8	1.2415	0.0000	SURCHARGED
15 minute summer	SB5.3	10	44.193	1.193	170.2	5.9308	0.0000	SURCHARGED
600 minute summer	SB5.4	420	43.376	0.451	38.1	224.2843	0.0000	SURCHARGED
120 minute summer	SB1.11	72	43.275	0.718	38.7	1.9930	0.0000	SURCHARGED
120 minute summer	SB1.12	72	43.259	0.940	42.1	2.7724	0.0000	FLOOD RISK
4320 minute summer	MH	2280	42.900	0.800	4.1	112.7278	178.5166	FLOOD
720 minute summer	SB1.13	390	43.250	1.235	17.8	2.1822	48.7172	FLOOD
15 minute summer	OUT1	1	41.980	0.000	7.3	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute summer	SB1.7	Hydro-Brake®	SB1.8	4.0				
2880 minute summer	SB4.0	SB4.0	SB4.1	-0.1	-0.004	-0.002	0.5409	
2880 minute summer	SB4.1	Hydro-Brake®	SB1.8	3.0				
120 minute summer	SB1.8	SB1.8	SB1.9	13.7	0.607	0.046	3.4073	
120 minute summer	SB1.9	SB1.9	SB1.10	17.4	0.697	0.064	4.2692	
120 minute summer	SB1.10	SB1.10	SB1.10A	20.1	0.825	0.055	3.7752	
120 minute summer	SB1.10A	SB1.10A	SB1.11	20.2	0.532	0.055	2.5218	
15 minute summer	SB5.0	SB5.0	SB5.1	9.6	0.440	0.152	1.2757	
15 minute summer	SB5.1	SB5.1	SB5.2	24.2	0.609	0.613	0.6842	
15 minute summer	SB5.2	SB5.2	SB5.3	33.3	0.837	0.785	0.5941	
15 minute summer	SB5.3	SB5.3	SB5.4	182.7	2.628	2.005	2.1501	
600 minute summer	SB5.4	Hydro-Brake®	SB1.11	1.9				
600 minute summer	SB5.4	Infiltration		5.5				
120 minute summer	SB1.11	SB1.11	SB1.12	30.9	0.683	0.078	20.1326	
120 minute summer	SB1.12	SB1.12	SB1.13	33.4	0.499	0.063	14.4379	
4320 minute summer	MH	Hydro-Brake®	SB1.13	0.3				
720 minute summer	SB1.13	Hydro-Brake®	OUT1	7.3				319.2

CATCHMENT B

Design Settings

Rainfall Methodology	FSR
Return Period (years)	5
Additional Flow (%)	0
FSR Region	Scotland and Ireland
M5-60 (mm)	17.200
Ratio-R	0.277
CV	1.000
Time of Entry (mins)	4.00
Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	0.200
Preferred Cover Depth (m)	0.600
Include Intermediate Ground	✓
Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SB7.0	0.033	4.00	43.700	1200	717360.812	729023.397	1.200
SB7.1	0.253	4.00	43.700	1350	717358.537	729046.984	1.640
SB7.2	0.033	4.00	43.700	1350	717355.029	729078.491	1.690
OUT 2	0.000	4.00	43.250	1350	717354.659	729086.655	1.270
SB6.0	0.000	4.00	44.635	1200	717279.389	729013.162	1.190
SB6.1	0.037	4.00	44.282	1200	717271.281	729018.810	0.887
SB6.2	0.014	4.00	44.800	1200	717248.235	729011.502	1.525
SB9.0	0.045	4.00	44.650	1200	717240.727	728979.415	1.250
SB9.1	0.000	4.00	44.800	1200	717234.518	728998.685	1.525
SB6.3	0.305	4.00	44.800	1200	717243.240	729021.013	1.575
OUT 3	0.000	4.00	44.700	1200	717234.102	729049.594	1.687
SB2.0	0.076	4.00	44.680	1200	717090.180	729005.064	1.045
SB1.0	0.002	4.00	45.040	1200	717098.176	729083.206	1.240
SB1.1	0.030	4.00	44.943	1200	717099.046	729074.197	1.199
SB2.1	0.003	4.00	44.810	1200	717091.669	729010.988	1.213
SB1.2	0.160	4.00	44.973	1200	717116.580	729018.884	1.511
SB1.3	0.069	4.00	45.159	1200	717150.487	729020.444	1.802
SB1.4	0.069	4.00	45.117	1350	717164.794	729014.172	1.827
SB3.0	0.107	4.00	45.286	1200	717161.809	728951.363	1.446
SB3.2	0.121	4.00	45.286	1200	717140.878	729017.392	1.862
SB3.1	0.000	4.00	45.286	1200	717148.816	728992.351	1.996
SB1.5	0.000	4.00	45.255	1350	717156.263	728994.711	2.050
SB1.6	0.069	4.00	45.240	1350	717162.185	728976.028	2.090
SB1.7	0.110	4.00	44.920	1350	717188.055	728984.228	1.820
SB4.0	0.000	4.00	45.150	1200	717148.553	729093.832	1.950
SB4.1	0.490	4.00	45.150	1350	717152.637	729080.859	2.050
SB1.8	0.028	4.00	45.150	1500	717170.987	729038.075	2.296
SB1.9	0.010	4.00	44.971	1500	717187.095	729043.184	2.181
SB1.10	0.010	4.00	44.795	1500	717205.877	729050.030	2.069
SB1.10A	0.000	4.00	44.615	1500	717219.891	729060.469	1.990
SB5.0	0.000	4.00	45.151	1200	717167.356	729131.520	1.151
SB5.1	0.000	4.00	45.094	1200	717199.427	729132.065	1.894
SB5.2	0.000	4.00	45.104	1200	717200.222	729114.879	2.004
SB5.3	0.293	4.00	44.656	1350	717215.160	729114.904	1.656
SB5.4	0.161	4.00	44.501	1350	717225.888	729080.985	1.576
SB1.11	0.098	4.00	44.499	1500	717231.022	729063.983	1.942
SB1.12	0.062	4.00	43.368	1500	717299.168	729085.538	1.049
MH	0.092	4.00	42.900	1200	717319.537	729135.812	0.800
SB1.13	0.000	4.00	43.250	1500	717348.285	729100.193	1.235
OUT1	0.000	4.00	43.250	1500	717351.888	729088.527	1.270

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
SB7.0	SB7.0	SB7.1	23.696	0.600	42.500	42.210	0.290	81.7	225	4.27	50.0
SB7.1	SB7.1	SB7.2	31.702	0.600	42.060	42.010	0.050	634.0	375	5.01	50.0
SB7.2	SB7.2	OUT 2	8.172	0.600	42.010	41.980	0.030	272.4	375	5.14	50.0
SB6.0	SB6.0	SB6.1	9.881	0.600	43.445	43.395	0.050	197.6	225	4.18	50.0
SB6.1	SB6.1	SB6.2	24.177	0.600	43.395	43.275	0.120	201.5	225	4.62	50.0
SB6.2	SB6.2	SB6.3	10.743	0.600	43.275	43.225	0.050	214.9	225	4.82	50.0
SB9.0	SB9.0	SB9.1	20.246	0.600	43.400	43.275	0.125	162.0	225	4.33	50.0
SB9.1	SB9.1	SB6.3	23.971	0.600	43.275	43.225	0.050	479.4	225	5.01	50.0
SB6.3	SB6.3	OUT 3	30.006	0.600	43.225	43.013	0.212	141.5	300	5.39	50.0
SB2.0	SB2.0	SB2.1	6.108	0.600	43.635	43.597	0.038	160.7	225	4.10	50.0
SB1.0	SB1.0	SB1.1	9.051	0.600	43.800	43.744	0.056	161.6	225	4.15	50.0
SB1.1	SB1.1	SB1.2	58.026	0.600	43.744	43.462	0.282	205.8	225	5.21	50.0
SB2.1	SB2.1	SB1.2	26.132	0.600	43.597	43.462	0.135	193.6	225	4.56	50.0
SB1.2	SB1.2	SB1.3	33.943	0.600	43.462	43.357	0.105	323.3	300	5.86	50.0
SB1.3	SB1.3	SB1.4	15.621	0.600	43.357	43.290	0.067	233.2	300	6.12	50.0
SB1.4	SB1.4	SB1.5	21.249	0.600	43.290	43.205	0.085	250.0	375	6.43	50.0
SB3.0	SB3.0	SB3.1	42.998	0.600	43.840	43.625	0.215	200.0	225	4.78	50.0
SB3.2	SB3.2	SB3.1	26.269	0.600	43.424	43.290	0.134	196.0	225	4.47	50.0
SB3.1	SB3.1	SB1.5	7.812	0.600	43.290	43.205	0.085	91.9	225	4.87	50.0
SB1.5	SB1.5	SB1.6	19.599	0.600	43.205	43.150	0.055	356.3	450	6.73	50.0
SB1.6	SB1.6	SB1.7	27.138	0.600	43.150	43.100	0.050	542.8	450	7.26	50.0
SB1.7	SB1.7	SB1.8	56.487	0.600	43.100	42.854	0.246	229.6	450	7.96	50.0
SB4.0	SB4.0	SB4.1	13.601	0.600	43.200	43.100	0.100	136.0	225	4.20	50.0
SB4.1	SB4.1	SB1.8	46.553	0.600	43.100	42.854	0.246	189.2	375	4.79	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
SB7.0	1.447	57.5	6.0	0.975	1.265	0.033	0.0	49	0.943
SB7.1	0.712	78.6	51.7	1.265	1.315	0.286	0.0	222	0.758
SB7.2	1.093	120.7	57.6	1.315	0.895	0.319	0.0	183	1.081
SB6.0	0.926	36.8	0.0	0.965	0.662	0.000	0.0	0	0.000
SB6.1	0.917	36.5	6.7	0.662	1.300	0.037	0.0	65	0.704
SB6.2	0.888	35.3	9.2	1.300	1.350	0.051	0.0	79	0.751
SB9.0	1.024	40.7	8.1	1.025	1.300	0.045	0.0	68	0.804
SB9.1	0.590	23.5	8.1	1.300	1.350	0.045	0.0	91	0.537
SB6.3	1.319	93.3	72.5	1.275	1.387	0.401	0.0	200	1.453
SB2.0	1.028	40.9	13.7	0.820	0.988	0.076	0.0	90	0.931
SB1.0	1.026	40.8	0.4	1.015	0.974	0.002	0.0	15	0.319
SB1.1	0.908	36.1	5.8	0.974	1.286	0.032	0.0	61	0.671
SB2.1	0.936	37.2	14.3	0.988	1.286	0.079	0.0	96	0.874
SB1.2	0.869	61.4	49.0	1.211	1.502	0.271	0.0	203	0.961
SB1.3	1.025	72.5	61.4	1.502	1.527	0.340	0.0	213	1.146
SB1.4	1.141	126.0	73.9	1.452	1.675	0.409	0.0	207	1.185
SB3.0	0.921	36.6	19.3	1.221	1.436	0.107	0.0	116	0.934
SB3.2	0.930	37.0	21.9	1.637	1.771	0.121	0.0	124	0.967
SB3.1	1.364	54.2	41.2	1.771	1.825	0.228	0.0	147	1.497
SB1.5	1.071	170.3	115.1	1.600	1.640	0.637	0.0	272	1.147
SB1.6	0.865	137.6	127.6	1.640	1.370	0.706	0.0	344	0.977
SB1.7	1.337	212.7	147.5	1.370	1.846	0.816	0.0	276	1.439
SB4.0	1.119	44.5	0.0	1.725	1.825	0.000	0.0	0	0.000
SB4.1	1.313	145.1	88.5	1.675	1.921	0.490	0.0	212	1.376

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
SB1.8	SB1.8	SB1.9	16.899	0.600	42.854	42.790	0.064	264.0	525	8.17	50.0
SB1.9	SB1.9	SB1.10	19.991	0.600	42.790	42.726	0.064	312.4	525	8.43	50.0
SB1.10	SB1.10	SB1.10A	17.475	0.600	42.726	42.625	0.101	173.0	525	8.60	50.0
SB1.10A	SB1.10A	SB1.11	11.673	0.600	42.625	42.557	0.068	171.7	525	8.71	50.0
SB5.0	SB5.0	SB5.1	32.076	0.600	44.000	43.535	0.465	69.0	225	4.34	50.0
SB5.1	SB5.1	SB5.2	17.204	0.600	43.200	43.100	0.100	172.0	225	4.63	50.0
SB5.2	SB5.2	SB5.3	14.938	0.600	43.100	43.000	0.100	149.4	225	4.86	50.0
SB5.3	SB5.3	SB5.4	35.575	0.600	43.000	42.925	0.075	474.3	375	5.58	50.0
SB5.4	SB5.4	SB1.11	17.760	0.600	42.925	42.557	0.368	48.3	375	5.69	50.0
SB1.11	SB1.11	SB1.12	71.474	0.600	42.557	42.319	0.238	300.3	600	9.57	49.4
SB1.12	SB1.12	SB1.13	51.257	0.600	42.319	42.015	0.304	168.6	600	10.02	48.4
MH	MH	SB1.13	45.773	0.600	42.100	42.015	0.085	538.5	225	5.37	50.0
SB1.13	SB1.13	OUT1	12.210	0.600	42.015	41.980	0.035	348.8	600	10.18	48.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
SB1.8	1.373	297.3	241.1	1.771	1.656	1.334	0.0	360	1.521
SB1.9	1.262	273.1	242.9	1.656	1.544	1.344	0.0	388	1.417
SB1.10	1.700	367.9	244.7	1.544	1.465	1.354	0.0	314	1.812
SB1.10A	1.706	369.4	244.7	1.465	1.417	1.354	0.0	313	1.819
SB5.0	1.576	62.7	0.0	0.926	1.334	0.000	0.0	0	0.000
SB5.1	0.994	39.5	0.0	1.669	1.779	0.000	0.0	0	0.000
SB5.2	1.067	42.4	0.0	1.779	1.431	0.000	0.0	0	0.000
SB5.3	0.825	91.1	52.9	1.281	1.201	0.293	0.0	205	0.855
SB5.4	2.613	288.6	82.0	1.201	1.567	0.454	0.0	137	2.265
SB1.11	1.400	395.8	340.4	1.342	0.449	1.906	0.0	432	1.564
SB1.12	1.872	529.4	344.0	0.449	0.635	1.968	0.0	353	1.987
MH	0.556	22.1	16.6	0.575	1.010	0.092	0.0	145	0.609
SB1.13	1.298	366.9	357.4	0.635	0.670	2.060	0.0	483	1.468

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	Scotland and Ireland	Drain Down Time (mins)	240
M5-60 (mm)	17.200	Additional Storage (m^3/ha)	20.0
Ratio-R	0.277	Check Discharge Rate(s)	x
Summer CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

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

Node SB7.2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	42.010	Product Number	CTL-SHE-0065-2000-1145-2000
Design Depth (m)	1.145	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node SB6.3 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	43.225	Product Number	CTL-SHE-0081-3500-1575-3500
Design Depth (m)	1.575	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.5	Min Node Diameter (mm)	1200

Node SB2.0 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	43.635	Product Number	CTL-SHE-0071-2000-0750-2000
Design Depth (m)	0.750	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node SB1.7 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	43.100	Product Number	CTL-SHE-0094-4000-1060-4000
Design Depth (m)	1.060	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	4.0	Min Node Diameter (mm)	1200

Node SB4.1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	43.100	Product Number	CTL-SHE-0076-3500-2050-3500
Design Depth (m)	2.050	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.5	Min Node Diameter (mm)	1200

Node SB5.4 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	42.925	Product Number	CTL-SHE-0071-2000-0762-2000
Design Depth (m)	0.762	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node MH Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	42.100	Product Number	CTL-SHE-0076-2000-0400-2000
Design Depth (m)	0.400	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node SB1.13 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	42.015	Product Number	CTL-SHE-0163-1500-1800-1500
Design Depth (m)	1.800	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	15.0	Min Node Diameter (mm)	1500

Node SB7.2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.26400	Safety Factor	5.0	Invert Level (m)	42.010
Side Inf Coefficient (m/hr)	0.26400	Porosity	1.00	Time to half empty (mins)	405

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	107.5	107.5	1.145	107.5	186.8	1.146	0.0	186.8

Node SB7.1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	42.060
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	969.0	0.0	0.065	969.0	0.0	0.066	0.0	0.0

Node SB6.3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	43.225
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	840

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	225.8	0.0	1.550	225.8	0.0	1.551	0.0	0.0

Node SB6.3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	43.225
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1225.0	0.0	0.065	1225.0	0.0	0.066	0.0	0.0

Node SB2.0 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.26400	Safety Factor	5.0	Invert Level (m)	43.635
Side Inf Coefficient (m/hr)	0.26400	Porosity	0.30	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	372.0	372.0	0.750	372.0	489.0	0.751	0.0	489.0

Node SB1.7 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	5.0	Invert Level (m)	43.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	510.4	510.4	1.060	510.4	644.3	1.061	0.0	644.3

Node SB4.1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	43.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	175.6	0.0	2.050	175.6	0.0	2.051	0.0	0.0

Node SB4.1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	43.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	2239.0	0.0	0.065	2239.0	0.0	0.066	0.0	0.0

Node SB5.4 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.26400	Safety Factor	5.0	Invert Level (m)	42.925
Side Inf Coefficient (m/hr)	0.26400	Porosity	1.00	Time to half empty (mins)	150

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	333.3	333.3	0.762	333.3	405.3	0.763	0.0	405.3

Node SB5.4 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	42.925
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1163.0	0.0	0.065	1163.0	0.0	0.066	0.0	0.0

Node MH Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	42.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	183.0	0.0	0.400	366.0	0.0	0.401	0.0	0.0

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 99.85%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SB7.0	10	42.565	0.065	10.1	0.1099	0.0000	OK
960 minute summer	SB7.1	615	42.318	0.258	10.5	61.4593	0.0000	OK
960 minute summer	SB7.2	615	42.317	0.307	10.3	33.6113	0.0000	OK
15 minute summer	OUT 2	1	41.980	0.000	0.4	0.0000	0.0000	OK
2160 minute summer	SB6.0	1380	43.554	0.109	0.0	0.1238	0.0000	OK
2160 minute summer	SB6.1	1380	43.554	0.159	0.8	0.3134	0.0000	OK
2160 minute summer	SB6.2	1380	43.554	0.279	1.1	0.3675	0.0000	SURCHARGED
2160 minute summer	SB9.0	1380	43.554	0.154	0.9	0.2859	0.0000	OK
2160 minute summer	SB9.1	1380	43.554	0.279	0.9	0.3161	0.0000	SURCHARGED
2160 minute summer	SB6.3	1380	43.554	0.329	8.0	152.2678	0.0000	SURCHARGED
15 minute summer	OUT 3	1	43.013	0.000	0.5	0.0000	0.0000	OK
30 minute summer	SB2.0	22	43.699	0.064	21.0	7.3161	0.0000	OK
15 minute summer	SB1.0	11	43.847	0.047	1.8	0.0550	0.0000	OK
15 minute summer	SB1.1	11	43.847	0.103	9.7	0.1688	0.0000	OK
15 minute summer	SB2.1	10	43.863	0.266	7.4	0.3133	0.0000	SURCHARGED
15 minute summer	SB1.2	11	43.832	0.370	57.6	1.2013	0.0000	SURCHARGED
15 minute summer	SB1.3	10	43.748	0.391	67.7	0.7410	0.0000	SURCHARGED
15 minute summer	SB1.4	10	43.671	0.381	86.6	0.8334	0.0000	SURCHARGED
15 minute summer	SB3.0	10	44.010	0.170	32.7	0.4435	0.0000	OK
15 minute summer	SB3.2	10	43.963	0.539	36.9	1.3107	0.0000	SURCHARGED
15 minute summer	SB3.1	10	43.818	0.528	67.9	0.5967	0.0000	SURCHARGED
15 minute summer	SB1.5	9	43.618	0.413	156.5	0.5910	0.0000	OK
1440 minute summer	SB1.6	990	43.585	0.435	16.6	0.9103	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SB7.0	SB7.0	SB7.1	10.1	1.078	0.175	0.2218	
960 minute summer	SB7.1	SB7.1	SB7.2	9.1	0.381	0.116	2.8121	
960 minute summer	SB7.2	Hydro-Brake®	OUT 2	1.8				67.1
960 minute summer	SB7.2	Infiltration		1.9				
2160 minute summer	SB6.0	SB6.0	SB6.1	0.0	0.003	-0.001	0.2433	
2160 minute summer	SB6.1	SB6.1	SB6.2	0.8	0.308	0.022	0.8446	
2160 minute summer	SB6.2	SB6.2	SB6.3	1.0	0.344	0.028	0.4273	
2160 minute summer	SB9.0	SB9.0	SB9.1	0.9	0.321	0.022	0.6968	
2160 minute summer	SB9.1	SB9.1	SB6.3	0.8	0.271	0.033	0.9534	
2160 minute summer	SB6.3	Hydro-Brake®	OUT 3	3.0				218.8
30 minute summer	SB2.0	Hydro-Brake®	SB2.1	1.2				
30 minute summer	SB2.0	Infiltration		5.5				
15 minute summer	SB1.0	SB1.0	SB1.1	1.9	0.206	0.047	0.1080	
15 minute summer	SB1.1	SB1.1	SB1.2	12.8	0.398	0.354	1.6706	
15 minute summer	SB2.1	SB2.1	SB1.2	-6.5	0.249	-0.174	1.0393	
15 minute summer	SB1.2	SB1.2	SB1.3	51.8	0.767	0.844	2.3902	
15 minute summer	SB1.3	SB1.3	SB1.4	69.2	0.983	0.955	1.1000	
15 minute summer	SB1.4	SB1.4	SB1.5	89.0	0.855	0.706	2.3437	
15 minute summer	SB3.0	SB3.0	SB3.1	32.9	1.006	0.898	1.4695	
15 minute summer	SB3.2	SB3.2	SB3.1	35.0	0.881	0.947	1.0447	
15 minute summer	SB3.1	SB3.1	SB1.5	67.4	1.696	1.244	0.3107	
15 minute summer	SB1.5	SB1.5	SB1.6	159.1	1.134	0.934	3.0136	
1440 minute summer	SB1.6	SB1.6	SB1.7	16.4	0.590	0.119	4.2792	

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 99.85%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	SB1.7	990	43.585	0.485	19.4	248.8702	0.0000	SURCHARGED
4320 minute summer	SB4.0	2640	43.610	0.410	0.1	0.4641	0.0000	SURCHARGED
4320 minute summer	SB4.1	2640	43.610	0.510	6.7	232.1115	0.0000	SURCHARGED
30 minute summer	SB1.8	18	42.922	0.068	10.5	0.1363	0.0000	OK
30 minute summer	SB1.9	18	42.870	0.080	13.0	0.1482	0.0000	OK
30 minute summer	SB1.10	18	42.802	0.076	15.6	0.1408	0.0000	OK
15 minute summer	SB1.10A	11	42.699	0.074	15.2	0.1299	0.0000	OK
15 minute summer	SB5.0	1	44.000	0.000	0.0	0.0000	0.0000	OK
15 minute summer	SB5.1	10	43.860	0.660	16.5	0.7460	0.0000	SURCHARGED
15 minute summer	SB5.2	10	43.842	0.742	20.2	0.8395	0.0000	SURCHARGED
15 minute summer	SB5.3	10	43.824	0.824	90.9	4.0965	0.0000	SURCHARGED
480 minute summer	SB5.4	312	43.047	0.122	26.2	113.4235	0.0000	OK
15 minute summer	SB1.11	10	42.691	0.134	43.9	0.3722	0.0000	OK
60 minute summer	SB1.12	43	42.629	0.310	46.9	0.9141	0.0000	OK
480 minute summer	MH	320	42.266	0.166	7.3	37.2522	0.0000	OK
60 minute summer	SB1.13	45	42.662	0.647	49.9	1.1432	0.0000	SURCHARGED
15 minute summer	OUT1	1	41.980	0.000	15.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute summer	SB1.7	Hydro-Brake®	SB1.8	4.0				
4320 minute summer	SB4.0	SB4.0	SB4.1	-0.1	-0.003	-0.001	0.5409	
4320 minute summer	SB4.1	Hydro-Brake®	SB1.8	2.6				
30 minute summer	SB1.8	SB1.8	SB1.9	10.4	0.566	0.035	0.3112	
30 minute summer	SB1.9	SB1.9	SB1.10	13.0	0.655	0.047	0.3960	
30 minute summer	SB1.10	SB1.10	SB1.10A	15.4	0.837	0.042	0.3222	
15 minute summer	SB1.10A	SB1.10A	SB1.11	15.4	0.545	0.042	0.3557	
15 minute summer	SB5.0	SB5.0	SB5.1	0.0	0.000	0.000	0.6379	
15 minute summer	SB5.1	SB5.1	SB5.2	18.0	0.454	0.457	0.6842	
15 minute summer	SB5.2	SB5.2	SB5.3	22.9	0.577	0.541	0.5941	
15 minute summer	SB5.3	SB5.3	SB5.4	106.4	1.852	1.167	2.0174	
480 minute summer	SB5.4	Hydro-Brake®	SB1.11	1.9				
480 minute summer	SB5.4	Infiltration		5.0				
15 minute summer	SB1.11	SB1.11	SB1.12	42.8	0.926	0.108	4.7739	
60 minute summer	SB1.12	SB1.12	SB1.13	49.9	0.474	0.094	10.7759	
480 minute summer	MH	Hydro-Brake®	SB1.13	1.6				
60 minute summer	SB1.13	Hydro-Brake®	OUT1	15.0				136.0

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.85%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute summer	SB7.0	645	42.699	0.199	1.7	0.3350	0.0000	OK
960 minute summer	SB7.1	645	42.699	0.639	14.5	63.1835	0.0000	SURCHARGED
960 minute summer	SB7.2	645	42.699	0.689	15.0	75.3390	0.0000	SURCHARGED
15 minute summer	OUT 2	1	41.980	0.000	1.0	0.0000	0.0000	OK
2160 minute summer	SB6.0	1440	43.841	0.396	0.1	0.4479	0.0000	SURCHARGED
2160 minute summer	SB6.1	1440	43.841	0.446	1.0	0.8765	0.0000	SURCHARGED
2160 minute summer	SB6.2	1440	43.841	0.566	1.2	0.7443	0.0000	SURCHARGED
2160 minute summer	SB9.0	1440	43.841	0.441	1.2	0.8164	0.0000	SURCHARGED
2160 minute summer	SB9.1	1440	43.841	0.566	1.1	0.6402	0.0000	SURCHARGED
2160 minute summer	SB6.3	1440	43.841	0.616	10.6	218.4056	0.0000	SURCHARGED
15 minute summer	OUT 3	1	43.013	0.000	1.0	0.0000	0.0000	OK
60 minute summer	SB2.0	40	43.746	0.111	24.3	12.6609	0.0000	OK
15 minute summer	SB1.0	11	44.268	0.468	9.4	0.5440	0.0000	SURCHARGED
15 minute summer	SB1.1	11	44.260	0.516	19.3	0.8417	0.0000	SURCHARGED
15 minute summer	SB2.1	11	44.258	0.661	8.4	0.7805	0.0000	SURCHARGED
15 minute summer	SB1.2	11	44.243	0.781	74.7	2.5377	0.0000	SURCHARGED
15 minute summer	SB1.3	11	44.064	0.707	98.4	1.3403	0.0000	SURCHARGED
15 minute summer	SB1.4	11	43.881	0.591	124.4	1.2923	0.0000	SURCHARGED
15 minute summer	SB3.0	11	44.477	0.637	47.9	1.6622	0.0000	SURCHARGED
15 minute summer	SB3.2	11	44.419	0.995	54.2	2.4193	0.0000	SURCHARGED
15 minute summer	SB3.1	11	44.148	0.858	90.9	0.9703	0.0000	SURCHARGED
1440 minute summer	SB1.5	990	43.800	0.595	19.9	0.8512	0.0000	SURCHARGED
1440 minute summer	SB1.6	990	43.800	0.650	22.1	1.3594	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
960 minute summer	SB7.0	SB7.0	SB7.1	1.7	0.621	0.030	0.9121	
960 minute summer	SB7.1	SB7.1	SB7.2	13.3	0.357	0.170	3.4966	
960 minute summer	SB7.2	Hydro-Brake®	OUT 2	1.8				80.1
960 minute summer	SB7.2	Infiltration		2.3				
2160 minute summer	SB6.0	SB6.0	SB6.1	-0.1	-0.009	-0.002	0.3930	
2160 minute summer	SB6.1	SB6.1	SB6.2	0.8	0.308	0.022	0.9615	
2160 minute summer	SB6.2	SB6.2	SB6.3	1.1	0.330	0.032	0.4273	
2160 minute summer	SB9.0	SB9.0	SB9.1	1.1	0.335	0.027	0.8052	
2160 minute summer	SB9.1	SB9.1	SB6.3	1.1	0.261	0.045	0.9534	
2160 minute summer	SB6.3	Hydro-Brake®	OUT 3	3.0				271.0
60 minute summer	SB2.0	Hydro-Brake®	SB2.1	1.8				
60 minute summer	SB2.0	Infiltration		5.6				
15 minute summer	SB1.0	SB1.0	SB1.1	-8.5	0.224	-0.209	0.3600	
15 minute summer	SB1.1	SB1.1	SB1.2	21.2	0.537	0.588	2.3078	
15 minute summer	SB2.1	SB2.1	SB1.2	-7.3	0.376	-0.195	1.0393	
15 minute summer	SB1.2	SB1.2	SB1.3	72.9	1.035	1.187	2.3902	
15 minute summer	SB1.3	SB1.3	SB1.4	99.0	1.406	1.366	1.1000	
15 minute summer	SB1.4	SB1.4	SB1.5	125.2	1.136	0.994	2.3437	
15 minute summer	SB3.0	SB3.0	SB3.1	42.5	1.070	1.162	1.7101	
15 minute summer	SB3.2	SB3.2	SB3.1	48.5	1.220	1.312	1.0447	
15 minute summer	SB3.1	SB3.1	SB1.5	91.7	2.305	1.690	0.3107	
1440 minute summer	SB1.5	SB1.5	SB1.6	19.5	0.398	0.115	3.1053	
1440 minute summer	SB1.6	SB1.6	SB1.7	21.7	0.614	0.157	4.2998	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.85%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	SB1.7	990	43.800	0.700	25.8	359.0323	0.0000	SURCHARGED
2880 minute summer	SB4.0	1920	44.139	0.939	0.1	1.0615	0.0000	SURCHARGED
2880 minute summer	SB4.1	1920	44.139	1.039	11.4	328.1426	0.0000	SURCHARGED
30 minute summer	SB1.8	17	42.936	0.082	15.2	0.1657	0.0000	OK
30 minute summer	SB1.9	18	42.887	0.097	19.0	0.1799	0.0000	OK
60 minute summer	SB1.10	49	42.853	0.127	18.9	0.2364	0.0000	OK
120 minute summer	SB1.10A	82	42.857	0.232	14.8	0.4104	0.0000	OK
15 minute summer	SB5.0	11	44.033	0.033	3.9	0.0368	0.0000	OK
15 minute summer	SB5.1	10	44.037	0.837	19.2	0.9468	0.0000	SURCHARGED
15 minute summer	SB5.2	10	44.036	0.936	24.1	1.0591	0.0000	SURCHARGED
15 minute summer	SB5.3	10	44.036	1.036	131.1	5.1465	0.0000	SURCHARGED
480 minute summer	SB5.4	328	43.207	0.282	36.8	167.3679	0.0000	OK
120 minute summer	SB1.11	80	42.846	0.289	35.5	0.8018	0.0000	OK
120 minute summer	SB1.12	84	42.845	0.526	47.5	1.5518	0.0000	OK
480 minute summer	MH	352	42.360	0.260	9.4	63.8065	0.0000	SURCHARGED
60 minute summer	SB1.13	44	42.862	0.847	60.0	1.4971	0.0000	SURCHARGED
15 minute summer	OUT1	1	41.980	0.000	15.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute summer	SB1.7	Hydro-Brake®	SB1.8	4.0				
2880 minute summer	SB4.0	SB4.0	SB4.1	-0.1	-0.004	-0.002	0.5409	
2880 minute summer	SB4.1	Hydro-Brake®	SB1.8	2.6				
30 minute summer	SB1.8	SB1.8	SB1.9	15.0	0.616	0.050	0.4110	
30 minute summer	SB1.9	SB1.9	SB1.10	19.1	0.721	0.070	0.5293	
60 minute summer	SB1.10	SB1.10	SB1.10A	18.9	0.860	0.051	1.0945	
120 minute summer	SB1.10A	SB1.10A	SB1.11	18.4	0.555	0.050	1.2317	
15 minute summer	SB5.0	SB5.0	SB5.1	-3.9	0.355	-0.062	0.6942	
15 minute summer	SB5.1	SB5.1	SB5.2	-19.2	-0.483	-0.486	0.6842	
15 minute summer	SB5.2	SB5.2	SB5.3	-24.1	-0.607	-0.569	0.5941	
15 minute summer	SB5.3	SB5.3	SB5.4	147.6	2.178	1.619	2.0654	
480 minute summer	SB5.4	Hydro-Brake®	SB1.11	2.0				
480 minute summer	SB5.4	Infiltration		5.2				
120 minute summer	SB1.11	SB1.11	SB1.12	35.0	0.789	0.089	14.1122	
120 minute summer	SB1.12	SB1.12	SB1.13	41.6	0.470	0.079	13.9317	
480 minute summer	MH	Hydro-Brake®	SB1.13	2.0				
60 minute summer	SB1.13	Hydro-Brake®	OUT1	15.0				176.9

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.85%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute summer	SB7.0	645	43.030	0.530	2.1	0.8905	0.0000	SURCHARGED
960 minute summer	SB7.1	645	43.030	0.970	18.0	64.6764	0.0000	SURCHARGED
960 minute summer	SB7.2	645	43.030	1.020	18.9	111.4630	0.0000	SURCHARGED
15 minute summer	OUT 2	1	41.980	0.000	1.5	0.0000	0.0000	OK
2160 minute summer	SB6.0	1500	44.123	0.678	0.1	0.7671	0.0000	SURCHARGED
2160 minute summer	SB6.1	1500	44.123	0.728	1.2	1.4311	0.0000	FLOOD RISK
2160 minute summer	SB6.2	1500	44.123	0.848	1.6	1.1155	0.0000	SURCHARGED
2160 minute summer	SB9.0	1500	44.123	0.723	1.5	1.3388	0.0000	SURCHARGED
2160 minute summer	SB9.1	1500	44.123	0.848	1.4	0.9594	0.0000	SURCHARGED
2160 minute summer	SB6.3	1500	44.123	0.898	13.1	283.5491	0.0000	SURCHARGED
15 minute summer	OUT 3	1	43.013	0.000	1.5	0.0000	0.0000	OK
60 minute summer	SB2.0	42	43.797	0.162	32.2	18.4503	0.0000	OK
15 minute summer	SB1.0	11	44.778	0.978	14.6	1.1369	0.0000	FLOOD RISK
15 minute summer	SB1.1	11	44.771	1.027	37.8	1.6755	0.0000	FLOOD RISK
15 minute summer	SB2.1	11	44.711	1.114	21.4	1.3146	0.0000	FLOOD RISK
15 minute summer	SB1.2	11	44.712	1.250	104.4	4.0597	0.0000	FLOOD RISK
15 minute summer	SB1.3	11	44.452	1.095	120.2	2.0772	0.0000	SURCHARGED
15 minute summer	SB1.4	11	44.181	0.891	154.5	1.9483	0.0000	SURCHARGED
15 minute summer	SB3.0	11	45.075	1.235	62.1	3.2246	0.0000	FLOOD RISK
15 minute summer	SB3.2	11	45.005	1.581	70.3	3.8441	0.0000	FLOOD RISK
15 minute summer	SB3.1	11	44.582	1.292	111.9	1.4618	0.0000	SURCHARGED
1440 minute summer	SB1.5	1050	43.998	0.793	24.1	1.1355	0.0000	SURCHARGED
1440 minute summer	SB1.6	1050	43.998	0.848	27.2	1.7750	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
960 minute summer	SB7.0	SB7.0	SB7.1	2.1	0.633	0.036	0.9424	
960 minute summer	SB7.1	SB7.1	SB7.2	16.8	0.456	0.213	3.4966	
960 minute summer	SB7.2	Hydro-Brake®	OUT 2	1.9				87.7
960 minute summer	SB7.2	Infiltration		2.6				
2160 minute summer	SB6.0	SB6.0	SB6.1	-0.1	-0.014	-0.002	0.3930	
2160 minute summer	SB6.1	SB6.1	SB6.2	1.1	0.308	0.029	0.9615	
2160 minute summer	SB6.2	SB6.2	SB6.3	1.5	0.319	0.043	0.4273	
2160 minute summer	SB9.0	SB9.0	SB9.1	1.4	0.321	0.035	0.8052	
2160 minute summer	SB9.1	SB9.1	SB6.3	1.4	0.254	0.058	0.9534	
2160 minute summer	SB6.3	Hydro-Brake®	OUT 3	3.0				259.3
60 minute summer	SB2.0	Hydro-Brake®	SB2.1	2.0				
60 minute summer	SB2.0	Infiltration		5.7				
15 minute summer	SB1.0	SB1.0	SB1.1	-13.4	-0.337	-0.328	0.3600	
15 minute summer	SB1.1	SB1.1	SB1.2	24.3	0.612	0.675	2.3078	
15 minute summer	SB2.1	SB2.1	SB1.2	-20.0	-0.502	-0.536	1.0393	
15 minute summer	SB1.2	SB1.2	SB1.3	89.1	1.266	1.451	2.3902	
15 minute summer	SB1.3	SB1.3	SB1.4	121.3	1.723	1.674	1.1000	
15 minute summer	SB1.4	SB1.4	SB1.5	155.9	1.414	1.237	2.3437	
15 minute summer	SB3.0	SB3.0	SB3.1	51.8	1.303	1.416	1.7101	
15 minute summer	SB3.2	SB3.2	SB3.1	60.0	1.510	1.624	1.0447	
15 minute summer	SB3.1	SB3.1	SB1.5	112.2	2.821	2.068	0.3107	
1440 minute summer	SB1.5	SB1.5	SB1.6	24.0	0.392	0.141	3.1053	
1440 minute summer	SB1.6	SB1.6	SB1.7	27.1	0.659	0.197	4.2998	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.85%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	SB1.7	1050	43.998	0.898	32.2	460.9471	0.0000	SURCHARGED
2880 minute summer	SB4.0	1980	44.541	1.341	0.1	1.5170	0.0000	SURCHARGED
2880 minute summer	SB4.1	1980	44.541	1.441	13.8	401.3696	0.0000	SURCHARGED
120 minute summer	SB1.8	94	43.163	0.309	12.6	0.6213	0.0000	OK
120 minute summer	SB1.9	98	43.163	0.373	19.9	0.6943	0.0000	OK
120 minute summer	SB1.10	98	43.165	0.439	17.7	0.8179	0.0000	OK
120 minute summer	SB1.10A	96	43.165	0.540	17.5	0.9544	0.0000	SURCHARGED
15 minute summer	SB5.0	10	44.261	0.261	8.9	0.2950	0.0000	SURCHARGED
15 minute summer	SB5.1	10	44.213	1.013	18.8	1.1459	0.0000	SURCHARGED
15 minute summer	SB5.2	10	44.198	1.098	25.8	1.2415	0.0000	SURCHARGED
15 minute summer	SB5.3	10	44.193	1.193	170.2	5.9308	0.0000	SURCHARGED
600 minute summer	SB5.4	420	43.363	0.438	38.1	220.0187	0.0000	SURCHARGED
120 minute summer	SB1.11	96	43.165	0.608	43.5	1.6884	0.0000	SURCHARGED
120 minute summer	SB1.12	96	43.165	0.846	55.4	2.4944	0.0000	FLOOD RISK
480 minute summer	MH	408	42.438	0.338	11.4	89.2324	0.0000	SURCHARGED
120 minute summer	SB1.13	96	43.164	1.149	34.7	2.0311	0.0000	FLOOD RISK
15 minute summer	OUT1	1	41.980	0.000	15.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute summer	SB1.7	Hydro-Brake®	SB1.8	4.0				
2880 minute summer	SB4.0	SB4.0	SB4.1	-0.1	-0.004	-0.002	0.5409	
2880 minute summer	SB4.1	Hydro-Brake®	SB1.8	3.0				
120 minute summer	SB1.8	SB1.8	SB1.9	18.3	0.601	0.062	2.5037	
120 minute summer	SB1.9	SB1.9	SB1.10	15.0	0.710	0.055	3.5699	
120 minute summer	SB1.10	SB1.10	SB1.10A	17.5	0.843	0.047	3.5726	
120 minute summer	SB1.10A	SB1.10A	SB1.11	17.1	0.552	0.046	2.5218	
15 minute summer	SB5.0	SB5.0	SB5.1	9.6	0.429	0.153	1.2757	
15 minute summer	SB5.1	SB5.1	SB5.2	24.2	0.609	0.613	0.6842	
15 minute summer	SB5.2	SB5.2	SB5.3	33.4	0.841	0.788	0.5941	
15 minute summer	SB5.3	SB5.3	SB5.4	182.7	2.628	2.005	2.1501	
600 minute summer	SB5.4	Hydro-Brake®	SB1.11	2.0				
600 minute summer	SB5.4	Infiltration		5.5				
120 minute summer	SB1.11	SB1.11	SB1.12	39.9	0.778	0.101	20.1326	
120 minute summer	SB1.12	SB1.12	SB1.13	34.7	0.503	0.066	14.4379	
480 minute summer	MH	Hydro-Brake®	SB1.13	2.0				
120 minute summer	SB1.13	Hydro-Brake®	OUT1	15.0				247.1

CATCHMENT C 50% BLOCKAGE

Design Settings

Rainfall Methodology	FSR
Return Period (years)	5
Additional Flow (%)	0
FSR Region	Scotland and Ireland
M5-60 (mm)	17.200
Ratio-R	0.277
CV	1.000
Time of Entry (mins)	4.00

Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	0.200
Preferred Cover Depth (m)	1.200
Include Intermediate Ground	✓
Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SC1.0	0.041	4.00	41.219	1200	717331.498	729184.401	1.479
SC1.1	0.001	4.00	41.258	1200	717339.567	729199.962	1.588
SC3.0	0.021	4.00	41.300	1200	717353.158	729232.112	0.900
SC4.0	0.021	4.00	41.300	1200	717358.307	729272.822	0.900
SC3.1	0.012	4.00	41.212	1200	717341.906	729267.624	0.962
SC3.2	0.001	4.00	41.551	1200	717323.700	729263.904	1.386
SC1.2	0.083	4.00	41.466	1200	717319.563	729263.059	2.061
SC2.0	0.010	4.00	43.632	1200	717253.223	729236.424	1.482
SC2.1	0.071	4.00	43.097	1200	717247.548	729254.265	1.477
SC2.2	0.051	4.00	41.858	1200	717290.453	729267.865	1.478
Tank K	0.310	4.00	41.150	1200	717302.832	729244.627	1.550
SC1.3	0.086	4.00	41.538	1350	717315.521	729275.811	2.188
SC1.4	0.035	4.00	41.340	1350	717329.642	729282.433	2.365
SC1.5	0.000	4.00	41.400	1350	717354.368	729290.271	2.475

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
SC1.0	SC1.0	SC1.1	17.529	0.600	39.740	39.670	0.070	250.4	225	4.36	50.0
SC1.1	SC1.1	SC1.2	66.192	0.600	39.670	39.405	0.265	249.8	225	5.70	50.0
SC3.0	SC3.0	SC3.1	37.252	0.600	40.400	40.250	0.150	248.3	225	4.75	50.0
SC4.0	SC4.0	SC3.1	17.205	0.600	40.400	40.250	0.150	114.7	225	4.24	50.0
SC3.1	SC3.1	SC3.2	18.582	0.600	40.250	40.165	0.085	218.6	225	5.10	50.0
SC3.2	SC3.2	SC1.2	4.222	0.600	40.165	39.965	0.200	21.1	225	5.13	50.0
SC1.2	SC1.2	SC1.3	13.377	0.600	39.405	39.350	0.055	243.2	300	5.92	50.0
SC2.0	SC2.0	SC2.1	18.722	0.600	42.150	41.620	0.530	35.3	225	4.14	50.0
SC2.1	SC2.1	SC2.2	45.009	0.600	41.620	40.380	1.240	36.3	225	4.49	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
SC1.0	0.822	32.7	7.4	1.254	1.363	0.041	0.0	73	0.666
SC1.1	0.823	32.7	7.6	1.363	1.836	0.042	0.0	73	0.671
SC3.0	0.825	32.8	3.8	0.675	0.737	0.021	0.0	51	0.552
SC4.0	1.220	48.5	3.8	0.675	0.737	0.021	0.0	43	0.733
SC3.1	0.880	35.0	9.8	0.737	1.161	0.054	0.0	81	0.757
SC3.2	2.860	113.7	9.9	1.161	1.276	0.055	0.0	44	1.767
SC1.2	1.003	70.9	32.5	1.761	1.888	0.180	0.0	143	0.983
SC2.0	2.208	87.8	1.8	1.257	1.252	0.010	0.0	22	0.892
SC2.1	2.178	86.6	14.6	1.252	1.253	0.081	0.0	62	1.626

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
SC2.2	SC2.2	SC1.3	26.297	0.600	40.380	40.100	0.280	93.9	225	4.81	50.0
Tank K	Tank K	SC1.3	33.667	0.600	39.600	39.350	0.250	134.7	225	4.50	50.0
SC1.3	SC1.3	SC1.4	15.597	0.600	39.350	39.285	0.065	239.9	450	6.12	50.0
SC1.4	SC1.4	SC1.5	25.939	0.600	38.975	38.925	0.050	518.8	450	6.61	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
SC2.2	1.349	53.6	23.9	1.253	1.213	0.132	0.0	105	1.311
Tank K	1.125	44.7	56.0	1.325	1.963	0.310	0.0	225	1.145
SC1.3	1.308	208.0	127.9	1.738	1.605	0.708	0.0	255	1.372
SC1.4	0.885	140.8	134.3	1.915	2.025	0.743	0.0	354	1.002

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	Scotland and Ireland	Drain Down Time (mins)	240
M5-60 (mm)	17.200	Additional Storage (m³/ha)	20.0
Ratio-R	0.277	Check Discharge Rate(s)	x
Summer CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

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

Node Tank K Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	39.600	Product Number	CTL-SHE-0042-1000-1600-1000
Design Depth (m)	1.600	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.0	Min Node Diameter (mm)	1200

Node SC1.5 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	38.925	Product Number	CTL-SHE-0060-2000-1600-2000
Design Depth (m)	1.600	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node Tank K Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	39.600
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	303.8	0.0	1.200	303.8	0.0	1.201	0.0	0.0

Node SC1.5 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	38.925
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	150.0	0.0	1.600	150.0	0.0	1.601	0.0	0.0

Node Tank K Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	39.600
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1249.0	0.0	0.065	1249.0	0.0	0.066	0.0	0.0

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
7200 minute summer	SC1.0	4560	40.017	0.277	0.4	0.4673	0.0000	SURCHARGED
7200 minute summer	SC1.1	4560	40.017	0.347	0.4	0.3974	0.0000	SURCHARGED
15 minute summer	SC3.0	10	40.466	0.066	6.4	0.1059	0.0000	OK
15 minute summer	SC4.0	10	40.455	0.055	6.4	0.0877	0.0000	OK
15 minute summer	SC3.1	10	40.359	0.109	16.4	0.1504	0.0000	OK
15 minute summer	SC3.2	11	40.230	0.065	16.1	0.0745	0.0000	OK
7200 minute summer	SC1.2	4560	40.017	0.612	1.7	1.1855	0.0000	SURCHARGED
15 minute summer	SC2.0	10	42.179	0.029	3.1	0.0366	0.0000	OK
15 minute summer	SC2.1	10	41.702	0.082	24.8	0.1714	0.0000	OK
15 minute summer	SC2.2	10	40.533	0.153	40.4	0.2781	0.0000	OK
7200 minute summer	Tank K	4980	40.079	0.479	3.1	225.6743	0.0000	SURCHARGED
7200 minute summer	SC1.3	4560	40.017	0.667	4.3	1.4795	0.0000	SURCHARGED
7200 minute summer	SC1.4	4560	40.017	1.042	4.5	1.8001	0.0000	SURCHARGED
7200 minute summer	SC1.5	4560	40.017	1.092	4.4	165.4102	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
7200 minute summer	SC1.0	SC1.0	SC1.1	0.4	0.282	0.012	0.6971	
7200 minute summer	SC1.1	SC1.1	SC1.2	0.4	0.174	0.012	2.6325	
15 minute summer	SC3.0	SC3.0	SC3.1	6.3	0.442	0.192	0.5363	
15 minute summer	SC4.0	SC4.0	SC3.1	6.4	0.512	0.132	0.2281	
15 minute summer	SC3.1	SC3.1	SC3.2	15.8	1.118	0.452	0.2650	
15 minute summer	SC3.2	SC3.2	SC1.2	16.0	1.849	0.141	0.0366	
7200 minute summer	SC1.2	SC1.2	SC1.3	1.6	0.314	0.022	0.9420	
15 minute summer	SC2.0	SC2.0	SC2.1	3.1	0.409	0.035	0.1499	
15 minute summer	SC2.1	SC2.1	SC2.2	24.8	1.218	0.286	0.9392	
15 minute summer	SC2.2	SC2.2	SC1.3	39.5	1.434	0.736	0.7243	
7200 minute summer	Tank K	Hydro-Brake®	SC1.3	0.6				
7200 minute summer	SC1.3	SC1.3	SC1.4	4.2	0.500	0.020	2.4712	
7200 minute summer	SC1.4	SC1.4	SC1.5	4.4	0.298	0.031	4.1099	
7200 minute summer	SC1.5	Hydro-Brake®		1.7				509.2

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute summer	SC1.0	1500	40.406	0.666	1.1	1.1227	0.0000	SURCHARGED
2160 minute summer	SC1.1	1500	40.406	0.736	1.1	0.8423	0.0000	SURCHARGED
15 minute summer	SC3.0	10	40.481	0.081	9.4	0.1298	0.0000	OK
15 minute summer	SC4.0	10	40.467	0.067	9.4	0.1066	0.0000	OK
2160 minute summer	SC3.1	1500	40.406	0.156	1.5	0.2157	0.0000	OK
2160 minute summer	SC3.2	1500	40.406	0.241	1.5	0.2762	0.0000	SURCHARGED
2160 minute summer	SC1.2	1500	40.406	1.001	4.7	1.9384	0.0000	SURCHARGED
15 minute summer	SC2.0	10	42.185	0.035	4.5	0.0437	0.0000	OK
15 minute summer	SC2.1	10	41.721	0.101	36.3	0.2112	0.0000	OK
15 minute summer	SC2.2	11	40.613	0.233	59.1	0.4237	0.0000	SURCHARGED
7200 minute summer	Tank K	5160	40.409	0.809	4.0	327.4969	0.0000	SURCHARGED
2160 minute summer	SC1.3	1500	40.406	1.056	10.7	2.3417	0.0000	SURCHARGED
2160 minute summer	SC1.4	1500	40.406	1.431	11.4	2.4718	0.0000	SURCHARGED
2160 minute summer	SC1.5	1500	40.406	1.481	11.2	224.3041	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
2160 minute summer	SC1.0	SC1.0	SC1.1	1.1	0.360	0.034	0.6971	
2160 minute summer	SC1.1	SC1.1	SC1.2	0.9	0.198	0.027	2.6325	
15 minute summer	SC3.0	SC3.0	SC3.1	9.3	0.492	0.284	0.7085	
15 minute summer	SC4.0	SC4.0	SC3.1	9.4	0.564	0.194	0.3008	
2160 minute summer	SC3.1	SC3.1	SC3.2	1.5	0.582	0.043	0.6430	
2160 minute summer	SC3.2	SC3.2	SC1.2	1.5	0.978	0.013	0.1679	
2160 minute summer	SC1.2	SC1.2	SC1.3	4.5	0.395	0.064	0.9420	
15 minute summer	SC2.0	SC2.0	SC2.1	4.5	0.448	0.051	0.1974	
15 minute summer	SC2.1	SC2.1	SC2.2	36.3	1.299	0.419	1.2832	
15 minute summer	SC2.2	SC2.2	SC1.3	54.4	1.511	1.015	0.9993	
7200 minute summer	Tank K	Hydro-Brake®	SC1.3	0.6				
2160 minute summer	SC1.3	SC1.3	SC1.4	10.4	0.583	0.050	2.4712	
2160 minute summer	SC1.4	SC1.4	SC1.5	11.2	0.306	0.080	4.1099	
2160 minute summer	SC1.5	Hydro-Brake®		1.9				214.9

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute summer	SC1.0	615	41.219	1.479	2.6	2.4921	0.3817	FLOOD
960 minute summer	SC1.1	615	41.220	1.550	2.4	1.7728	0.0000	FLOOD RISK
720 minute summer	SC3.0	525	41.213	0.813	1.6	1.2987	0.0000	FLOOD RISK
960 minute summer	SC4.0	615	41.212	0.812	2.4	1.2979	0.0000	FLOOD RISK
2160 minute summer	SC3.1	1320	41.212	0.962	3.5	1.3276	20.9224	FLOOD
960 minute summer	SC3.2	615	41.217	1.052	3.5	1.2041	0.0000	SURCHARGED
960 minute summer	SC1.2	615	41.218	1.813	11.0	3.5093	0.0000	FLOOD RISK
15 minute summer	SC2.0	10	42.189	0.039	5.8	0.0495	0.0000	OK
15 minute summer	SC2.1	10	41.737	0.117	47.1	0.2458	0.0000	OK
960 minute summer	SC2.2	615	41.222	0.842	8.3	1.5326	0.0000	SURCHARGED
8640 minute summer	Tank K	6240	40.730	1.130	4.7	426.6772	0.0000	SURCHARGED
960 minute summer	SC1.3	615	41.219	1.869	24.3	4.1438	0.0000	SURCHARGED
960 minute summer	SC1.4	615	41.219	2.244	25.5	3.8761	0.0000	FLOOD RISK
960 minute summer	SC1.5	615	41.220	2.295	25.3	243.3587	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
960 minute summer	SC1.0	SC1.0	SC1.1	2.3	0.456	0.071	0.6971	
960 minute summer	SC1.1	SC1.1	SC1.2	2.3	0.242	0.069	2.6325	
720 minute summer	SC3.0	SC3.0	SC3.1	1.6	0.293	0.049	1.4816	
960 minute summer	SC4.0	SC4.0	SC3.1	-1.8	0.300	-0.038	0.6843	
2160 minute summer	SC3.1	SC3.1	SC3.2	-2.7	0.613	-0.076	0.7390	
960 minute summer	SC3.2	SC3.2	SC1.2	3.5	1.241	0.031	0.1679	
960 minute summer	SC1.2	SC1.2	SC1.3	10.6	0.488	0.150	0.9420	
15 minute summer	SC2.0	SC2.0	SC2.1	5.8	0.473	0.066	0.2392	
15 minute summer	SC2.1	SC2.1	SC2.2	47.1	1.363	0.544	1.3666	
960 minute summer	SC2.2	SC2.2	SC1.3	8.3	0.974	0.155	1.0459	
8640 minute summer	Tank K	Hydro-Brake®	SC1.3	0.7				
960 minute summer	SC1.3	SC1.3	SC1.4	23.3	0.687	0.112	2.4712	
960 minute summer	SC1.4	SC1.4	SC1.5	25.3	0.647	0.180	4.1099	
960 minute summer	SC1.5	Hydro-Brake®		2.4				126.9

CATCHMENT C

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	17.200	Minimum Backdrop Height (m)	0.200
Ratio-R	0.277	Preferred Cover Depth (m)	1.200
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SC1.0	0.041	4.00	41.219	1200	717331.498	729184.401	1.479
SC1.1	0.001	4.00	41.258	1200	717339.567	729199.962	1.588
SC3.0	0.021	4.00	41.300	1200	717353.158	729232.112	0.900
SC4.0	0.021	4.00	41.300	1200	717358.307	729272.822	0.900
SC3.1	0.012	4.00	41.212	1200	717341.906	729267.624	0.962
SC3.2	0.001	4.00	41.551	1200	717323.700	729263.904	1.386
SC1.2	0.083	4.00	41.466	1200	717319.563	729263.059	2.061
SC2.0	0.010	4.00	43.632	1200	717253.223	729236.424	1.482
SC2.1	0.071	4.00	43.097	1200	717247.548	729254.265	1.477
SC2.2	0.051	4.00	41.858	1200	717290.453	729267.865	1.478
Tank K	0.310	4.00	41.150	1200	717302.832	729244.627	1.550
SC1.3	0.086	4.00	41.538	1350	717315.521	729275.811	2.188
SC1.4	0.035	4.00	41.340	1350	717329.642	729282.433	2.365
SC1.5	0.000	4.00	41.400	1350	717354.368	729290.271	2.475

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
SC1.0	SC1.0	SC1.1	17.529	0.600	39.740	39.670	0.070	250.4	225	4.36	50.0
SC1.1	SC1.1	SC1.2	66.192	0.600	39.670	39.405	0.265	249.8	225	5.70	50.0
SC3.0	SC3.0	SC3.1	37.252	0.600	40.400	40.250	0.150	248.3	225	4.75	50.0
SC4.0	SC4.0	SC3.1	17.205	0.600	40.400	40.250	0.150	114.7	225	4.24	50.0
SC3.1	SC3.1	SC3.2	18.582	0.600	40.250	40.165	0.085	218.6	225	5.10	50.0
SC3.2	SC3.2	SC1.2	4.222	0.600	40.165	39.965	0.200	21.1	225	5.13	50.0
SC1.2	SC1.2	SC1.3	13.377	0.600	39.405	39.350	0.055	243.2	300	5.92	50.0
SC2.0	SC2.0	SC2.1	18.722	0.600	42.150	41.620	0.530	35.3	225	4.14	50.0
SC2.1	SC2.1	SC2.2	45.009	0.600	41.620	40.380	1.240	36.3	225	4.49	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
SC1.0	0.822	32.7	7.4	1.254	1.363	0.041	0.0	73	0.666
SC1.1	0.823	32.7	7.6	1.363	1.836	0.042	0.0	73	0.671
SC3.0	0.825	32.8	3.8	0.675	0.737	0.021	0.0	51	0.552
SC4.0	1.220	48.5	3.8	0.675	0.737	0.021	0.0	43	0.733
SC3.1	0.880	35.0	9.8	0.737	1.161	0.054	0.0	81	0.757
SC3.2	2.860	113.7	9.9	1.161	1.276	0.055	0.0	44	1.767
SC1.2	1.003	70.9	32.5	1.761	1.888	0.180	0.0	143	0.983
SC2.0	2.208	87.8	1.8	1.257	1.252	0.010	0.0	22	0.892
SC2.1	2.178	86.6	14.6	1.252	1.253	0.081	0.0	62	1.626

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
SC2.2	SC2.2	SC1.3	26.297	0.600	40.380	40.100	0.280	93.9	225	4.81	50.0
Tank K	Tank K	SC1.3	33.667	0.600	39.600	39.350	0.250	134.7	225	4.50	50.0
SC1.3	SC1.3	SC1.4	15.597	0.600	39.350	39.285	0.065	239.9	450	6.12	50.0
SC1.4	SC1.4	SC1.5	25.939	0.600	38.975	38.925	0.050	518.8	450	6.61	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
SC2.2	1.349	53.6	23.9	1.253	1.213	0.132	0.0	105	1.311
Tank K	1.125	44.7	56.0	1.325	1.963	0.310	0.0	225	1.145
SC1.3	1.308	208.0	127.9	1.738	1.605	0.708	0.0	255	1.372
SC1.4	0.885	140.8	134.3	1.915	2.025	0.743	0.0	354	1.002

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	Scotland and Ireland	Drain Down Time (mins)	240
M5-60 (mm)	17.200	Additional Storage (m³/ha)	20.0
Ratio-R	0.277	Check Discharge Rate(s)	x
Summer CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

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

Node Tank K Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	39.600	Product Number	CTL-SHE-0042-1000-1600-1000
Design Depth (m)	1.600	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.0	Min Node Diameter (mm)	1200

Node SC1.5 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	38.925	Product Number	CTL-SHE-0086-4000-1600-4000
Design Depth (m)	1.600	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	4.0	Min Node Diameter (mm)	1200

Node Tank K Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	39.600
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	303.8	0.0	1.200	303.8	0.0	1.201	0.0	0.0

Node SC1.5 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	38.925
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	150.0	0.0	1.600	150.0	0.0	1.601	0.0	0.0

Node Tank K Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	39.600
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1249.0	0.0	0.065	1249.0	0.0	0.066	0.0	0.0

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 99.75%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SC1.0	10	39.840	0.100	12.5	0.1691	0.0000	OK
15 minute summer	SC1.1	11	39.763	0.093	12.7	0.1066	0.0000	OK
15 minute summer	SC3.0	10	40.466	0.066	6.4	0.1059	0.0000	OK
15 minute summer	SC4.0	10	40.455	0.055	6.4	0.0877	0.0000	OK
15 minute summer	SC3.1	10	40.359	0.109	16.4	0.1504	0.0000	OK
15 minute summer	SC3.2	11	40.230	0.065	16.1	0.0745	0.0000	OK
960 minute summer	SC1.2	735	39.706	0.301	6.5	0.5832	0.0000	SURCHARGED
15 minute summer	SC2.0	10	42.179	0.029	3.1	0.0366	0.0000	OK
15 minute summer	SC2.1	10	41.702	0.082	24.8	0.1714	0.0000	OK
15 minute summer	SC2.2	10	40.533	0.153	40.4	0.2781	0.0000	OK
8640 minute summer	Tank K	5820	40.022	0.422	2.7	207.9481	0.0000	SURCHARGED
960 minute summer	SC1.3	735	39.706	0.356	15.1	0.7898	0.0000	OK
960 minute summer	SC1.4	735	39.706	0.731	16.4	1.2628	0.0000	SURCHARGED
960 minute summer	SC1.5	735	39.706	0.781	15.8	118.2972	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SC1.0	SC1.0	SC1.1	12.4	0.794	0.381	0.2857	
15 minute summer	SC1.1	SC1.1	SC1.2	12.0	0.377	0.367	1.8301	
15 minute summer	SC3.0	SC3.0	SC3.1	6.3	0.442	0.192	0.5363	
15 minute summer	SC4.0	SC4.0	SC3.1	6.4	0.512	0.132	0.2281	
15 minute summer	SC3.1	SC3.1	SC3.2	15.8	1.118	0.452	0.2650	
15 minute summer	SC3.2	SC3.2	SC1.2	16.0	1.849	0.141	0.0366	
960 minute summer	SC1.2	SC1.2	SC1.3	6.5	0.492	0.092	0.9418	
15 minute summer	SC2.0	SC2.0	SC2.1	3.1	0.409	0.035	0.1499	
15 minute summer	SC2.1	SC2.1	SC2.2	24.8	1.218	0.286	0.9392	
15 minute summer	SC2.2	SC2.2	SC1.3	39.5	1.434	0.736	0.7243	
8640 minute summer	Tank K	Hydro-Brake®	SC1.3	0.6				
960 minute summer	SC1.3	SC1.3	SC1.4	15.1	0.752	0.073	2.2525	
960 minute summer	SC1.4	SC1.4	SC1.5	15.8	0.562	0.112	4.1099	
960 minute summer	SC1.5	Hydro-Brake®		3.6				184.8

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.75%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	SC1.0	990	40.065	0.325	1.5	0.5472	0.0000	SURCHARGED
1440 minute summer	SC1.1	990	40.065	0.395	1.5	0.4516	0.0000	SURCHARGED
15 minute summer	SC3.0	10	40.481	0.081	9.4	0.1298	0.0000	OK
15 minute summer	SC4.0	10	40.467	0.067	9.4	0.1066	0.0000	OK
15 minute summer	SC3.1	10	40.386	0.136	24.1	0.1880	0.0000	OK
15 minute summer	SC3.2	10	40.247	0.082	23.9	0.0940	0.0000	OK
1440 minute summer	SC1.2	990	40.065	0.660	6.7	1.2772	0.0000	SURCHARGED
15 minute summer	SC2.0	10	42.185	0.035	4.5	0.0437	0.0000	OK
15 minute summer	SC2.1	10	41.721	0.101	36.3	0.2112	0.0000	OK
15 minute summer	SC2.2	11	40.613	0.233	59.1	0.4237	0.0000	SURCHARGED
8640 minute summer	Tank K	5880	40.248	0.648	3.5	277.9063	0.0000	SURCHARGED
1440 minute summer	SC1.3	990	40.065	0.715	14.9	1.5845	0.0000	SURCHARGED
1440 minute summer	SC1.4	990	40.065	1.090	15.7	1.8819	0.0000	SURCHARGED
1440 minute summer	SC1.5	990	40.065	1.140	15.3	172.5772	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute summer	SC1.0	SC1.0	SC1.1	1.5	0.419	0.046	0.6971	
1440 minute summer	SC1.1	SC1.1	SC1.2	1.5	0.240	0.046	2.6325	
15 minute summer	SC3.0	SC3.0	SC3.1	9.3	0.492	0.284	0.7085	
15 minute summer	SC4.0	SC4.0	SC3.1	9.4	0.564	0.194	0.3008	
15 minute summer	SC3.1	SC3.1	SC3.2	23.5	1.232	0.672	0.3552	
15 minute summer	SC3.2	SC3.2	SC1.2	23.7	2.020	0.208	0.0496	
1440 minute summer	SC1.2	SC1.2	SC1.3	6.1	0.475	0.085	0.9420	
15 minute summer	SC2.0	SC2.0	SC2.1	4.5	0.448	0.051	0.1974	
15 minute summer	SC2.1	SC2.1	SC2.2	36.3	1.299	0.419	1.2832	
15 minute summer	SC2.2	SC2.2	SC1.3	54.4	1.511	1.015	0.9993	
8640 minute summer	Tank K	Hydro-Brake®	SC1.3	0.7				
1440 minute summer	SC1.3	SC1.3	SC1.4	14.4	0.723	0.069	2.4712	
1440 minute summer	SC1.4	SC1.4	SC1.5	15.3	0.468	0.108	4.1099	
1440 minute summer	SC1.5	Hydro-Brake®		3.6				271.9

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.75%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute summer	SC1.0	690	40.402	0.662	2.6	1.1160	0.0000	SURCHARGED
960 minute summer	SC1.1	690	40.402	0.732	2.7	0.8377	0.0000	SURCHARGED
15 minute summer	SC3.0	10	40.494	0.094	12.2	0.1497	0.0000	OK
15 minute summer	SC4.0	10	40.476	0.076	12.2	0.1220	0.0000	OK
15 minute summer	SC3.1	10	40.411	0.161	31.3	0.2217	0.0000	OK
960 minute summer	SC3.2	690	40.402	0.237	3.5	0.2717	0.0000	SURCHARGED
960 minute summer	SC1.2	690	40.402	0.997	11.3	1.9307	0.0000	SURCHARGED
15 minute summer	SC2.0	10	42.189	0.039	5.8	0.0495	0.0000	OK
15 minute summer	SC2.1	10	41.737	0.117	47.1	0.2458	0.0000	OK
15 minute summer	SC2.2	11	40.872	0.492	76.8	0.8966	0.0000	SURCHARGED
7200 minute summer	Tank K	5160	40.471	0.871	4.7	346.6482	0.0000	SURCHARGED
960 minute summer	SC1.3	690	40.402	1.052	24.7	2.3327	0.0000	SURCHARGED
960 minute summer	SC1.4	690	40.402	1.427	26.2	2.4647	0.0000	SURCHARGED
960 minute summer	SC1.5	690	40.402	1.477	25.6	223.6826	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
960 minute summer	SC1.0	SC1.0	SC1.1	2.6	0.486	0.079	0.6971	
960 minute summer	SC1.1	SC1.1	SC1.2	2.7	0.258	0.082	2.6325	
15 minute summer	SC3.0	SC3.0	SC3.1	12.1	0.527	0.370	0.8559	
15 minute summer	SC4.0	SC4.0	SC3.1	12.2	0.601	0.252	0.3629	
15 minute summer	SC3.1	SC3.1	SC3.2	30.7	1.306	0.876	0.4337	
960 minute summer	SC3.2	SC3.2	SC1.2	3.5	1.244	0.031	0.1679	
960 minute summer	SC1.2	SC1.2	SC1.3	10.5	0.506	0.148	0.9420	
15 minute summer	SC2.0	SC2.0	SC2.1	5.8	0.473	0.066	0.2392	
15 minute summer	SC2.1	SC2.1	SC2.2	47.1	1.363	0.544	1.3666	
15 minute summer	SC2.2	SC2.2	SC1.3	70.8	1.779	1.319	1.0299	
7200 minute summer	Tank K	Hydro-Brake®	SC1.3	0.8				
960 minute summer	SC1.3	SC1.3	SC1.4	24.0	0.748	0.115	2.4712	
960 minute summer	SC1.4	SC1.4	SC1.5	25.6	0.648	0.182	4.1099	
960 minute summer	SC1.5	Hydro-Brake®		3.9				226.5

Appendix 7

Surface Water Drainage Contributing Areas

Catchment		Manhole Ref 2024	Total unfactored areas m²	Surface Roof	CV Value 0.95	Surface Green Roof (Extensive or Intensive)	CV Value 0.8	Surface Road + Footpath	CV Value 0.9	Surface Permeable Paving	CV Value 0.8	Surface Landscape	CV Value 0.3	Effective Impermeable Areas m²
Catchment B	Tank C	SB7.0	1100									1100.0	330.0	330
		SB7.1	3063	518.0	492.1	2545.0	2036.0							2528
		SB7.2	1100									1100.0	330.0	330
		OUT 2	0											0
	Tank B	SB6.0	0											0
		SB6.1	413					380.0	342.0	33.0	26.4			368
		SB6.2	450									450.0	135.0	135
		SB9.0	1510									1510.0	453.0	453
		SB9.1	0											0
		SB6.3	4008	515.0	489.3	3028.0	2422.4					465.0	139.5	3051
		OUT 3	0											0
	Tank F	SB2.0	948							948.0	758.4			758
	Tank A	SB1.0	30							30.0	24.0			24
		SB1.1	326	121.5	115.4			204.0	183.6					299
		SB2.1	36	36.0	34.2									34
		SB1.2	1797	246.5	234.2			1268.0	1141.2	282.0	225.6			1601
		SB1.3	763					763.0	686.7					687
		SB1.4	2286									2286.0	685.8	686
		SB3.0	1286	304.0	288.8	981.5	785.2							1074
		SB3.2	1386	644.0	611.8	741.5	593.2							1205
		SB3.1	0											0
		SB1.5	0											0
		SB1.6	2286									2286.0	685.8	686
		SB1.7	1858					908.0	817.2			950.0	285.0	1102
	Tank E	SB4.0	0											0
		SB4.1	5989	739.0	702.1	5250.0	4200.0							4902
		SB1.8	310					310.0	279.0					279
		SB1.9	111					111.0	99.9					100
		SB1.10	111					111.0	99.9					100
		SB1.10A	0											0
	Tank D	SB5.0	0											0
		SB5.1	0											0
		SB5.2	0											0
		SB5.3	3576	453.0	430.4	3123.0	2498.4							2929
		SB5.4	2292					1531.0	1377.9			761.0	228.3	1606
		SB1.11	1101					1001.0	900.9	100.0	80.0			981
		SB1.12	693					693.0	623.7					624
		MH	1262					905.0	814.5			357.0	107.1	922
		SB1.13	0											0
		OUT1	0											0
	totals		40089											27794
Catchment C	Tank G	SC1.0	842					144.0	129.6	138.0	110.4	560.0	168.0	408
		SC1.1	45									45.0	13.5	14
		SC3.0	428	127.7	121.3							300.0	90.0	211
		SC4.0	443	122.5	116.4							320.0	96.0	212
		SC3.1	128	127.7	121.3							0.0	0.0	121
		SC3.2	25									25.0	7.5	8
		SC1.2	920	255.4	242.6			589.0	530.1	76.0	60.8			834
		SC2.0	219							75.0	60.0	144.0	43.2	103
		SC2.1	819					674.0	606.6	120.0	96.0	25.0	7.5	710
		SC2.2	612					451.0	405.9	121.0	96.8	40.0	12.0	515
	Tank K	Tank K	3775	521.2	495.1	3254.0	2603.2							3098
	Tank G	SC1.3	985					843.0	758.7	110.0	88.0	32.0	9.6	856
		SC1.4	591	170.5				263.0	236.7	125.0	100.0	32.0	9.6	346
		SC1.5	0											0
	totals		9831											7436
Catchment A	Tank J	SA2.0	672	121.5	115.4			550.0	495.0					610
		SA2.1	625	234.0	222.3			323.0	290.7	68.2	54.5			568
		SA5.0	0											0
		SA2.2	129							128.9	103.1			103
		SA1.4	435					351.0	315.9	83.8	67.0			383
		SA1.5	281					281.0	252.9					253
		SA1.6	172					172.0	154.8					155
		SA1.7	172					172.0	154.8					155
		SA1.8	386					386.0	347.4					347
		SA1.9												0
		SA1.10	0											0
		SA1.11	0											0
		SA1.12	96					95.8	86.2					86
		SA1.13	145					144.5	130.1					130
		SA1.14	194					193.7	174.3					174
		SA1.15												0
		SA1.16	686	105.7	100.4			355.0	319.5	224.9	179.9			600
		SA1.17	0											0
	Tank J	SA1.0	525					524.5	472.1					472
		SA1.1	928	295.7	280.9			524.5	472.1	107.6	86.1			839
		SA1.2	610	113.0	107.4			497.0	447.3					555
		SA1.3	111					111.0	99.9					100
	Tank H	SA3.0	5938	884.0	839.8	4274.0	3419.2					780.0	234.0	4493
	Tank J	SA3.1												0
	Tank L	SA4.0	633					633.0	569.7					570
		SA4.1	684	302.8	287.6			275.0	247.5	106.5	85.2			620
		SA4.2	523	125.5	119.2			397.0	357.3					477
		SA4.3	138					137.6	123.8					124
		SA4.4	0											0
		SA4.5	0											0
		SA4.6	0											0
		SA4.7	0											0
		SA4.8	0											0
		SA4.9	0											0
	totals		14079											11813
		TOTAL	63999											47043

Average CV value	0.74

Appendix 8

Stormwater Audit Report

STORMWATER AUDIT (STAGE 1)

JBA Project Code	2024s0921
Contract	Part 10 Planning Application, Dundrum CMH, Dundrum, Co Dublin
Client	Reddy Architecture & Urbanism
Prepared by	Jack Shanahan/Leanne Leonard
Subject	Stormwater Audit Stage 1 Report

Revision History

Issue	Date	Status	Issued to
S3-P01	14/08/2024	First issue (DRAFT)	BMCE
S4-P02	29/08/2024	Final Issue	BMCE
S4-P03	18/09/2024	Issued for Planning	BMCE

1 Introduction

JBA Consulting have been contracted by Reddy Architecture & Urbanism to undertake a Stage 1 SW Audit of the surface water drainage design prepared by Barrett Mahony Consulting Engineers (BMCE) for the development at Dundrum Central Mental Hospital site, Dundrum, Co. Dublin. The surface water audit was undertaken in advance of a Part 10 Planning Application to An Bord Pleanála.

The subject of this Stage 1 stormwater audit is to review the proposed surface water drainage design and sustainable urban drainage system (SuDS) proposals for the proposed development. The audit has been completed in accordance with Dún Laoghaire Rathdown County Council's (DLRCC) Stormwater Audit Procedure (Rev 0, Jan 2012) as set out below.

Stage 1 – Pre Planning Stage: *A Stage 1 audit shall be carried out of the Stormwater Impact Assessment (SIA) prepared by the applicant. The audit will focus on the SUDS management train and whether the applicant has carefully considered all known SUDS techniques and applied the most appropriate type(s) for the site that will ensure improved water quality, biodiversity and volume control*.

1.1 Report Structure

This report summarises and comments on the initial proposals by the designer. The Feedback Form in Appendix A identifies queries raised in this report which are to be answered by the Design Engineers. Once an 'Acceptable' status is achieved for each query the audit is deemed to be closed out.

The results of the audit are set out hereunder, where items raised in the feedback form are shown in bold within this report.

1.2 Planning History

Pre-Planning Meetings

Various meetings and correspondence have been held with DLRCC which has been set out in S1.5.2 of the BMCE report.

SHD Planning Application to An Bord Pleanála (Planning Ref: ABP-313176-22)

A SHD Planning Application was lodged with An Bord Pleanála in 2022 (Planning Ref: ABP-313176-22) which was granted by the Bord subject to a number of conditions. Various meetings and correspondence were held with DLRCC ahead of this submission and are outlined in the original Infrastructure Report. As a result of the planning conditions, changes were made to the site layout which resulted in the need for an updated SW Audit. As a number of parameters and features used in the drainage design and guidance (e.g. DLR Development Plan 2022-2028) had changed since the initial submission, this audit report relates only to the updated proposals to avoid confusion.

A Part X Planning Application to An Bord Pleanála is to be made for the development lands which forms part of a masterplan for the wider site area. Dún Laoghaire Rathdown County Council (DLRCC) are the applicant and the Land Development Agency (LDA) are the agent.

1.3 Relevant Studies and Documents

The following documents were considered as part of this surface water audit:

- Greater Dublin Strategic Drainage Strategy (GDSDS);
- Greater Dublin Regional Code of Practice for Drainage Works;
- The SUDs Manual (CIRIA C753).
- DLRCC Development Plan 2022-2028

1.4 Key Considerations and Benefits of SuDS

The key benefits and objectives of SuDS considered as part of this audit and listed below include:

- Water Quantity
- Water Quality
- Amenity
- Biodiversity

Which can be achieved by;

- Storing runoff and releasing it slowly (attenuation)
- Harvesting and using the rain close to where it falls
- Allowing water to soak into the ground (infiltration)
- Slowly transporting (conveying) water on the surface
- Filtering out pollutants
- Allowing sediments to settle out by controlling the flow of the water

1.4.1 SuDS Management Train

A SuDS Management Train is a robust pollutant removal strategy. The treatment train can comprise four stages:

1. *Prevention*
2. *Source Control*
3. *Site Control*
4. *Regional control*

In S3.4 of the report BMCE have demonstrated that a SuDS management train has been sufficiently demonstrated for the majority of runoff with at least two SuDS components. A 'Simple Index Approach' has been presented for permeable paving to demonstrate that the mitigation indices are greater than the pollutant hazard indices which is considered appropriate. The designer should carry out this exercise for all surface types.

2 Proposed Development at Dundrum CMH, Dundrum, Co. Dublin

The subject site is located the site of the former Central Mental Hospital, Dundrum Road, Dundrum, Dublin 14 as shown in Figure 1

Figure 1- Site Location (Ref: BMCE Infrastructure Report)

The total site area is stated to be c9.7ha.and the positively drained area is c6.4ha. comprising of three catchment areas of Catchment A (1.41ha.), Catchment B (4.01ha.) and Catchment C (0.98ha.). This would suggest that the large green areas are not included in the area takeoff calculations. If this is the case, Figure 3.2 in the Infrastructure Report should be amended to reflect this. However, BMCE drawing DR-C-11020 shows filter trenches and bioretention areas in the green area to the north of Catchment B/southeast of Catchment A which discharge to the Catchment B network. Therefore some runoff from this area should be expected.

Existing buildings and infrastructure on the site will be demolished. The existing buildings discharge to a combined drainage system which connects to the DN300 combined sewer in the Dundrum Road.

BMCE to review catchment areas, particularly open landscaped areas to confirm whether runoff from these areas can enter the network (either by overland flows due to topography or via interception trenches/bioretention areas etc). If areas are deemed to contribute, then they should be included in the area take-off. The Qbar calculation could also be updated to reflect this.

2.1 Review of SW Drainage Proposals

The review is based on the following documents provided by BMCE on 1st August 2024;

- 20.170-IR-01L Report
- 20170-QPF06.01 – Dundrum P10 Civils Drawing Register
- DCD-BMD-00-00-DR-C-11020 Buried Surface Water Drainage Layout
- DCD-BMD-00-00-DR-C-11022 Combined Services Layout
- DCD-BMD-00-00-DR-C-11023 Main Drainage Manhole Schedule
- DCD-BMD-00-00-DR-C-11030 Roof & Podium SuDS Layout
- DCD-BMD-00-00-DR-C-11031 Ground Level SuDS Layout
- DCD-BMD-00-00-DR-C-11115 Surfacel Water Drainage Longitudinal Sections Sheet 1 of 2
- DCD-BMD-00-00-DR-C-11116 Surfacel Water Drainage Longitudinal Sections Sheet 2 of 2
- DCD-BMD-00-00-DR-C-11205 SuDS Details. Typical Green & Blue Roof Details
- DCD-BMD-00-00-DR-C-11206 SuDS Details. Permeable Paving Details
- DCD-BMD-00-00-DR-C-11207 SuDS Details. Filter Drain Typical Details
- DCD-BMD-00-00-DR-C-11208 SuDS Details. Typical Stormtech Attenuation Tank Details
- DCD-BMD-00-00-DR-C-11209 SuDS Details. Typical Bio-Retention & Tree Pit Details
- DCD-BMD-00-00-DR-C-11210 SuDS Details. Swales, Detention Basin & Over-the-Edge- Road Drainage

2.1.1 Site Characteristics

The general fall across the lands is from south to north.

A site investigation was carried out by S.I Ltd. between March 2021 and September 2021 and a summary of the report provided in Appendix 1 of the BMCE report. Four number soakage tests were completed. Two failed the test and two provided infiltration 'f' values of 7.36x10-5 m/s (SA02) and 2.2x10-4 m/s (SA703) which are located in the upper north/northwest of the development (Catchment C). The ground is typically made ground overlying a black slightly sandy gravelly silty CLAY and natural ground conditions consistent with cohesive soils encountered across the site.

Groundwater was encountered in the majority of boreholes and a third of the trial pits, ranging in depth from 0.8mbgl to 3.3mbgl typically. Standpipes were provided in 5 locations. Details of where GW was encountered are not provided and consideration of SuDS proposals will have to take cognisance of the depth of GW rising within 1m of the base. It may be required to line SuDS features

Details of trial holes and boreholes are not included in the report submitted.

The SOIL type adopted by BMCE is SOIL 4 and SPR 0.47 which would seem appropriate with poor infiltration although the northwest area of the site Catchment C could be classed as good infiltration.

Groundwater monitoring has not been referred to within the report however infiltration is proposed for infiltration areas that are not beneath a basement.

BMCE to consider carrying out groundwater monitoring at detailed design stage to ensure that 1m separation can be achieved between the infiltrating planes and the highest winter GW table.

2.2 Design Parameters

Rainfall parameters can be estimated using Met Eireann data, using the Flood Studies Report (FSR) values or the values in the GDSDS. The Met Eireann method can be more representative of a site if selected correctly. The design values used by BMCE and considered by JBA are shown below:

Rainfall parameters	Designer values	JBA Comment
M5_60 (mm)	17.2	Ok - Met Eireann 2023
Ratio R	0.**278**	Ok – Met Eireann 2023
SAAR (mm)	800	Ok – Met Eireann 2023
Qbar (l/s)	36.1	Ok – 36.12 Based on Soil Type 4 (SPR = 0.47) Table 3.1 in S3.3.2 of the Infrastructure Report states that the runoff coefficient, as agreed with DLR, for landscaping areas is 0.3. Typically the SPR for green areas should be the same for the Qbar calculation and the area runoff calculations.
Climate Change	20%	Ok – 20% required in DLRCC Development Plan 2022-2028, Appendix 7

The BMCE report states that the discharge limit from the site (Qbar) has been taken as a conservative 32.4 l/s which is less than those noted in the table below. The runoff rate for each catchment is set out in table 3.2 (BMCE report) and repeated below;

Table 3.2 Runoff rate per catchment

Catchment	Area (m^2)	Positively Drained Area (m^2)	Calculated Qbar (l/s)	Proposed Qbar (l/s)
Catchment A	29 747	14 079	7.95	7.9
Catchment B	47 961	40 089	22.63	20.5
Catchment C	17 788	9831	5.55	4.0
Total	95 496*	63999	36.1l/s	32.4l/s

The calculated Qbar is based upon an SPR value of 0.47 however a runoff factor of 0.3 for landscaped green areas has been applied for the effective area calculations. BMCE have indicated that this runoff factor has been agreed with DLRCC and therefore consideration should be given to using an SPR value of 0.3 in the Qbar calculations. This would result in a much-reduced total Qbar of 11.54 l/s for a catchment area of 6.4 ha.

BMCE to consider using the same SPR in both the Qbar calculations and the catchment area calculations.

2.3 Surface Water Drainage Strategy

The development is split into three catchments. Catchment A has three attenuation structures and one discharge point, Catchment B has seven attenuation structures and three discharge points and Catchment C has three attenuation structures and one discharge point.

A fairly comprehensive SuDS management system has been proposed by BMCE which is generally clearly laid out and should achieve the general principles and aims of SUDS. A pollutant analysis has also been undertaken. A review of the proposals is considered in more detail below.

A FLOW model has been used for the drainage analysis.

2.3.1 SuDS Measures Considered

SuDS Technology	Comments
Green/Blue Roofs	Green roofs are proposed, both intensive and extensive. The coverage for both roofs and podiums is provided on drawing DR-C-11030 which shows that 70% coverage may not be achieved on many roofs. However, it is not clear whether 70% coverage has been achieved for the roof area in total. **BMCE to advise whether the green roof coverage meets the minimum DLRCC requirements.**
Swale, Filter Drain, Infiltration Trench	Some filter/infiltration drains are proposed adjacent to some green areas and to the rear of some buildings despite questions about soil type of the site and a relatively high groundwater level at different locations around the site. **BMCE to ensure that 1m separation can be achieved between all infiltration measures and the highest winter GW table.**
Tree Pits, Bioretention Areas, Rain Gardens	Tree pits and bioretention areas have been proposed throughout the site to intercept runoff from roads and parking areas. The Infrastructure Report states that permeable liners are proposed. **BMCE to ensure that 1m separation can be achieved between all infiltration measures and the highest winter GW table.**
Permeable Paving	Permeable paving is proposed for car parking spaces, podium courtyards and footpaths throughout the site. Typical detail drawings are provided but it is not clear if the pavements to be provided are lined or unlined however the detail provided in the infrastructure report (Figure 3.5) would suggest that an impermeable liner will be provided. The report states that the outlet will be raised 100mm above the gravel bed however the detail suggests that it will be raised 75mm above the base of the underdrain. This will provide limited opportunity for interception. **BMCE to clarify whether permeable or impermeable liners are proposed to permeable paving areas and ensure that 1m separation can be achieved between all infiltration measures and the highest winter GW table.**
Soakaways	Permeable liners have been proposed to attenuation areas J and L in Catchment A and to structures C, D and F in Catchment B. The remaining structures in these catchments are generally beneath podiums and are therefore concrete attenuation tanks. The structures in Catchment C are also concrete attenuation tanks. Four infiltration tests were carried out on site, with two of them failing. The same infiltration rate has been applied to all permeable attenuation structures despite the variable measured infiltration rates across the site. Furthermore, groundwater was encountered and various depths across the site with some strikes being within 1m of the surface. Borehole and trial pit logs have not been provided to assess the GW levels across the site. This is discussed further in S2.3.3. **BMCE to review the infiltration rates used in the attenuation design to ensure that they correlate to the measured infiltration rates for that location.** **BMCE to ensure that 1m separation can be achieved between all infiltration measures and the highest winter GW table.**
Detention Basins, Retention Ponds, Stormwater Wetlands	A detention basin is proposed in catchment B. No infiltration is proposed.

Rainwater Harvesting	None proposed
Petrol Interceptor	The report refers to basement car park drainage and use of a PI to pump to the foul network. Petrol Interceptors are not proposed to the SW network. **BMCE to consider the inclusion of petrol interceptors on the SW network, upstream of attenuation structures where possible, where the structures receive runoff from trafficked roads.**
Attenuation	RC tanks, stormtech units and geocellular tanks are proposed. The use of RC tanks outside of buildings is queried and alternatives may be possible (e.g. 2nr. Tank G). **BMCE to advise whether an alternative to RC tanks can be proposed for tanks G.**
Other	N/A

2.3.2 Review of drainage drawings and report

A number of storage tanks are concrete tanks which are not normally considered acceptable. For those under or within building structures then no other alternative may be available. However, tanks G are not located under buildings and there could be more suitable alternatives. Use of concrete tanks is also subject to Planning Authority approval.

A table such as that in Section 7.1.5 of the appendices to DLRCC's Development Plan 2022-2028 showing the breakdown of the areas within the site should be included in the infrastructure report.

BMCE to clarify the use of concrete tanks and consider alternatives outside building footprints.

BMCE to provide table such as that in Section 7.1.5 of the appendices to DLRCC's Development Plan

2.3.3 Review of Hydraulic Model

FLOW hydraulic model has been used for the design. A Detailed Area Summary is provided in Appendix 7 of the BMCE report which includes for surface type breakdown with Cv factor applied. A spot check would indicate that the aeras in the model are complimentary to those in the summary sheet for each node.

An allowance of 20% has been made for climate change which is in compliance with the DLRCC Development Plan 2022-2028.

An allowance for urban creep does not appear to have been made in the Flow model.

The Flow model includes additional storage structures at some nodes, which are not indicated on the drawing. The shallow depth and extensive area of these structures would suggest that they may be podium storage but this is not clear.

Each catchment has been simulated with both a free outflow and with 50% blockage at the final outfall (Note: Catchment B applies blockage to outfall from the largest network only. Blockage has not been applied to the outflows from Tanks B and C). In the blockage scenarios flooding of 3.9m3 is experienced at node SA1.16 (hydrobrake manhole) in Catchment A in the Q100 event which is not expected to cause major issues. Flooding of 92.6m3 is shown at the detention basin in Catchment B and 8.9m3 at the hydrobrake manhole in the Q30 event with 50% blockage, with this increasing to 178.5m3 and 48.7m3 respectively in the Q100 event with blockage. Do surrounding ground levels allow this overflow to be stored within the green area on site? Flooding of 21m3 is shown at node SC3.1 in Catchment C in the Q100 event with blockage.

No surcharging has been applied to any outfalls based on the flow monitoring carried out from February 2021 to May 2021. S3.2.3 of the Infrastructure Report states that the depth of water in the drainage ditch varied between 25mm and 180mm during this time and that there is insufficient data to calculate a flood level for the 1 in 100 year event. BMCE should consider carrying out modelling of the ditch to determine the potential Q100 flood levels and whether surcharging may limit the outflow from the development.

BMCE to clarify if it has been agreed with DLRCC to not include urban creep.

BMCE to clarify additional storage at Tank H, Tank B, Tank E and Tank D within the Flow models.

BMCE to advise whether the flood volumes during the blockage scenarios can be stored on site until the blockage has cleared.

BMCE should consider carrying out modelling of the ditch at detailed design stage to determine the potential Q100 flood levels and whether surcharging may limit the outflow from the development.

2.3.4 Interception

Interception of runoff is intended to prevent any runoff for small rainfall events which are less than 5mm (and up to 10mm if possible). Treatment of 15mm is required if interception is not provided.

Table 24.6 of the CIRIA manual provides indication of deemed to satisfy criteria and it is considered that this should be complied with. All sources of runoff should also be intercepted where possible. A high level of Interception provided for some parts of the site is not to be considered as adequate compensation for a low degree of interception provision for other locations. Compliance is required for the whole site, or at least for road/paved areas, for it to be considered effective. Interception mechanisms are based on runoff retention. This can be achieved using rainwater harvesting or using soil storage and evaporation. Either infiltration or transpiration rates can dispose of the runoff from minor events to enable the next event to be captured.

Interception of flow is dealt with in S3.4.5 of the BMCE Infrastructure Report. The means by which interception was calculated is incorrect by comparing "available volume" with "interception volume required". However, the SuDS treatment train and simple index approach presented in the Infrastructure Report would suggest that all areas are likely to be intercepted sufficiently. BMCE should satisfy themselves that runoff from all areas is intercepted in accordance with Table 24.6 of the CIRIA SuDS Manual.

2.3.5 Exceedance Flows

A drawing showing the overland flow paths has not been provided.

BMCE to provide Exceedance Flows drawing.

2.4 Health & Safety and Maintenance Issues

The proposed drainage system comprises SuDS devices, traditional road gullies, manholes, attenuation systems, a petrol interceptor and underground pipes. These elements are considered acceptable from a Health & Safety perspective once supplier/manufacturers guides are followed and complied with during the detailed design, construction and operation.

Optimum performance of the SUDs treatment train is subject to the frequency of maintenance provided. At detailed design stage, it is recommended that a maintenance regime be adopted.

Particular consideration is required at detailed design stage to the design, maintenance requirements and whole life plan (and replacement) of the SuDS system as a whole.

Regular maintenance of the hydrobrake will be required to remove any blockages, particularly in the wake of heavy rainfall events or local floods.

It is recommended that the petrol interceptors be fitted with an audible high-level silt and oil alarm for maintenance and safety purposes. Regular inspection and maintenance is recommended for the petrol interceptor.

Please note that silt and debris removed from the petrol interceptor during maintenance will be classified as contaminated material and should only be handled and transported by a suitably licensed contractor and haulier and disposed of at a suitably licensed landfill only.

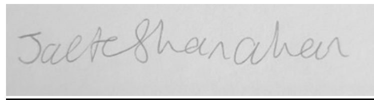
2.5 Items to be considered at Detailed Design Stage

This report outlines the review of the initial submission by the designer. JBA comments are also included in the Audit Feedback Form in Appendix A. This feedback form shows the audit trail and the responses from the designer. The audit will be deemed closed out once an “Acceptable” status has been achieved for each query. The following queries may be considered acceptable subject to Local Authority agreement:

- Groundwater was encountered in the majority of boreholes and a third of the trial pits, ranging from 0.8mbgl to 3.3mbgl. Infiltration is proposed throughout the site (except for some attenuation structures). Groundwater monitoring has not been carried out to date. The designer confirmed that further trial pits and standpipe investigations will be carried out at detailed design stage to ensure that 1m separation can be achieved.
- Soil Type 4 has been used in the calculation of Qbar, supported by the soil encountered on site. However, a runoff factor of 0.3 (Soil Type 2) has been applied to green areas in the runoff calculations. The designer notes that a higher quality topsoil and mulches for landscaping purposes will be applied to all soft landscaping areas allowing for a greater level of natural infiltration through the soils, combined with granular fills over buried tanks, around basements and under permeable paved surfaces. However, although the overlying soil layers will encourage infiltration through these layers, the infiltration capabilities of the underlying soil, or non-permeable basement will ultimately determine the infiltration capability.
- The designer advised that petrol interceptors were included where there were large areas of road drainage conveyed directly to the drainage system however, these have not been indicated on the drawing. To be reviewed at detailed design stage.
- Concrete attenuation structures have been included beneath buildings which is reasonable as no other alternative is available. Two RC tanks are proposed at location G which is not located beneath a building. This is to be reviewed at detailed design stage to determine whether another solution is feasible.
- Urban Creep has not been included in the drainage design. The designer advised that this is because all of the buildings in the development will remain under the control of a management company so urban creep that is typically associated with extensions to private dwellings has not been considered. JBA recommend DLRCC approval in this regard as there may be scope to increase hardstanding footprint in the future.
- The designer has modelled the networks both with free outfalls and with 50% blockage on the final hydrobrakes. Significant flooding is shown in the blockage scenarios, particularly in Catchment B (178.5m3 and 48.7m3 at two different manholes in Q100 + 50% blockage). The designer advised that this will be routed towards the dry ditch. DLRCC to confirm whether this is acceptable or whether exceedance volumes should be stored on site until such time as it can re-enter the network.
- Four soakaway tests were carried out on site. Two failed and two returned different infiltration rates which suggests that the infiltration across the site is variable. The designer has adopted an average rate across all infiltrating structures across the site. JBA recommend using actual measured infiltration rates in the vicinity of the proposed attenuation structures, in the attenuation calculations as infiltration cannot be relied upon in areas where the infiltration tests failed.

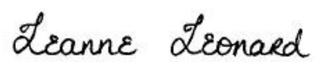
2.6 Audit Report Sign Off

Audit Report Prepared by:



Jack Shanahan
Technical Assistant

Approved by:



Leanne Leonard BEng (Hons) MIEI
Design Engineer

<u>Audit Report Findings are accepted by the Project Design Engineer</u>

Representative:	
Name of Company:	
Date:	

Note:

JBA Consulting Engineers & Scientists Ltd. role on this project is as an independent reviewer/auditor. JBA Consulting Engineers & Scientists hold no design responsibility on this project. All issues raised and comments made by JBA are for the consideration of the Design Engineer. Final design, construction supervision, with sign-off and/or commissioning of the surface water system so that the final product is fit for purpose with a suitable design, capacity and life-span, remains the responsibility of the Design Engineers.

Appendix A – Audit Feedback Form

JBA Consulting Stormwater Audit - Stage 1 Feedback Form	
Project:	Part 10 Application at CMH Dundrun Road, Dundrum, Dublin 14
Date:	18/09/2024
JBA Reviewers	Jack Shanahan/Leanne Leonard
Status	S3-P04
Project Number:	2024s0921

PLEASE NOTE THAT 'DLRCC' IN THE TABLE BELOW REFERS TO THE DLR DRAINAGE PLANNING AND MUNICIPAL SERVICES DEPARTMENT

Item No.	JBA Review Comment	Comment/Clarification Request/Suggested Mitigation	Response from Client/Client Representative	Acceptable / Not Acceptable
	14/08/2024	14/08/2024		
	Reference Documents 20.170-IR-01L Report 20170-QPF06.01 – Dundrum P10 Civils Drawing Register DCD-BMD-00-00-DR-C-11020 Buried Surface Water Drainage Layout DCD-BMD-00-00-DR-C-11022 Combined Services Layout DCD-BMD-00-00-DR-C-11023 Main Drainage Manhole Schedule DCD-BMD-00-00-DR-C-11030 Roof & Podium SuDS Layout DCD-BMD-00-00-DR-C-11031 Ground Level SuDS Layout DCD-BMD-00-00-DR-C-11115 Surfacel Water Drainage Longitudinal Sections Sheet 1 of 2 DCD-BMD-00-00-DR-C-11116 Surfacel Water Drainage Longitudinal Sections Sheet 2 of 2 DCD-BMD-00-00-DR-C-11205 SuDS Details. Typical Green & Blue Roof Details DCD-BMD-00-00-DR-C-11206 SuDS Details. Permeable Paving Details DCD-BMD-00-00-DR-C-11207 SuDS Details. Filter Drain Typical Details DCD-BMD-00-00-DR-C-11208 SuDS Details. Typical Stormtech Attenuation Tank Details DCD-BMD-00-00-DR-C-11209 SuDS Details. Typical Bio-Retention & Tree Pit Details DCD-BMD-00-00-DR-C-11210 SuDS Details. Swales, Detention Basin & Over-the-Edge- Road Drainage			
1	The total site area is stated to be c9.7ha.and the positively drained area is c6.4ha. comprising of three catchment areas of Catchment A (1.41ha.), Catchment B (4.01ha.) and Catchment C (0.98ha.). This would suggest that the large green areas are not included in the area takeoff calculations. If this is the case, Figure 3.2 in the Infrastructure Report should be amended to reflect this. However, BMCE drawing DR-C-11020 shows filter trenches and bioretention areas in the green area to the north of Catchment B/southeast of Catchment A which discharge to the Catchment B network. Therefore some runoff from this area should be expected.	**BMCE to review catchment areas, particularly open landscaped areas to confirm whether runoff from these areas can enter the network (either by overland flows due to topography or via interception trenches/bioretention areas etc). If areas are deemed to contribute, then they should be included in the area take-off. The Qbar calculation could also be updated to reflect this.**	**We have added a note to Fig 3.2 in our Civil Engineering Infrastructure Report (IR report) copy attached, to explain that the existing green areas are not included in the drained area calculation. Drg C-11020, attached, has been updated with the drainage in the existing green area disconnected from the site system.**	Acceptable subject to bioretention area being sized using measured infiltration rate
2	Groundwater was encountered in the majority of boreholes and a third of the trial pits, ranging in depth from 0.8mbgl to 3.3mbgl typically. Standpipes were provided in 5 locations. Details of where GW was encountered are not provided and consideration of SuDS proposals will have to take cognisance of the depth of GW rising within 1m of the base. It may be required to line SuDS features. Groundwater monitoring has not been referred to within the report however infiltration is proposed for infiltration areas that are not beneath a basement.	**BMCE to consider carrying out groundwater monitoring at detailed design stage to ensure that 1m separation can be achieved between the infiltrating planes and the highest winter GW table.**	**We confirm that trial pits and standpipe investigations will be carried out at detailed design stage at the location of SuDS devices incorporating infiltration to ensure that there is a 1metre separation between the base of the device and the winter GW table level. We note that the trial pits/boreholes in the vicinity of Tanks C,D,F,J & L were considered at design stage. These are generally dry. Some seepage at a depth of 1.8m below existing ground level was noted in TP17 & TP22 in the vicinity of Tank D which will be considered further at detailed design stage.**	Acceptable, subject to DLRCC approval
3	The calculated Qbar is based upon an SPR value of 0.47 however a runoff factor of 0.3 for landscaped green areas has been applied for the effective area calculations. BMCE have indicated that this runoff factor has been agreed with DLRCC and therefore consideration should be given to using an SPR value of 0.3 in the Qbar calculations. This would result in a much-reduced total Qbar of 11.54 l/s for a catchment area of 6.4 ha.	**BMCE to consider using the same SPR in both the Qbar calculations and the catchment area calculations.**	**The SOIL Class for the existing undeveloped greenfield site is esimated as Class 4 which has an SPR value of 0.45 (low permeability boulder clay typical of the Dublin area). The development, by its nature will change the topography of the site, and higher quality topsoil & mulches for landscaping purposes will be applied to all soft landscape areas to ensure proposed planting can thrive, and to allow for a greater level of natural infiltration through the soil. There will also be a contribution from the granular fills over buried tanks, around basements and under permeable paved surfaces. It is therefore considered reasonable to use a Cv value of 0.3 bearing in mind the current industry guidance which suggest run-off coefficients from soft landscaping in the region of 0.10-0.25. This was the approach agreed & taken in the previous SHD application. ADDITIONAL NOTE: The run-off factor is determined by the permeability of both the underlying material and that of the top layers. Using tthe SPR value as the run-off factor or vice-versa as suggested, would be highly conservative. Table 10.3 in the attached extract from the publication 'Urban Drainage' 4th Edition by D.Butler gives a range of values for the run-off factor of between 0.5 & 0.30. Using the high end value of 0.3 as we have done in our design is therefore a reasonable & conservative design approach. Aligning the SPR value with this value, we strongly contend, is not required.**	Acceptable, subject to DLRCC approval (Note: Although the overlying soil layers will encourage infiltration through these layers, the infiltration capabilities of the underlying soil, or non-permeable basement, will ultimately determine the infiltration capability.)
4	Green roofs are proposed, both intensive and extensive. The coverage for both roofs and podiums is provided on drawing DR-C-11030 which shows that 70% coverage may not be achieved on many roofs.However, it is not clear whether 70% coverage has been achieved for the roof area in total.	**BMCE to advise whether the green roof coverage meets the minimum DLRCC requirements.**	**Green roofs are excluded from the own-door low rise apartment blocks on site - on the west of the site, Blocks 8 & 9. In these buildings there is no communal stairwell that could provide access up to the roofs for maintenance. Green roofs were also excluded on the east of the site in Block 02, the two two storey blocks east of the road closest to the wall. Maintenance access to these roofs would need to be from a MEWP. This is not deemed to be practical in the case of Blocks 8 & 9. Following a discussion with the Architect it has been agreed to add an extensive green roof over the two apartment blocks in Block 02 east of the road. These two roofs are readily accessible by MEWP. This additional green roof area is shown on our updated drawing C-11030 attached. This increases the green roof coverage to 70.3% of the total. This is also noted in Section 3.4.5.4 of the IR Report.**	Acceptable

JBA Consulting Stormwater Audit - Stage 1 Feedback Form	
Project:	Part 10 Application at CMH Dundrun Road, Dundrum, Dublin 14
Date:	18/09/2024
JBA Reviewers	Jack Shanahan/Leanne Leonard
Status	S3-P04
Project Number:	2024s0921

PLEASE NOTE THAT 'DLRCC' IN THE TABLE BELOW REFERS TO THE DLR DRAINAGE PLANNING AND MUNICIPAL SERVICES DEPARTMENT

Item No.	JBA Review Comment	Comment/Clarification Request/Suggested Mitigation	Response from Client/Client Representative	Acceptable / Not Acceptable
	14/08/2024	14/08/2024		
5	Permeable liners are proposed to most SuDS measures.	**BMCE to ensure that 1m separation can be achieved between all infiltration measures and the highest winter GW table. BMCE to clarify whether permeable or impermeable liners are proposed to permeable paving areas.**	**Based on the SI report and experience in the south Dublin area, the groundwater table is likely to be 3.0-4.0m bgl but with higher level water locally perched on top of and travelling over the relatively impermeable boulder clays. SuDS devices located below the perched water level will be lined. As per the response to Item 2 above, further site investigations (trial pits) will be carried out prior to construction to confirm the water table levels in more detail at the locations of the larger buried devices e.g. the attenuation tanks (these are generally unlined & indicated 'Permeable' in the tank details note on BM drg C1020). Permeable pavements will be unlined where possible (also subject to trial pit investigations at detailed design stage).**	Acceptable, subject to DLRCC approval
6	Permeable liners have been proposed to attenuation areas J and L in Catchment A and to structures C, D and F in Catchment B. The remaining structures in these catchments are generally beneath podiums and are therefore concrete attenuation tanks. The structures in Catchment C are also concrete attenuation tanks. Four infiltration tests were carried out on site, with two of them failing. The same infiltration rate has been applied to all permeable attenuation structures despite the variable measured infiltration rates across the site. Furthermore, groundwater was encountered and various depths across the site with some strikes being within 1m of the surface. Borehole and trial pit logs have not been provided to assess the GW levels across the site.	**BMCE to review the infiltration rates used in the attenuation design to ensure that they correlate to the measured infiltration rates for that location. BMCE to ensure that 1m separation can be achieved between all infiltration measures and the highest winter GW table.**	**The full SI report is attached to this document. In relation to the infiltration values used for Catchment A & Catchment B tanks J, L, C, D & F, we have used the average infiltration value from the four test locations of 0.274 m/hr. We have added a note to the surface water drainage layout drawing C11020 in relation to these tanks requesting that this rate is confirmed by a soakaway test at each location prior to detailed design. Conservatively no infiltration was taken for in the detention basin or in the bio-retention areas. Please refer to the attached updated surface water drainage layout drawing C-11020.**	See Note 14
7	The report refers to basement car park drainage and use of a PI to pump to the foul network. Petrol Interceptors are not proposed to the SW network.	**BMCE to consider the inclusion of petrol interceptors on the SW network, upstream of attenuation structures where possible, where the structures receive runoff from trafficked roads.**	**We have added petrol interceptors to the sw drainage layout where large areas of road drainage are taken into the drainage system directly i.e. not via permeable paving or bio-retention areas/tree pits. Please refer to the attached updated sw drainage layout drawing C-11020. This can be reviewed further at detailed design stage.**	Acceptable, subject to DLRCC approval
8	A number of storage tanks are concrete tanks which are not normally considered acceptable. For those under or within building structures then no other alternative may be available. However, tanks G are not located under buildings and there could be more suitable alternatives. Use of concrete tanks is also subject to Planning Authority approval.	**BMCE to clarify the use of concrete tanks and consider alternatives outside building footprints.**	**Concrete tanks under the buildings have been provided because of the particular space constraint on this site associated with the retention & protection of a large number of retained mature trees. In the case of Tank G in the north east corner there is insufficient space available for the preferred Stormtech type tank so concrete tanks were provided. At detailed design stage we will look to revise Tank G to a Stormtech type tank by introducing additional blue roof storage in Block 02 or increasing the size of upstream Tank K.**	Acceptable, subject to DLRCC approval
9	A table such as that in Section 7.1.5 of the appendices to DLRCC's Development Plan 2022-2028 showing the breakdown of the areas within the site should be included in the infrastructure report.	**BMCE to provide table such as that in Section 7.1.5 of the appendices to DLRCC's Development Plan**	**Please refer to the attached completed table for inclusion in the SW Audit report.**	Acceptable
10	An allowance for urban creep does not appear to have been made in the Flow model.	**BMCE to clarify if it has been agreed with DLRCC to not include urban creep.**	**As all of the buildings in the development will remain in the control of a management company, the urban creep associated with extensions to private dwellings is not therefore considered to be an issue on the site. This is the same approach as that used for the granted SHD.**	Acceptable, subject to DLRCC approval
11	The Flow model includes additional storage structures at some nodes, which are not indicated on the drawing. The shallow depth and extensive area of these structures would suggest that they may be podium storage but this is not clear.	**BMCE to clarify additional storage at Tank H, Tank B, Tank E and Tank D within the Flow models.**	**Yes, these are podium 'blue roof' build-ups.**	Acceptable
12	Each catchment has been simulated with both a free outflow and with 50% blockage at the final outfall (Note: Catchment B applies blockage to outfall from the largest network only. Blockage has not been applied to the outflows from Tanks B and C). In the blockage scenarios flooding of 3.9m3 is experienced at node SA1.16 (hydrobrake manhole) in Catchment A in the Q100 event which is not expected to cause major issues. Flooding of 92.6m3 is shown at the detention basin in Catchment B and 8.9m3 at the hydrobrake manhole in the Q30 event with 50% blockage, with this increasing to 178.5m3 and 48.7m3 respectively in the Q100 event with blockage. Do surrounding ground levels allow this overflow to be stored within the green area on site? Flooding of 21m3 is shown at node SC3.1 in Catchment C in the Q100 event with blockage.	**BMCE to advise whether the flood volumes during the blockage scenarios can be stored on site until the blockage has cleared.**	**In Catchment A, the 3.9cum flood flow at SA1.16 will be directed into the soft landscaped area via the adjacent break outs in the road kerb shown on our overland flow route drawing C-11025, attached. In Catchment B, any overlow in the detention basin will fall towards the dry ditch on the inside of the wall as shown on C-11025. This falls towards the outlet to the watercourse at the northeast corner. Note we have increased the perimeter bund in the detention basin to 600mm - this will store an additional 73cum of water in the event of an overflow. Please refer to the updated sw drainage layout drawing c-11020. In Catchment C, the overflow at mh SC3.1 will also flow eastwards to the dry ditch. ADDITIONAL NOTE: Please note that locally reducing the levels or making other alterations to the ground levels in and around the detention basin is limited by the presence of a badger sett in the trees just north of the basin. There is a 30m exclusion zone around the sett where works are highly restricted. In the highly unlikely event of a 50% blockage coinciding with a Q100event the dry ditch will provide infiltration & storage of the exceedance. There may be some additional discharge at the outfall in the northeast corner.**	Acceptable subject to DLRCC approval (should exceedance flows be stored on site prior to re-entering the network when capacity is available)
13	A drawing showing the overland flow paths has not been provided.	**BMCE to provide Exceedance Flows drawing.**	**Apologies this drawing should have been included in the package issued to you. A copy is now attached. Drg no. C-11025**	Acceptable
	28/08/2024	28/08/2024		

JBA Consulting Stormwater Audit - Stage 1 Feedback Form	
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	14/08/2024	14/08/2024		
	Reference Documents 20.170-IR-01L.pdf 5811 Dundrum Central Development SI Report.pdf bmce_20-170-ir-01l-pdf_2024-08-20_1129.zip DCD-BMD-00-00-DR-C-11020 Buried Surface Water Drainage Layout.pdf DCD-BMD-00-00-DR-C-11025 Surface Water Overland Flow Routes.pdf DCD-BMD-00-00-DR-C-11030 Roof & Podium SuDS Layout.pdf NJI-JBAI-XX-XX-AU-C-0001-S3-P01-St1_SW_Audit_Feedback_Form.xlsx DP 7.1.5 SuDS and green areas table.docx			
14	The SI results suggest that infiltration is variable across the site (2 successful tests and 2 failed tests). Infiltration cannot be relied upon where infiltration tests have failed. JBA recommend that the actual measures infiltration rates in the vicinity of the proposed attenuation structures is used in the attenuation calculations.	BMCE to consider using actual measures infiltration rates in the vicinity of the attenuation structures rather than a site averaged value.	**Please refer to the attached marked up Surface Water drainage drawing showing the soakaway test locations/results & the infiltration values used in the design of the tanks with a permeable liner. As noted on the mark-up the largest tank in the development Tank 'A' is designed for zero infiltration. The detention basins and bio-retention areas are also designed for zero infiltration. We consider that using the average infiltration value of 0.274m/hr to be reasonable approach for the remaining tanks given the information available. As noted in item 6 above, a note has been added on our surface water drainage drawing C11020 requesting that a soakaway test is carried out at each permeable tank location & at the detention basin, to allow the tank sizes to be confirmed prior to construction. The winter water table level is also to be confirmed. We will organise to have these tests carried out to allow the detailed design check be carried out by us prior to the Stage 2 Stormwater Audit.**	**Acceptable subject to DLRCC approval**

Appendix 9

Comments From DLR Drainage Planning, Municipal Services Department

Text of an Email of the 06.09.24 from DLR Drainage in relation to the Stormwater Audit

Hi John

In relation to the Storm Water Audit, I am satisfied with the comments.
As noted within the audit there are a number of areas to re-examine at detailed design stage.

In relation to the run-off rates, as noted these have previously been agreed with my predecessors, therefore, in this site specific case, they are acceptable.

Regards,

Johanne Codd BA BAI CEng MIEI
A/Senior Executive Engineer
Drainage Planning, Municipal Services ,
Dún Laoghaire-Rathdown County Council, County Hall, Marine Road, Dún Laoghaire.

Text of an Email of the 06.09.24 from DLR Drainage following a review of the Barrett Mahony final planning packing of surface water drainage and SuDS information:

Hi John
The report/drawings provide an appropriate level of detail for the planning design stage of the proposed development. In order to satisfy the requirements of the local authority, the application will be subject to a number of standard conditions.
For clarity where construction details are requested in the conditions listed below it is in reference to updated design drawings that reflect the changes (if any) that may have occurred during the detailed design and tender/construction stage and that reflect the final design that is to be constructed on site. As such all compliance submissions by the applicant should include tender/construction stage drawings informed by the detailed design process. This may follow a period of initial development, as such the compliance submissions should be issued prior to commencement of drainage development.

1. *Prior to the commencement of development, the applicant shall submit to the Planning Authority for its written agreement a combined Taking in Charge and Wayleave drawing and a draft wayleave agreement in favour of Dun Laoghaire-Rathdown County Council for the sections of proposed public surface water infrastructure that are to be located in lands not to be taken in charge. Such a draft wayleave agreement shall be accompanied by dimensioned drawings showing the locations of all surface water drainage elements in relation to adjoining property boundaries. The wayleave shall be agreed and in place prior to the taking in charge of the development.*

2. *Prior to the commencement of development, the applicant shall submit to the Planning Authority for its written agreement fully dimensioned site-specific construction stage details and communally accessible maintenance arrangements for the proposed:*
    a) *Attenuation systems*
    b) *Green roofs/podiums*

c) *SuDS measures (treepits, SuDS basins, filter drains and permeable paving etc)*
d) *Headwall/outlets to the watercourse/public sewer*

3. *Prior to the commencement of development, the applicant shall submit full details of the flow control devices, including model and make number, orifice size and flow control hydraulic characteristics graph. A penstock must be provided in the manhole in which each flow control device is located.*

4. *Prior to the commencement of development, the applicant shall submit to the Planning Authority for its written agreement a Stage 2 - Detailed Design Stage Stormwater Audit, as required under Policy EI9: Stormwater Impact Assessments of the County Development Plan, so as to check the detail of all the SuDS elements and to ensure that any necessary amendments have been included in the construction stage drawings. The applicant shall also include a standalone 1-2 page design statement for the proposed surface water management system noting critical elements, their operation and significant design parameters (attenuation volumes, flow rates etc).*

5. *Upon completion of the development, the applicant shall submit to the Planning Authority for its written agreement a Stage 3 Completion Stage Stormwater Audit to ensure the SuDS measures were installed and working as designed, no misconnections have taken place and that damage has not occurred to any of the stormwater drainage infrastructure during construction. A report shall, be issued to the Planning Authority and any necessary recommendations carried out, unless agreed otherwise with the Planning Authority. This stage may require the installation of flow monitors and/or dye testing; the extent of monitoring will depend on the findings of the audit. A CCTV survey shall be carried out of all stormwater pipes and the survey and report forwarded to the Planning Authority.*

6. *The applicant shall implement a construction management plan and programme of works that amongst other items provides for interception, containment and treatment of construction runoff. No construction runoff should be diverted to proposed SuDS measures. Any surface water sewer pipes used to convey construction runoff should be thoroughly cleaned before subsequent connection to SuDS elements.*

7. *The applicant shall ensure that all drainage works are carried out in accordance with the agreed details and that a post-construction maintenance specification and schedule is implemented on site. Maintenance contractors with specialist training in SuDS care should be used. Thereafter, all elements of the surface water management system shall be maintained at all times in accordance the post-construction maintenance specification and schedule, which shall be included in the site Safety File.*

8. *The applicant shall ensure that all underground attenuation systems within 5 meters of foundations or site boundaries have an impermeable liner and are offset sufficiently from the site boundary to provide sufficient space for future maintenance.*

9. *The Green roofs/podiums shall be designed and constructed in accordance with the SUDS Manual (C753) and BS EN 12056-3:2000.*

10. *All SuDs measures shall be designed and constructed in accordance with The SUDS Manual (C753).*

11. *The applicant shall ensure that the landscape proposals are compatible with the drainage proposals.*

Regards,

Johanne Codd BA BAI CEng MIEI
A/Senior Executive Engineer
Drainage Planning, Municipal Services ,
Dún Laoghaire-Rathdown County Council, County Hall, Marine Road, Dún Laoghaire.

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